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Research Product 90-20

Abbreviated Assessment of Embedded Training for the Howitzer Improvement Program M109A6 Howitzer

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May 1990

Fort Sill Field Unit
Systems Research Laboratory

U.S. Army Research Institute for the Behavioral and Social Sciences

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) For this study, researchers assessed the Embedded Trainer (ET) on the Howitzer Improvement Program (HIP) self-propelled M109A6 howitzer. The research addressed (a) subjective evaluations of the perceived merits of the ET rendered by four subject matter experts (SMEs), (b) subjective reactions to the Level III scenario by 18 HIP-naive 13B soldiers considered to be viable candidates for the chief-of-section (COS) position, (c) measures of the hands-on performance of these same HIP-naive 13Bs during exposure to the ET Tutorial (Levels I and II) and a Level III scenario, (d) a detailed screen-by-screen review of the tutorial portion of the ET, and (e) other procedural matters observed during the preparation for and conduct of the assessment. Perceptions of the HIP ET by the SMEs and 13Bs were positive. The ET was perceived as logical, practical, needed, and relevant by the SMEs and as interesting, effective, and satisfactory by the 13B soldiers. A need for additional hardware, communication software, and pertinent documentation was identified at the outset to enable operator performance (Continued)						
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summaries to be offloaded. Objective performance data revealed that HIP-naive 13Bs with GT scores above 110 (Mental Categories I-II) made fewer errors and completed tasks (initialization and ammo entry) more quickly than did soldiers with GT scores less than 110 (Mental Categories III-IV). The screen-by-screen review of the tutorial revealed the need for modifications to enhance screen interpretability (e.g., the elimination of multiple commands within a single screen, the revision of some of the terminology employed, more consistent use of terms, as well as a more consistent relationship between keys and their related functions). The early-configuration ET evaluated required that considerable assistance and information be provided to the participants by SME-observers before the tutorial and during the transition between the tutorial and the Level III scenario.

Recommendations addressed the need to (a) provide the additional hardware, software, information, and screen revisions and additions required to conduct training and enhance its effectiveness, and (b) undertake follow-on research to assess the impact of these changes.



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Research Product 90-20

**Abbreviated Assessment of Embedded Training for
the Howitzer Improvement Program M109A6 Howitzer**

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FOREWORD

The Howitzer Improvement Program (HIP) self-propelled M109A6 howitzer is equipped with an Embedded Trainer (ET). However, the ET was not included in the HIP Initial Operational Test and Evaluation (IOTE) and, consequently, the merits of the system were unknown as the Army prepared for the pre-Army Systems Acquisition Review Council (pre-ASARC) meeting. To remedy this circumstance, the HIP Product Manager (PM) requested support from the Army Research Institute for the Behavioral and Social Sciences.

This report describes the research undertaken to evaluate the HIP ET. A full-scale assessment was not possible because of the limited availability of a HIP howitzer. Both subjective reactions to the ET and objective performance were measured. Additionally, a detailed screen-by-screen analysis of the tutorial was performed.

A major MANPRINT concern in the development of the HIP is whether or not the entire targeted user population can perform the chief-of-section functions adequately. This report addresses that issue and provides recommendations to increase the effectiveness and viability of the HIP ET.


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Technical Director

ABBREVIATED ASSESSMENT OF EMBEDDED TRAINING FOR THE HOWITZER
IMPROVEMENT PROGRAM M109A6 HOWITZER

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ABBREVIATED ASSESSMENT OF EMBEDDED TRAINING
FOR THE HOWITZER IMPROVEMENT PROGRAM M109A6 HOWITZER

Introduction

The scheduled development cycle for the Howitzer Improvement Program (HIP) self-propelled M109A6 howitzer included a pre-Army Systems Acquisition Review Council (pre-ASARC) meeting in November 1989. During preparations for that review, it became apparent that no empirical research had been accomplished to assess the merits of the Embedded Trainer (ET) included in the HIP. Because the ET software wasn't available early enough to allow sufficient time for the using unit to learn how to employ it, it was not included in the HIP Initial Operational Test and Evaluation (IOTE) undertaken during June-July 1989. Accordingly, the HIP Product Manager (PM) requested support from the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to conduct such an evaluation (DA, AMCPM-HIP-LO, 28 July 1989).

The Embedded Training concept is relatively new to U.S. Army systems. The intent is to provide the using unit an effective means of maintaining the proficiency of its operators and crews during sustainment training while using the actual end-item hardware (Finley, Alderman, Peckham, & Strasel, 1988). The ET for the HIP howitzer is built into the Automated Fire Control System (AFCS) computer on board the HIP. By being able to switch rapidly from a fully operational system to one that can support a range of training functions, the on-board AFCS provides a potentially powerful and versatile ET capability.

The HIP AFCS includes a visual display and a total of 26 keys and switches used by the soldier to control the operation and input information. The visual display is an orange-colored electroluminescent screen. Both upper-case and lower-case alphabetic characters can be depicted in either normal (black characters on an orange background) or reverse video. The AFCS includes three switches to control power to the AFCS itself and to the gun servos, and to switch between the training and operational modes. There are five "hard-function" keys, a numeric keypad for data entry, four cursor control arrow keys, and four "soft-function" keys whose function varies with (and is displayed upon) the particular screen that requires their use. The entering of alphabetic characters is accomplished via the combined use of the arrow keys and the enter key to select characters displayed on the screen.

The HIP ET provides four levels of training. There are two levels of tutorial instruction (Levels I and II) and two levels of scenario-based training (Levels III and IV).

Level I is a brief tutorial intended to provide initial familiarization for the trainee having no prior experience with the HIP. The trainee learns, in step-by-step fashion, the physical location and elementary function(s) of the various input keys appearing on the front of the AFCS. The second, Level II, tutorial provides system start-up training. This level is much more detailed. It addresses each of the various menus which must be completed during the HIP AFCS initialization and start-up procedures in a highly structured, step-by-step fashion. The ET instructs the trainee concerning the inputs required, and, as with the Level I Tutorial, the trainee receives feedback regarding the correctness of each selection he makes. At both levels, following each incorrect response, the tutorial provides information intended to clarify the nature of the response or selection needed from the trainee, and redirects him back to the screen wherein the incorrect input or selection was made.

The two levels of scenario-based training are intended for individuals who are already familiar with the AFCS. They are intended to sustain performance at acceptable levels. Both provide the capability to download operator performance data summaries through a downloading port provided on the AFCS. Three scenarios may be selected: "move heavy," "shoot heavy," or "balanced." Level IV differs from level III in that, if an instructor is present, the destinations and target locations can be altered and instructor-generated faults (e.g., failure of the hydraulics, communications, navigational, and electrical systems) can be introduced.

With the publication of AR 602-2 (Headquarters, Department of the Army, 1987), the regulation implementing the U.S. Army's MANPRINT program, there existed the requirement to carefully and fully consider the soldier-related factors which could affect overall performance of systems under development. Since its inception, an operational requirement of the HIP was that it be capable of being successfully operated by those throughout the entire range of capabilities inherent within the population of soldiers in the military occupational specialty 13B. The doctrine governing the tactical employment of the HIP requires frequent and rapidly-executed displacements, emplacements, and firings to enable it to provide the desired increases in responsiveness, effectiveness, and survivability. Because these requirements place a much-increased tactical decision-making burden on the HIP chief-of-section (COS) than had heretofore existed, the question of whether-or-not those at the lower end of the range of 13B capabilities could perform satisfactorily became a significant MANPRINT issue to be addressed during the development of the HIP. At the time of the request for research support, the data from the HIP IOTE had not yet been analyzed; hence, there existed no directly applicable HIP- or AFCS-related empirical data with which to address the issue.

The present abbreviated assessment was conducted in response to the HIP PM's request. A full-scale evaluation was not possible due to the limited time available to prepare a research effort of larger scope, and the limited availability (approximately 12 days) of a functional HIP for the purpose of conducting such research.

The severe time constraint and resource limitations which existed precluded consideration of an extensive evaluation of the variety of Level III or IV scenarios which could be invoked during field exercises. Additionally, the time constraint preempted consideration of a comparative assessment evaluation approach. It was impossible to consider the use of any approach which would have compared final performance levels while using a HIP in the field because of the extensive amount of time (and instrumentation-related resources) required merely to conduct the "test" portion of such a process (i.e., in addition to the time required for training, per se). The consideration of an approach which would compare the performance of those undergoing ET-based training with those who were given some other form of training was similarly preempted due to time and resource constraints. To adopt such a strategy would have increased markedly both the number of soldier-participants and the amount of time required to execute the research. The latter (increased execution time) reflects the fact that (a) the same, limited number of HIP-qualified SME-instructors would have had to have conducted the training for both groups, and (b) the only other previously employed "standard" HIP AFCS training procedure was the lengthy procedure, entailing individual hands-on instruction, developed for use during the train-up period preceding the HIP IOTE.

Given the circumstances described, the decision was made to adopt an assessment approach which would provide empirical data pertaining to the MANPRINT domain in sufficient quantity to provide some reasonable expectation that inferential statistics could be applied and yield statistically reliable statements regarding the outcomes. Accordingly, the research approach, as described below, focused on 13B soldiers with a wide range of aptitudes during their exposure to both Level I and II tutorials, and during their execution of a single "shoot heavy" Level III scenario. All training was videotaped and conducted on a non-moving HIP with a fully operational turret.

Method

General

As discussed further in the succeeding section, the research was confined to an assessment of Levels I, II, and III of the ET. Hands-on experience and performance assessments with the ET were

limited to an immobile HIP with a functional turret and gun tube. The research assessed (a) subjective evaluations of the perceived merits of ET rendered by subject matter experts (SMEs) based on hands-on experience with both Levels I and II of the Tutorial, and a single scenario from Level III, (b) subjective reactions to the Level III scenario by individual HIP-naive 13B soldiers considered to be viable candidate Chiefs-of-Section (COSs) in terms of rank and experience, (c) measures of the hands-on performance (time-for-task-completions and accuracy) of these same HIP-naive 13Bs during their initial exposure to ET Levels I, II, and III, (d) a detailed document-based, screen-by-screen review of the Tutorial portion of the ET (i.e., Levels I and II) by ARI personnel, and (e) observations of other preparatory and procedural issues noted by ARI personnel during the preparation for, and the conduct of the assessment.

Assessment Environment

The hands-on assessments were conducted on an actual HIP howitzer in a vehicle bay within the Gunnery Department of the U.S. Army Field Artillery School. This environment was chosen because it was compatible with the need to videotape the performance of all hands-on performance by the participants. The front one-half of the howitzer protruded through an open door of the bay to the outside of the building. During the hands-on portions of the evaluation, the howitzer itself did not move, albeit the turret would turn and the gun-tube would change in elevation in response to commands from the AFCS computer, just as it would during normal operations. The extent of such movement was constrained, however, by prior calculations to assure that the relative location and size of the target box would preclude the slewing of the gun tube into the walls of the bay when specific targets were identified for engagement during the execution of the Level III scenario.

SME-Assessment

Subjects. Four subject matter experts (SME's) were employed to assess the perceived merits of the ET. Two of the SMEs were from the Gunnery Department (GD) and two were HIP COSs assigned to A-2/17 FA. The two GD SMEs previously had served as trainers for the FA units using the HIP during the IOTE. The COS SMEs were trained as HIP COSs and had performed that role during the HIP IOTE.

On the average, the gunnery department SME's had served as 13Bs for 14.3 years, had 11.3 years experience with field artillery weapon systems, and 14 months experience with the HIP. One gunnery SME was a Staff Sergeant (SSG), while the other was a Sergeant First Class (SFC). Their average age was 41.5 years.

In contrast, the COS SMEs had served as 13Bs for an average of 6.3 years, had 4.1 years experience with field artillery weapon systems, and 4 months experience with the HIP. They were both Sergeants (SGTs) and had an average age of 27.5 years.

Procedures. The SMEs received an introductory briefing on the HIP ET from a contractor's representative who had been involved in the writing of the software for Levels III and IV of the ET. This briefing outlined the manner in which the system was designed and indicated the nature of the preparations and calculations required before an individual could begin training in the constrained environment under which the evaluation was conducted.

Subsequent to receiving the introductory briefing, the SMEs completed a biographical data sheet (see Appendix A). The SMEs then collectively performed Levels I and II in their entirety, and executed a single "shoot heavy" scenario from Level III. After performing each Level, the SMEs completed a data collection form containing 18 items (see Appendix B). Each item consisted of adjective-pairs separated by a 7-point scale. The adjectives appeared at the end-points of the scales as labels. The items were presented in random order. To minimize possible effects associated with a response bias, labels considered more positive appeared with equal frequency on the left and right sides of the data collection form. In general, the 18 items addressed topics pertaining to the degree of logic, depth, and integration evidenced; the perceived worth, need, relevance, and practicality of the ET; the perceived quantity of the material presented, and the personal reaction evoked (e.g., the degree of stress and boredom inherent in the training process).

COS-Candidate Assessments

Subjects. The novice participants used in this study were eighteen 13B COS candidates. Their Armed Services Vocational Aptitude Battery (ASVAB) General Technical (GT) scores ranged from 79 to 121. Of the 18 subjects, 10 had a GT score of 110 or above and were assigned to the Categories I-II group, while the remaining 8 had a GT score below 110 and were assigned to the Categories III-IV group.

The subjects assigned to Categories I-II group had served as a 13B for an average of 4.9 years and had an average of 4.2 years experience with field artillery weapon systems. There were eight Corporals (CPLs) and two SGTs, with an average age of 25.6 years.

The subjects assigned to Categories III-IV group had served as a 13B for an average of 7.0 years and had an average of 6.0 years experience with field artillery weapon systems. There were five SGTs and three SSGs, with an average age of 28.3 years.

Procedures. On reporting to the vehicle bay, each subject completed a biographical data sheet (see Appendix A) and was shown the opinion survey (see Appendix C) to be completed after training.

The subject, instructor, and observer then entered the HIP and subjects were given a brief orientation. They were informed that this was to be a test of the adequacy of the ET, rather than a test of their ability, and that the test would take approximately two hours. Subjects were asked to try to complete the training without assistance, but were told that if at any point they were unable to proceed the instructor would be available. Subjects then completed training Levels I and II. The observer recorded errors made and the instructor provided assistance as necessary.

Prior to initiating Level 3, subjects were given the data values to be entered and a brief introduction to the use of the hydraulics system. They were also instructed on how to use the "load" and "lay" keys and warned not to deactivate the "training on/off" or "gun servo" switches. (Note: This report cites requirements for additional instruction as areas to be addressed and corrected during further developmental efforts on the HIP ET.)

After completing the data entry phase of Level III, all subjects required additional instruction on how to use the navigational screens and process the fire missions. The ET Level III performance errors captured by the system were "offloaded" through the serial port to a diskette in a portable computer using CROSSTALK communication software. A special cable (borrowed from the contractor) to interface between the ET port and the computer was necessary to accomplish the offloading task.

Following completion of the Level III scenario, subjects responded to a survey designed to assess their opinion of that portion of the ET. The survey was composed of 11 bipolar adjective pairs separated by a 7-point scale. Physical, mental, and training aspects were evaluated. Sample adjective pairs include relaxing-stressful, boring-interesting, and ineffective-effective. Item pairs were counterbalanced as to their desirability.

The total number of errors committed and the times required to complete Levels I and II of the tutorial were recorded. On Level III, the times required to initialize the system and enter the ammo data were recorded. The offloaded performance summary data were employed to assess errors made during the Level III scenario.

GT scores were obtained after the testing was completed. Analyses were conducted by mental category level, with subjects

scoring 110 or above assigned to the Categories I-II group, and subjects scoring below 110 assigned to the Categories III-IV group.

Tutorial Screen Review (ET Levels I and II)

To accomplish a screen-by-screen review of the Level I and II tutorials, the most recent existing documentation was sought from the software developer. The documentation provided to the Fort Sill Field Unit from the developer was dated 18 January 1988. The hardcopy representation of each screen, plus the branching instructions provided for each response option cited for each screen were individually examined. The review addressed issues pertaining to the logic of the branching instructions, the content of each screen, the consistency of terminology employed, the manner of presentation, and other issues which might affect interpretation by the COS candidate trainees.

Results

SME-Assessment

In general, the reactions indicate that the ET is viewed positively; i.e., the perceptions were that ET was logical, practical, needed, and relevant. There were no statistically significant differences among the three ET Levels addressed. The overall mean SMEs' perceptions are summarized in Table 1. (Note: The manner in which these findings are presented does not reflect the construction of the data collection form [see Appendix B], rather they are grouped to reflect similarities in content and placement of adjectives. Labels having more "favorable" [rather than "less favorable"] or "greater" [rather than "lesser"] connotations have been re-arranged to all appear on the right side of the table.)

COS-Candidate Assessment

Subjective perceptions. The opinion survey, administered only after Level III and pertaining to that level, was analyzed by comparing the participants' mean responses with the neutral point for each item pair. The value 4 was taken as the neutral point for each 7-point scale. The ratings revealed to be significantly different from the neutral point were those which found the ET to be interesting ($t[17] = 9.78, p < .01$), effective ($t[17] = 3.83, p < .01$), satisfactory ($t[17] = 4.44, p < .01$), requiring a high degree of coordination, ($t[17] = 3.13, p < .01$), and paced too fast, ($t[17] = 2.12, p < .05$). None of the other ratings differed significantly from the scale midpoint. The perceptions did not differ significantly ($p > .05$) between

categories I-II and III-IV. Table 2 depicts the mean response magnitudes for each item.

Objective performance measures. The Level I tutorial is an elementary one. It can be successfully completed in a total of 15 screens (of which three are used merely to provide the word "CORRECT" as feedback, and one is used to indicate that Level I has been completed). Level II is a much more comprehensive tutorial, involving more than eight times as many screens to be completed. Accordingly, to obtain a more reliable estimate of error performance, the number of errors committed in the Level I tutorial was added to the number of errors in Level II tutorial.

For all of the measures employed, the mean performance for those with GT scores 110 or higher was better (i. e., they made fewer errors and completed each task more quickly) than the mean performance for individuals with lower GT scores. The differences were statistically significant for initialization time, $t(17) = 2.68$, $p < .02$, and ammo entry time, $t(17) = 2.63$, $p < .02$. The mean times to complete each task and the mean number of total errors committed within the Level I and II Tutorials (combined) are shown in Table 3 for the two category groupings. The findings are also depicted in Figures 1-5.

Table 1

SME-Assessment of the Embedded Trainer

ILLOGICAL	*-----*-----*-----*-----*-----* X -----*-----*	LOGICAL
SUPERFICIAL	*-----*-----*-----*-----*-----* X -----*-----*	IN-DEPTH
DISORGANIZED	*-----*-----*-----*-----*-----*-----* X -----*	ORGANIZED
POORLY THOUGHT OUT	*-----*-----*-----*-----*-----* X -----*-----*	WELL THOUGHT OUT
ARTIFICIAL	*-----*-----*-----*-----*-----* X -----*-----*	REALISTIC
UNNECESSARY	*-----*-----*-----*-----*-----*-----* X -----*	NECESSARY
INEFFECTIVE	*-----*-----*-----*-----*-----*-----* X -----*	EFFECTIVE
IMPRACTICAL	*-----*-----*-----*-----*-----*-----* X -----*	PRACTICAL
IRRELEVANT	*-----*-----*-----*-----*-----*-----* X -----*	RELEVANT
UNSATISFACTORY	*-----*-----*-----*-----*-----*-----* X -----*	SATISFACTORY
RELAXING	*-----*-----*-----*-----*-----*-----* X -----*	STRESSFUL
PACE TOO SLOW	*-----*-----*-----*-----*-----*-----* X -----*	PACE TOO FAST
BORING	*-----*-----*-----*-----*-----*-----* X -----*	INTERESTING
UNFAMILIAR	*-----*-----*-----*-----*-----*-----* X -----*	FAMILIAR
TOO EASY	*-----*-----*-----*-----*-----*-----* X -----*	TOO DIFFICULT
TOO LITTLE	*-----*-----*-----*-----*-----*-----* X -----*	TOO MUCH
TOO SIMPLE	*-----*-----*-----*-----*-----*-----* X -----*	TOO COMPLEX
TOO SHORT	*-----*-----*-----*-----*-----*-----* X -----*	TOO LONG

Table 2

COS-Candidate Assessment of the Embedded Trainer

Subscales	M	SD
Physical Aspects		
Not Fatiguing - Fatiguing	3.39	1.79
Relaxing - Stressful	4.28	1.49
Low--High Coordination Requirement	5.17**	1.58
Mental Aspects		
Too Easy - Too Difficult	3.78	1.06
Boring - Interesting	6.39**	1.04
Familiar - Unfamiliar	3.33	1.50
Relaxing - Stressful	3.95	1.66
Training Aspects		
Pace too Slow - Pace too Fast	4.39*	.78
Ineffective - Effective	5.61**	1.79
Too Simple - Too Complex	3.94	.87
Unsatisfactory - Satisfactory	5.78**	1.70

Notes: A 7-point scale with labeled endpoints was used. The labels for each scale are cited. The left label corresponds to the scale value 1.

N = 18.

Asterisks denote levels of statistical significance:

* denotes $p < .05$; ** denotes $p < .01$.

Table 3

Means and Standard Deviations for Training Performance
by Category

Training Performance Measures	Categories	
	I-II ^a	III-IV ^b
Level 1 Completion Time		
<u>M</u>	6.29	8.26
<u>SD</u>	2.43	2.96
Level 2 Completion Time		
<u>M</u>	32.40	35.27
<u>SD</u>	9.48	10.21
Errors Committed on Levels 1 & 2		
<u>M</u>	3.90	7.00
<u>SD</u>	3.03	8.52
Initialization Time		
<u>M</u>	13.13	20.78*
<u>SD</u>	4.99	7.14
Ammo Entry Time		
<u>M</u>	15.02	19.69*
<u>SD</u>	4.19	3.11

Notes: ^an = 10. ^bn = 8.

* Level of statistical significance: $p < .02$.

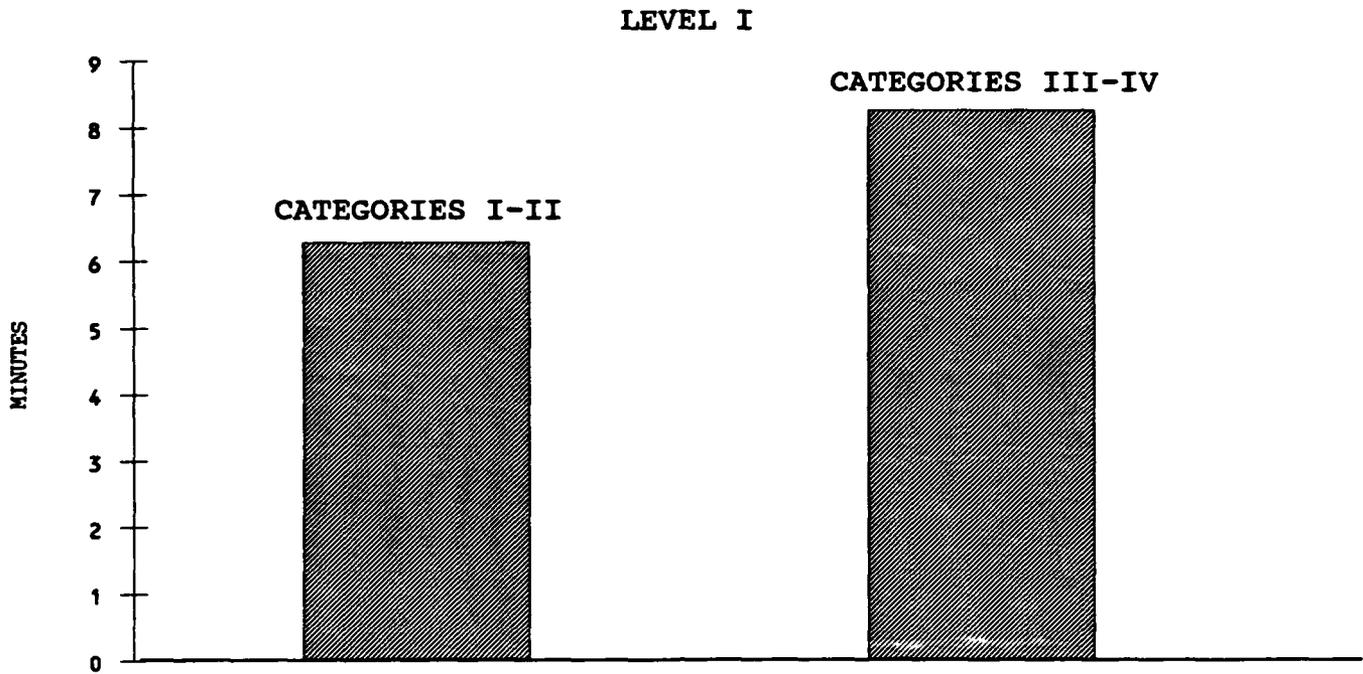


FIGURE 1. Time required to complete Level I training by mental category grouping

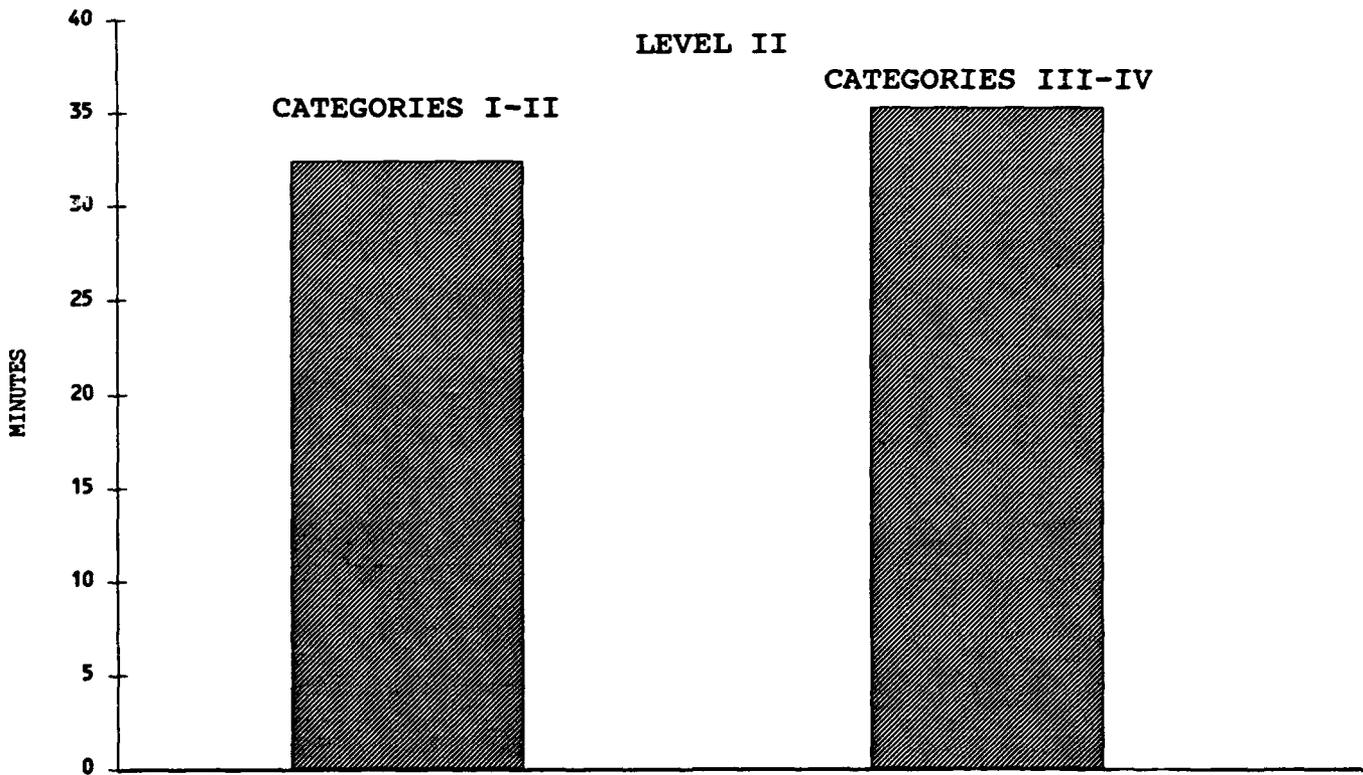


FIGURE 2. Time required to complete Level II training by mental category grouping

ERROR SCORES

LEVELS I AND II

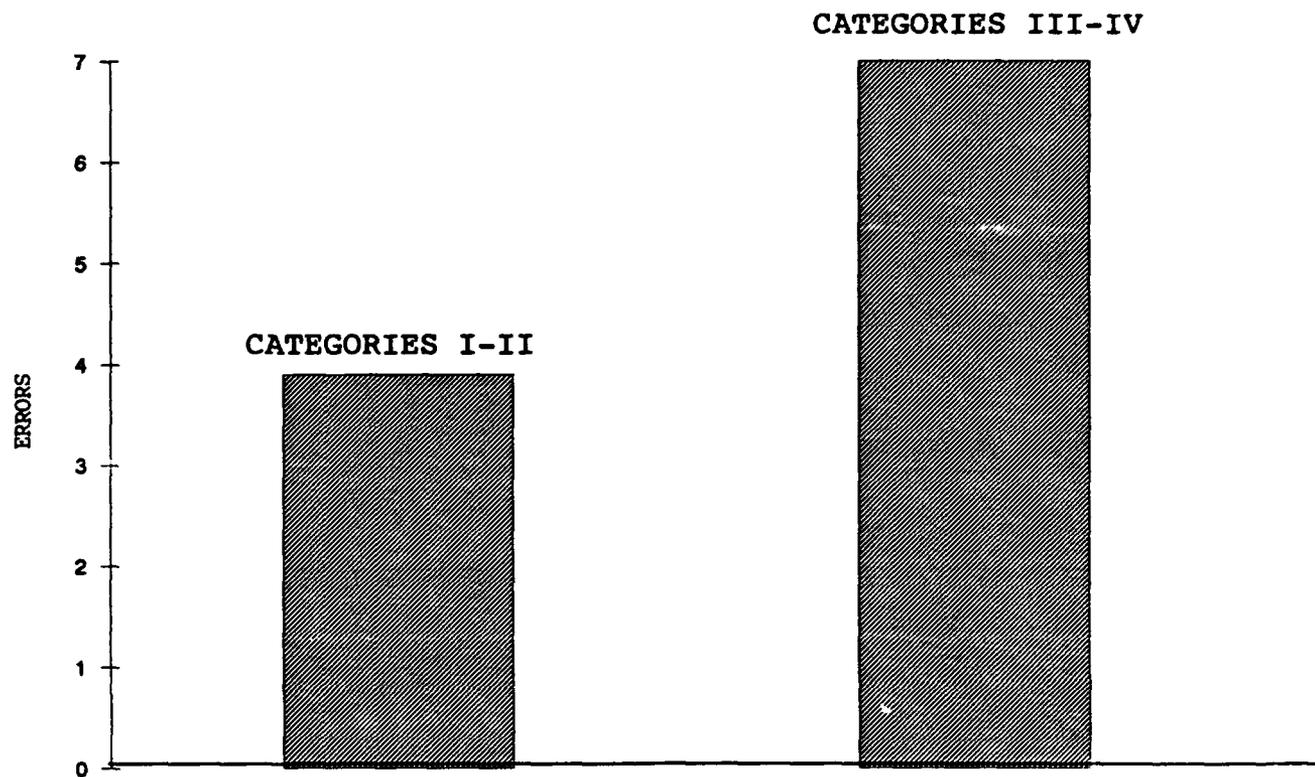


Figure 3. Errors committed on Levels I and II by mental category grouping.

INITIALIZATION

LEVEL III

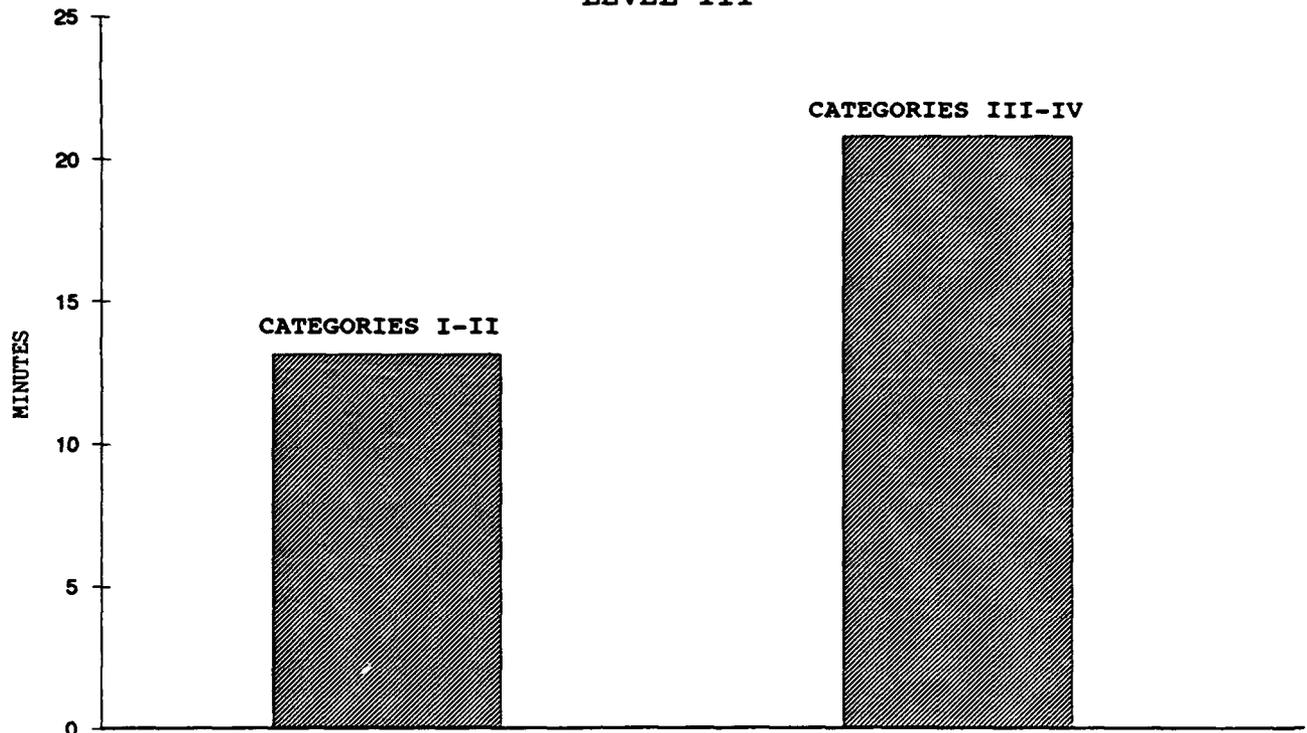


Figure 4. System Initialization time requirement by mental category grouping.

AMMO ENTRY

LEVEL III

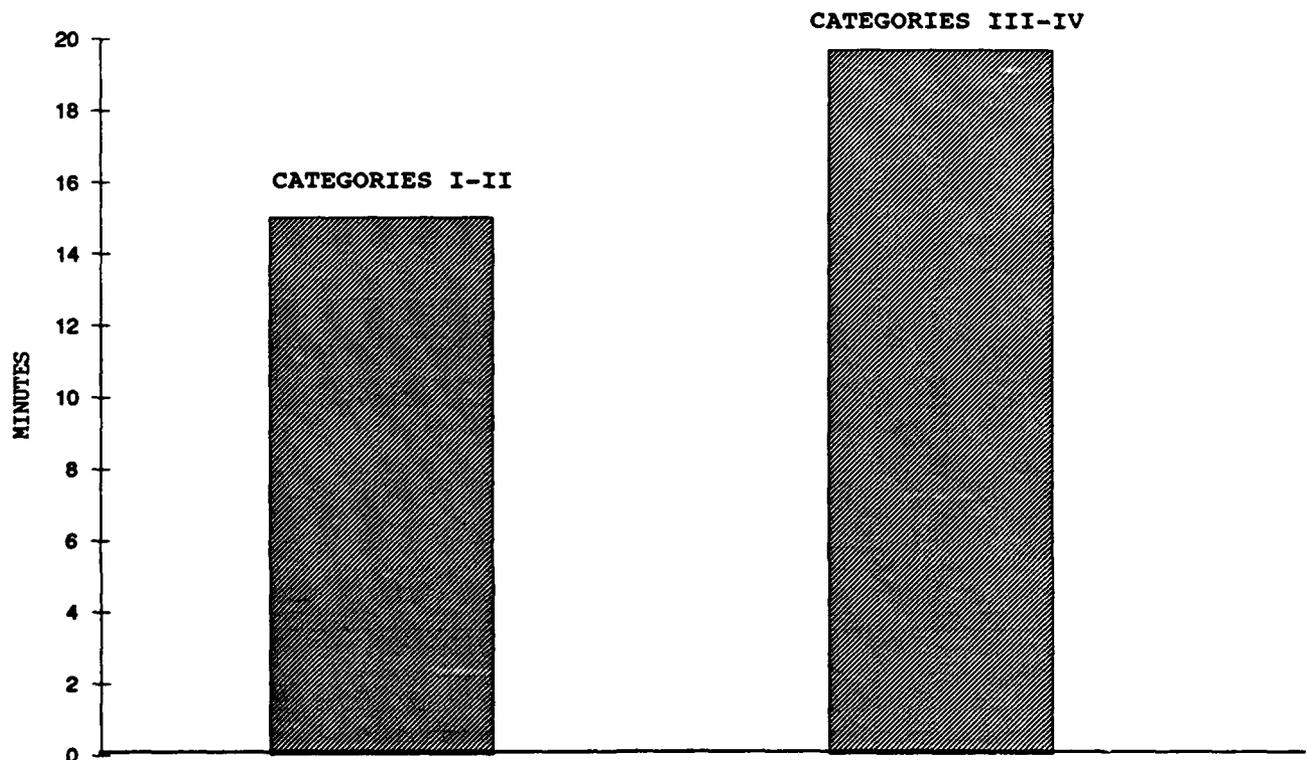


Figure 5. Ammo entry time requirement by mental category grouping

Tutorial Screen Review (Levels I and II)

The following comments characterize the results of the review of the screens used in the Level I and II tutorials. (The detailed comments appear in Appendix D.)

Computer literacy issues. Given the degree of computer literacy that may exist (i.e., next to zero in many instances), one recommendation is that the soldier be provided with an initial functional definition of pertinent terms which appear (or are recommended in this report to appear) within the ET screens. There is a need for a description of the functional differences between, and the locations of the "hardkeys" and "SOFTKEYS," at the outset of the tutorial. There is also a need to introduce and define the terms "MENU" (to refer to the lists of items from which selections are to be made), "HIGHLIGHT" (to refer to the reverse video used to indicate the position of the "cursor" when the arrow keys are used to designate an option or item selected from a menu), and a specialized meaning of the word "TYPE" (to refer to key presses on the numeric keypad) early in the sequence of screens. The term "SCREEN" is preferred to the term "DISPLAY" throughout (the term DISPLAY within the human factors area has a more generic meaning; i.e., there are "auditory displays," "tactile displays," as well as "visual displays").

Multiple commands. Potential confusion exists on many screens in Levels I and II because two commands appear within a single screen. Evidence of such confusion appeared during the actual hands-on assessments. As cited below, such screens typically include both (a) a description of an action which is to be executed when the succeeding screen is presented (e.g., SELECT BAUD RATE), and (b) a description of the action necessary to terminate the current screen (e.g., with the words "PRESS CONTINUE TO PROCEED").

Initial key definitions. The nature ("soft" or "hard," particularly for the "soft" keys) and location of a key to be pressed is not provided when the key is first used. There is a need to provide such information at the initial encounter.

Consistency of terminology. There were instances wherein the identifying names and titles used within screens were inconsistent with the names and titles actually appearing on the hardware, the screens, and the menu-related tasks and subtasks to which they refer. Within the main body of the instructional screens, there were names and titles which reflect errors of two principal types. One type did not reflect the use of the full name or title that actually appeared (this occurred most frequently when referring to titles of succeeding screens). The second type was the reverse of the first; i.e., the screen cited the full name for a referent which actually appeared in an abbreviated form on another screen (especially when referring to items of screen menus and keys).

Differentiation of referents. The referents employed in the body of many screens cited the titles of succeeding screens, items on menus appearing on succeeding screens, and keys to be pressed. To make it easier for operators to identify and discriminate the referent, there is a need to employ specific and consistent ways of identifying and differentially indicating to the trainer and trainee that the referent is a **SCREEN TITLE**, a (soft or hard) **KEY** to be pressed, or an **ITEM** to be selected from a menu presented on a screen. In the absence of specific knowledge regarding the availability of software capabilities which might otherwise be employed to accomplish these goals, it may possible to use bold characters (or reverse video) in conjunction with double quotation marks to refer to a "**SCREEN TITLE**," bold characters (or reverse video) within single quotation marks to refer to a '**MENU ITEM**,' and bold letters (or reverse video) alone to identify a **KEY** to be pressed.

Deletion of "DIRECTIONS" subtitle. The inclusion of a separate line stating "DIRECTIONS" (on the initial line within the main body of the screen) adds very little to the tutorial and requires memory space which might be otherwise used. The term "DIRECTIONS" could be eliminated from the top of screens without adversely affecting operator performance.

Deletion of separate "CORRECT" screens. Whenever a selection is to be made by a trainee, and the trainee makes a correct response, a separate screen displays the word "CORRECT" along with an instruction to "PRESS CONTINUE TO PROCEED." In contrast to this procedure, whenever an incorrect response is made, the initial line of the succeeding screen identifies the response as having been incorrect (e.g., YOU HAVE MADE AN INCORRECT SELECTION) and devotes the remainder of the screen to providing additional information to assist the trainee to determine the correct response. The latter procedure, the one pertaining to feedback for incorrect responses, is a more efficient approach in that better use is made of the available memory. The use of a separate screen to display the word "CORRECT" appears unwarranted. If "CORRECT" were placed at the beginning of the succeeding screen along with a transitional word or phrase to introduce the next topic (for example: CORRECT! NOW PRESS THE CLR KEY TO), then the remainder of the screen could be used to provide other, more useful information (see Appendix D).

Observational Findings

AFCS interface equipment, software, and instructions. The statement of the Required Operational Capability (ROC) and the documentation provided are consistent in stating the need for a means of "offloading" performance data from the AFCS. However, the equipment (to include relevant interface items needed), the software, and the instructions required to accomplish this operation were not available. The necessary equipment was not cited in the TOE, nor were relevant procedures found in any draft

operator's manual or handbook. (The actual equipment and instructions employed to conduct the assessment were provided by representatives from the PM's office and the developer.)

Preliminary data requirements, calculations, and information needs. The circumstances under which the present assessment was undertaken were described earlier in the METHOD section. While the assessment environment does present some unusual constraints (versus undertaking same in a field training area), the preparations necessary did surface the fact that information regarding the existing location of the howitzer and the anticipated location of the target area must be known and relevant calculations performed before training can safely begin.

During the present effort, the SMEs who monitored the COS candidate's efforts and answered questions posed by same had to accomplish a number of otherwise unidentified tasks before the trainee could begin the ET process. These tasks, as indicated by the PM and the developer's representatives, consisted of the following: power-up the howitzer and select the ET training option, select Level III, identify the scenario to be run, select the "Performance Save" method, enter the current Grid Zone to initialize the Dynamic Reference Unit, and enter three maps (the training area map, the howitzer area map, and the target area map). Site data and mask information were also required.

In addition to these tasks, the trainee's supervisor may have to perform the calculations to assure that the relative sizes and geometries of the howitzer and target area maps will permit safe operation of the howitzer and are consistent with the additional information (locations) to be employed during the conduct of Level III or IV scenarios.

Transition from Level II to Level III. The present Level I and II Tutorial materials do not provide sufficiently generalizable information, examples, and practice opportunities to enable the COS candidate trainee to successfully transition to a Level III scenario without a significant amount of support from an on-site COS-qualified individual. Considerable instructor support was required at the beginning of Level III; e.g., instructions regarding the hydraulics system activation, and positioning of the GUN SERVO SWITCH and information regarding the GUN SERVO INDICATOR were required for all participants. Additionally, confusion was evidenced by all COS candidate trainees at their initial encounters with the navigational screens ("STEER TO" and "EMPLACE") and the initial fire mission screen. These are not addressed previously during the Level I and II Tutorial.

The COS trainees' supervisors must also address the following prior to beginning a Level III or IV scenario: define restart locations to be used, provide a list of ammunition to be used, identify relevant radio communication parameters to be employed.

Discussion

The subjective reactions of both the SMEs and those participating as COS candidate trainees reflected quite positively on the ET. With the exception of a perception that the pace of the Level III instruction was "too fast," there was no instance of any perception that was critical of the ET concept or the system.

One of the major concerns appearing in the HIP MANPRINT area is that pertaining to the ability of the entire target population to be able to adequately perform the COS functions. Clearly the present sample size is small, and, as a consequence, the results cannot be considered definitive. However, the findings and observations permit some degree of plausible inference to be made. While it is emphasized that virtually all of the participants appeared to be very sincerely trying to perform the task, it was clear from the perseveration evidenced by one of the participants that it would require extensive and intensive training to attain acceptable levels of performance. For two of the others, the task appeared to represent a highly demanding undertaking, and considerable assistance was required to complete it.

Among the objective time and accuracy performance data, the present research also yielded consistent findings of superior performance by those in the Category I-II group relative to that evidenced by those in the Category III-IV group. Hence, the informal observations cited, when coupled with the reliable empirical performance differences encountered, suggests that there is reason for continuing concern regarding whether or not the entire target population of 13B COS candidates will be able to function at acceptable levels of performance in the role of HIP COS. The need for further research is indicated.

As regards the overall level of implementation, it was the consensus of the SMEs and the present authors that the absence of adequate information and instruction at the beginning of the Tutorial and at the transition between Level II of the Tutorial and the Level III scenario constitutes a significant drawback to the ET in its present state of development. The present Level I and II Tutorials do not address the preparatory requirements at all. Neither do they provide sufficiently generalizable, operationally-relevant or "operationally-similar" information, examples, and practice opportunities to enable the COS candidate trainee to successfully transition to a Level III scenario without a considerable amount of support from an on-site COS-qualified individual.

At the present state of development, the HIP ET requires the presence of a HIP-qualified instructor to assist the student during the conduct of training. The HIP ET could achieve a greater degree of self-teaching capability if additional information and instructions were provided regarding the "pre-Level I" preparations

required before beginning a training session; incorporating more readily generalizable information, examples, and practice opportunities within Level II; and adding additional transitional information between Levels II and III. Such would have to be either incorporated in the software itself (perhaps prohibitive in lieu of existing memory size limitations) or in separate-but-necessary, closely integrated operator's and trainer's handbooks to accompany the ET.

While the Level IV simulation capabilities were not addressed in the present evaluation due to the existing resource and time constraints, the contractor's description of same clearly suggest that the HIP ET will provide a markedly enhanced unit training capability--stretching the units' training capabilities beyond circumstances that they would otherwise be able to address. Moreover, the ET will provide field units with a crucial element that is largely absent in the sustainment training process: the capability to obtain objective data for the purpose of providing performance-related feedback to their soldiers. Hence, while it is the case that the present research has encountered areas wherein levels I, II, and III of the HIP ET are presently in need of revision and augmentation, the HIP ET is viewed as representing a much-desired and powerful concept worthy of the additional effort required to bring it to fruition.

Conclusions

Predicated upon the findings and observations of the present research, the following conclusions apply:

1. The subjective perceptions provided indicate that the HIP ET was well received by both the SMEs and those participating as COS candidates.
2. Objective performance by those having ASVAB GT scores placing them in higher Categories (I and II) was consistently better than that for those having GT scores placing them in lower Categories (III and IV).
3. There is a need for revisions to the content of the screens presented to accommodate the low degree of computer literacy anticipated in the target population, reduce confusion associated with the appearance of multiple commands within a single screen, provide clearer identification of keys and differentiation of referent terms, obtain greater consistency in the terminology employed, and achieve greater effectiveness of screen usage through deletion of recurrent subtitles and separate "CORRECT" screens.
4. There is a need to add either additional screens to the existing ET or provide supplemental manuals for the trainer and the trainee to meet requirements not now addressed regarding computations to be performed and information required to perform

all tasks adequately; e.g., the information needed prior to beginning an ET session and in transitioning from the Level II Tutorial to the Level III scenario, information regarding the use of the navigational screens and how to process fire missions, and instructions regarding the set-up and use the operator performance downloading capability.

5. There is a need to assure that the using units possess the software, documentation, and hardware needed to download performance summaries.

Recommendations

It is recommended that:

1. Research be performed to further investigate the relationship between mental categories and level-of-performance and to assess the adequacy of COS performance at the lower ranges of capabilities anticipated for the 13B COS candidate population.

2. The existing HIP ET software be modified to enhance the interpretability of the screens (see Appendix D).

3. Additional screens and closely integrated HIP trainer and trainee user manuals be developed to provide the additional information and describe the calculations required both to begin an ET training session to effectively transition between the Level II Tutorial and Level III scenarios, and (as a minimum) to minimize or (preferred) to eliminate the need for other instructor-provided information or guidance as was evidenced during the course of this research.

4. Using unit be provided the hardware, software, and documentation necessary to support the downloading of performance summary information.

5. Additional research be undertaken to similarly assess the impact of the recommended revisions to the system.

References

- Finley, D. L., Alderman, I. N., Peckham, D. S., and Strasel, H. D. (1988). Implementing embedded training (ET): Volume 1 of 10: Overview (ARI Research Product 88-12). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A201 401)
- Headquarters, Department of the Army. (1987). Manpower and Personnel Integration (MANPRINT) in the Material Acquisition Process (AR 602-2). Washington, DC: Author.

APPENDIX A
BIOGRAPHICAL DATA SHEET

BIOGRAPHICAL DATA SHEET

Name: _____ SSN: _____-_____-_____
Date: _____ Time: _____
Unit: _____ Length of time in unit: _____ (mo.)
Primary MOS: _____ Secondary MOS (if any): _____
Rank: _____ Date of Rank: _____ Age: _____
Date of graduation from 13B AIT: _____
Total months of service as 13B: _____

Indicate how many months of "hands-on" experience you have had with each of the weapon systems below (if none, enter zero: 0):

WEAPON SYSTEM	NO. MONTHS
M109 SELF-PROPELLED 155mm HOWITZER: (excluding HIP)	_____
M109 SELF-PROPELLED "HIP" HOWITZER:	_____
M102 TOWED 105mm HOWITZER:	_____
M110 SELF-PROPELLED 8-Inch HOWITZER:	_____
OTHER: _____	_____

APPENDIX B
SME SUBJECTIVE ASSESSMENT
DATA COLLECTION FORM

Describe your reaction to LEVEL of the EMBEDDED TRAINER by placing an "X" along the line provided between each of the pairs of words appearing below:

- LOGICAL *-----*-----*-----*-----*-----*-----*-----*-----* ILLOGICAL
- TOO EASY *-----*-----*-----*-----*-----*-----*-----*-----* TOO DIFFICULT
- REALISTIC *-----*-----*-----*-----*-----*-----*-----*-----* ARTIFICIAL
- STRESSFUL *-----*-----*-----*-----*-----*-----*-----*-----* RELAXING
- SUPERFICIAL *-----*-----*-----*-----*-----*-----*-----*-----* IN-DEPTH
- PRACTICAL *-----*-----*-----*-----*-----*-----*-----*-----* IMPRACTICAL
- DISORGANIZED *-----*-----*-----*-----*-----*-----*-----*-----* ORGANIZED
- PACE TOO FAST *-----*-----*-----*-----*-----*-----*-----*-----* PACE TOO SLOW
- SATISFACTORY *-----*-----*-----*-----*-----*-----*-----*-----* UNSATISFACTORY
- FAMILIAR *-----*-----*-----*-----*-----*-----*-----*-----* UNFAMILIAR
- TOO SIMPLE *-----*-----*-----*-----*-----*-----*-----*-----* TOO COMPLEX
- NECESSARY *-----*-----*-----*-----*-----*-----*-----*-----* UNNECESSARY
- INEFFECTIVE *-----*-----*-----*-----*-----*-----*-----*-----* EFFECTIVE
- TOO LONG *-----*-----*-----*-----*-----*-----*-----*-----* TOO SHORT
- WELL THOUGHT OUT *-----*-----*-----*-----*-----*-----*-----*-----* POORLY THOUGHT OUT
- INTERESTING *-----*-----*-----*-----*-----*-----*-----*-----* BORING

APPENDIX C
COS CANDIDATE OPINION SURVEY
DATA COLLECTION FORM

Describe your reaction to the training you have just received on LEVEL 3 of the EMBEDDED TRAINER by placing an "X" along the line provided between each of the pairs of words appearing below:

PHYSICAL ASPECTS

NOT FATIGUING *-----*-----*-----*-----*-----*-----*-----*-----*-----* FATIGUING

STRESSFUL *-----*-----*-----*-----*-----*-----*-----*-----*-----* RELAXING

HIGH COORDINATION REQUIREMENT *-----*-----*-----*-----*-----*-----*-----*-----*-----* LOW COORDINATION REQUIREMENT

MENTAL ASPECTS

TOO EASY *-----*-----*-----*-----*-----*-----*-----*-----*-----* TOO DIFFICULT

INTERESTING *-----*-----*-----*-----*-----*-----*-----*-----*-----* BORING

FAMILIAR *-----*-----*-----*-----*-----*-----*-----*-----*-----* UNFAMILIAR

STRESSFUL *-----*-----*-----*-----*-----*-----*-----*-----*-----* RELAXING

TRAINING PROCESS

PACE TOO FAST *-----*-----*-----*-----*-----*-----*-----*-----*-----* PACE TOO SLOW

INEFFECTIVE *-----*-----*-----*-----*-----*-----*-----*-----*-----* EFFECTIVE

TOO SIMPLE *-----*-----*-----*-----*-----*-----*-----*-----*-----* TOO COMPLEX

SATISFACTORY *-----*-----*-----*-----*-----*-----*-----*-----*-----* UNSATISFACTORY

Do you have any other comments regarding the training you have just received? _____

(Continue as needed on the other side.)

APPENDIX D

RESULTS OF FRAME-BY-FRAME REVIEW OF
TUTORIAL LEVELS I AND II

COMMENTS ON LEVEL I and II TUTORIALS

Note: The following comments pertain to documentation dated 18 January 1988. This documentation was provided to the ARI Fort Sill Field Unit as being the most recent version available applicable to the contents of the TUTORIALS.

Screen No.

Comment

GENERAL 1. Given the degree of computer literacy that may exist (i.e., next to zero in many instances), recommend that a description of the functional differences and locations of the "hardkeys" and "SOFTKEYS" be provided at the outset of the Tutorial. Additionally, the introduction and definition of the term "MENU" (to refer to the lists of items from which selections are to be made, e.g., see T0118 comment #3), "HIGHLIGHT" (to refer to the reverse video used to indicate the position of "cursor" when the arrow keys are used to designate an option selected from a menu, e.g., see T0161 comment), and a specialized meaning of the word "TYPE" (to refer to key presses on the numeric keypad, e.g., T0156 comments) should be provided at the beginning of the Tutorial.

GENERAL 2. Potential confusion exists on several frames in Levels I and II because two commands appear within a single screen. As cited below, such screens typically include both (a) a description of an action which is to be executed when the succeeding screen is presented (e.g., SELECT RESTART), and (b) a description of the action necessary to terminate the current screen (e.g., with the words "PRESS CONTINUE TO PROCEED"). Recommend considering the adoption of one or both of the following practices to unambiguously differentiate between the action to be executed on the succeeding screen from the action necessary to terminate the presentation of the presently existing screen:

1. When addressing actions to be executed on the following screen, precede the description of such deferred actions with the words "ON THE NEXT SCREEN, SELECT _____."

2. Precede and follow the line of text designating the actual key to be pressed to terminate the current screen with a double asterisk, double dash, etc. Within that instruction, consistently use **BOLD** (or reverse video) letters to identify the key to be pressed (such is inconsistently done now, e.g., compare T1002 and T1003). Example: ** PRESS CONTINUE TO PROCEED **

GENERAL 3. Consider deleting the term "DIRECTIONS" from the top of most screens; it adds very little to the tutorial and requires memory space which might be otherwise used. If this practice is adopted, the deletion should be consistent throughout the ET package.

GENERAL 4. Recommend that at the first time a specific key is cited to be pressed, the nature ("soft" or "hard," particularly for the "soft" keys) and location of the key should be identified.

GENERAL 5. Care should be taken to assure that the names used within screens are consistent with those actually appearing on the hardware, the screens, and the tasks and subtasks to which they refer, e.g., within T0110 there is a reference to T0111 as "NETWORK ACCESS;" the actual title of T0111 is "NET ACCESS".

GENERAL 6. Use specific and consistent ways to differentially indicate to the reader that you are referring to a SCREEN, a (soft or hard) KEY to be pressed, or an item to be selected from a menu presented on a screen; e.g., consider the use of bold (or reverse video) characters in conjunction with double quotation marks to refer to a "SCREEN TITLE," bold (or reverse video) characters within single quotation marks to refer to a 'MENU ITEM,' and bold (or reverse video) letters alone to identify a KEY to be pressed.

GENERAL 7. Consider deleting the practice of using separate screens to provide CORRECT feedback. Incorporate CORRECT at the beginning of the succeeding screen and, if needed, include a transitional word or phrase to introduce the next topic. Rationale: Conservation of memory.

Examples:

T1011 The initial line should read: CORRECT. NOW PRACTICE
MAKING ...

T1015 The initial line should read: CORRECT. NOW PRESS THE
CLR KEY to

T0141 The initial line should read CORRECT. NOW INITIALIZE
THE PROPELLANT TEMPERATURE ...

Note: The comments provided above are intended to reflect characteristics which are present in multiple locations throughout the documentation. While, in the spirit of attempting to expedite subsequent revisions, an effort will be made to identify each applicable occurrence (via an abbreviated reference to the appropriate general comment in the following manner: G1, G2, ...), it is likely that there may occur instances where a general comment will apply, but it has not been identified specifically. Hence, during efforts to implement changes, all GENERAL comments should be kept in mind by those responsible for actual changes to the code to maximize the likelihood that all relevant occurrences are corrected.

The comments which follow use the designation employed on the documentation provided to identify each screen; e.g., T0118.

(Comments on Level I)

T1001 G4. Uses the word "SOFTKEY" without defining same beforehand (i.e., "SOFTKEY" is computer jargon, apt to be unfamiliar to those unfamiliar with computers). As a minimum, the general location of the "SOFTKEYs" should be cited before asking the operators to employ them (as is done on the succeeding screen, T1002).

T1003 G2.2. EMBOLDen the word "CONTINUE" (or reverse video) on the last line to be consistent with the practice reflected elsewhere within the screens of identifying keys to be pressed by making them bold (or using reverse video) . Enclose the phrase with double asterisks.

T1004 1. Change "AROUND" to "TO" (Line 3).

2. EMBOLDen "SELECT" and "K" (or use reverse video) only.

T1006, T1010, T1014 G3. Delete screen. Incorporate the word "CORRECT" in place of the term "DIRECTIONS" on the succeeding screen.

T1010 G2.2.

T1011 The last line of text ("YOUR LAST SELECTION: x") is confusing. Delete or clarify.

T1012 G4. Because this is the first reference to the use of a "hardkey," suggest the last line as follows: THEN PRESS THE ENT KEY ON THE BOTTOM LINE OF THE NUMERIC KEYPAD.

T1015 G4. In consonance with the orientation of the preceding comment:

1. Indicate the location of the CLR key after the word "OVER."

2. Insert the word "SOFTKEY" prior to "+/-" and indicate its location ("ON THE BOTTOM LINE OF THE NUMERIC KEYPAD") after the word "KEY."

3. As in the preceding comment, incorporate the nature and location of the first-time-used CONFIRM softkey.

4. Additionally, the use of the softkey "CONFIRM" to indicate that you have made an error is a logical inconsistency; recommend that the "CANCEL" softkey be employed instead. Throughout the majority of the ET screens, "CONFIRM" is employed in a positive context--to associate it here with the need to correct an erroneous entry is inconsistent. (If CANCEL cannot be used, then some other term should be generated to indicate the need to revise an erroneous TOO LARGE or TOO SMALL value.)

T1016 Place "WHEN FINISHED, PRESS CONTINUE at bottom of screen.
(Note the embOLDened "CONTINUE.")
T1017 G2.

(Comments on Level II)

T0002 G6.

T0003 1. To unambiguously identify previous efforts, the software should add an asterisk or otherwise indicate completion of each topic at the time it is finished--or, conversely, start with all items with asterisks and successively delete the asterisk as has been done with the "SYSTEM STARTUP TRAINING" screen menu. (Individuals were observed unintentionally repeating topics during the evaluation.)

2. G5. (Re "SYSTEM STARTUP" on the menu or "SYSTEM STARTUP TRAINING" on the screens)

T0102 Present wording is confusing and somewhat contrary to logic, indicating that the operator is to "CONFIRM" that the system is "not OK " as the basis for continuing. Suggest that the present screen be replaced with the following:

THE NEXT SCREEN YOU WILL SEE IS THE "POWER UP STATUS" SCREEN. TO PROCEED WITH TRAINING ON THE PRESENT TUTORIAL, PRESS CONTINUE REGARDLESS OF THE STATUS INDICATED FOR THE ITEMS SHOWN.

Are there any circumstances that you would not want the operator to continue? As it reads now, there is no indication that the operator should ever discontinue because of what is shown on the POWER UP STATUS screen. Is this true? To minimize potential confusion, it is recommended that the text be revised to more clearly indicate what is occurring. Is it necessary to introduce a new term ("CONFIRM") when it appears that what is being asked is simply to "CONTINUE" (i.e., continue in spite of the fact that all system components may not be "OK")? If appropriate, it would be more straightforward to use the wording indicated above.

T0104 G7. DELETE.

T0105 G2.1, G2.2, G3, G4. Confusing. Multiple instructions, apparently applicable to a screen which is not even to be addressed in the Tutorial. Clarification and revision are needed. (See "NOTE" appearing in the documentation as well.)

T0110 G2.1, G2.2, G3, G5.

T0112 G2.1, G2.2.

T0113 G7.

T0114 G2.1, G2.2, G3, G5, G6.

T0116 G2.1, G2.2, G5, G6.

T0117 G7.
T0118 1. G3

2. Confusion between the use of the term "STARRED" and the actual appearance of an asterisk was evidenced during the assessment. Change to the use of the term ASTERISK in lieu of STARRED.

3. Suggest this screen be broken into two separate screens as follows:

(T0118a) ON THE NEXT TWO SCREENS IS THE "SETUP AND INFORMATION" MENU. YOU CAN SWITCH BACK AND FORTH BETWEEN THESE TWO SCREENS BY PRESSING THE NEXTPAGE SOFTKEY. YOU MUST INITIALIZE ALL OF THE ITEMS WITH ASTERISKS (*) ON BOTH PAGES TO START THE SYSTEM. AFTER AN ITEM IS SELECTED AND COMPLETED, THE ASTERISK WILL DISAPPEAR FROM THE MENU.

** PRESS CONTINUE TO PROCEED **

(T0118b) DURING ACTUAL FIELD OPERATIONS, YOU COULD SELECT ITEMS IN ANY ORDER; HOWEVER, TO COMPLETE THIS TUTORIAL YOU SHOULD DO THE PAGES IN ORDER. COMPLETE ALL ITEMS WITH AN ASTERISK ON THE FIRST PAGE BEFORE PROCEEDING TO THE SECOND. AFTER COMPLETION OF THE FIRST PAGE, THE SECOND WILL APPEAR AUTOMATICALLY. TO BEGIN, SELECT ANY OF THE ITEMS WITH AN ASTERISK (*) FROM THE NEXT SCREEN.

** PRESS CONTINUE TO PROCEED **

4. Inherent in the preceding comment is the need to include code to monitor progress and determine when all starred items have been completed and automatically switch to the succeeding screen when all items with an asterisk have been completed on the first of the two screens. Recommend further that upon completion of asterisked items from both pages, the Tutorial automatically increment to a separate screen announcing that they have completed "SYSTEM STARTUP" training, and directing them to ** PRESS CONTINUE TO PROCEED ** (with this response taking them back to T0003's main menu). If adopted, this approach would also lead to the deletion of T0121 (and, perhaps, T0123).

T0122 1. Delete the second sentence (lacks context and relevance).

2. Change the "DO NOT ..." to an affirmative statement:

RETURN TO THE "SYSTEM STARTUP SCREEN" AND SELECT AN ASTERISKED ITEM.

3. Consistent with comment 2, change the last line to:

** PRESS CONTINUE TO RETURN TO THE "SYSTEM STARTUP SCREEN" **

T0124 1. This screen caused significant problems with many of those participating in the evaluation. More information is needed

to enable the HIP-naive soldier to understand what is meant by the first two sentences, e.g., participants were unfamiliar with the concept of, and the need to, "INITIALIZE" the BCS DATA TRANSFER (As reflected in the MANPRINT meeting on 28 September, such information should be integrated into the present software, presented in a separate special text or manual to accompany the HIP ET, or otherwise made available to the trainer and the trainee.)

2. G2.1, G2.2, G6. Change "SELECT INITIALIZATION FROM ..." to: ON THE NEXT SCREEN, MOVE THE CURSOR TO THE '* INITIALIZATION' ITEM, AND PRESS THE SELECT SOFTKEY.

** PRESS CONTINUE TO PROCEED **

T0126 Same as comment 2 of the preceding item.

T0127 G7.

T0128 1. G3, G5, G6. Change first sentence to: INITIALIZE THE 'TOT RESPONSE TIME' ITEM APPEARING ON THE SUCCEEDING "TIME-ON-TARGET CREW RESPONSE TIME" SCREEN. Insert "of 1.5" after the words RESPONSE TIME in the second sentence. Substitute the following for the "PRESS THE ENTER KEY ...":

ON THE NEXT SCREEN, ACCOMPLISH THE INITIALIZATION BY PRESSING THE ENT KEY AT THE BOTTOM OF THE NUMERIC KEYPAD. (NOTE THAT DURING ACTUAL OPERATIONS, YOU WOULD BE ALLOWED TO ENTER ANY VALUE BETWEEN .5 AND 10.0.)

T0129 Insert hyphens in the screen title: TIME-ON-TARGET ... Re G5: Change ENTER to ENT.

T0130 G5. Change ENTER to ENT.

T0131 G7.

T0132 1. G3.

2. This is the soldier's first contact with the "NAVIGATION SUBSYSTEM RESTART" screen and menu; recommend revision of the initial sentence to eliminate the notion that he is "restarting" something he has not encountered previously.

3. G2.2.

T0133 1. G3.

2. Same as preceding comment 2, consider deleting the first sentence (RESTART ...) entirely; it is redundant with the preceding screen.

3. G2.1, G2.2. Replace with:

"PRESS USE ALL ..." with: ON THE NEXT SCREEN, "NAVIGATION SUBSYSTEM RESTART", PRESS THE USE ALL SOFTKEY.

**** PRESS CONTINUE TO PROCEED ****

T0135 Same as T0133.

T0136 G7.

T0137 1. G3.

2. G2.1, G2.2. Replace PRESS YES ... with:

ON THE NEXT SCREEN, "NAVIGATION SUBSYSTEM RESTART", PRESS THE YES SOFTKEY.

**** PRESS CONTINUE TO PROCEED ****

T0139 Same as for T0137.

T0140 G7.

T0141 G2, G3, G5. Replace with:

CORRECT. NOW INITIALIZE THE NEXT SCREEN, "PROPELLANT TEMPERATURE". ALTHOUGH A RANGE OF TEMPERATURE VALUES FROM -130 TO +145 COULD BE ENTERED DURING ACTUAL OPERATIONS, ENTER THE VALUE SHOWN ON THE NEXT SCREEN, +70, BY PRESSING THE ENT KEY ON THE NUMERIC KEYPAD.

**** PRESS CONTINUE TO PROCEED ****

T0142 G2, G5. Add the location of the ENTER key to the last line and enclose in double parentheses:

**** PRESS ENT ON THE NUMERIC KEYPAD ****

T0143 1. G5. Change ENTER to ENT.

2. G2.2.

T0144 G7.

T0145 1. G3.

2. G2.1, G5, G6. Replace with:

ON THE NEXT SCREEN "TUBE LOAD ELEVATION", INITIALIZE 'LOAD ELEVATION.' ALTHOUGH DURING ACTUAL OPERATIONS, ANY VALUE BETWEEN -200 AND +1333 COULD BE USED, ASSUME THE LOAD ELEVATION OF +300 IS CORRECT. ON THE NEXT SCREEN, PRESS THE ENT KEY ON THE NUMERIC KEYPAD TO ENTER THE NUMBER 300.

(Note that the present text states that the ENTER key is on the display itself.)

T0148 G7.

T0149 G2, G3, G5, G6. (Comments similar in nature and scope to those for T0145.) Recommend inclusion of phrase that indicates to the operator that ALL sector settings displayed are to be assumed to be correct.

- T0151 1. G2.2.
2. Change PRESS USE ALL ON ... to:

PRESS THE SOFTKEY USE ALL ON THE "DEFINE SECTOR OF FIRE" SCREEN.

T0152 G7.

- T0153 1. G3.
2. G2.1, G5, G6. Replace with:

ON THE NEXT SCREEN, "SET DATE / TIME GROUP", INITIALIZE THE DATE AND TIME USING THE KEYS ON THE NUMERIC KEYPAD. USE THE CURRENT DATE AND TIME. PRESS THE CLR KEY IF

** PRESS CONTINUE TO PROCEED **

- T0155 1. G5. Change CLEAR to CLR
2. G2

- T0156 1. G3
2. G2, G6. Replace with:

TO SET THE CLOCK TO THE DATE AND TIME YOU TYPED, PRESS THE SOFTKEY MARK ON THE NEXT SCREEN.

** PRESS CONTINUE TO PROCEED **

T0158 Change the second sentence to read as follows:
TO SET THE CLOCK TO THE DATE AND TIME YOU PREVIOUSLY TYPED, PRESS THE SOFTKEY MARK. PRESS MARK ON THE NEXT SCREEN.

** PRESS CONTINUE TO PROCEED **

T0159 G7.

- T0160 1. G3.
2. G2, G5, G6. Replace with:

YOU ARE NOW TO INITIALIZE THE AMMO INVENTORY. ON THE NEXT SCREEN, "INVENTORY MANAGEMENT", HIGHLIGHT THE 'EDIT CURRENT AFCS' OPTION BY USING THE ARROW KEYS, THEN SELECT THAT OPTION BY PRESSING THE SELECT SOFTKEY.

** PRESS CONTINUE TO PROCEED **

T0161 & T0165 1. It appears that the "INVENTORY MANAGEMENT" menu involves a total of five items appearing on two separate screens. Is this true, such should be stated. If true, can the soldier toggle back and forth between the two screens during actual operations? If yes, then additional explanation is needed. (See additional confusion related to the use of the terminology 'AMMO INVENTORY' in the comment addressing T0164.)

2. The ET Testing results suggest that additional experience with the ammunition-inventory-related screens would likely prove helpful in the transition between Tutorial Level II and a Level III scenario.

T0162 G2, G5, G6. Beginning with the second sentence, replace with:

ON THE "INVENTORY MANAGEMENT" SCREEN, HIGHLIGHT THE 'EDIT CURRENT AFCS' OPTION BY USING THE ARROW KEYS, THEN SELECT THAT OPTION BY PRESSING THE SELECT SOFTKEY.

**** PRESS CONTINUE TO PROCEED ****

T0163 G7.

T0164 1. G2, G3.

2. See previous comments regarding T0161 & T0165. The next screen introduces three additional 'INVENTORY MANAGEMENT' menu options, and each is referred to as a separate INVENTORY. However, the soldier is told to assume that the 'AMMO INVENTORY' is correct. There is no actual item appearing as 'AMMO INVENTORY' on the menu.

3. G2.2. Change the last two lines to indicate that the **FINISHED** key is to be pressed to terminate the present screen and proceed: **** PRESS THE FINISHED SOFTKEY TO INDICATE THE INVENTORY UPDATE IS COMPLETE ****

T0166 1. G2, G5, G6.

2. Reconcile with previous T016x-series comments

T0201 G2.2, G5. Change "Network Access" Display to "Network Access" Screen. The use of "display" may confuse computer illiterate users.

T0202 G2.2, G3, G5.

1. As in the preceding comment, change "display" to "screen."

2. To unambiguously identify correct current values change "verify the current values" to "verify the values shown."
T0203 G2.2, G3, G4, G5. Present wording is confusing and somewhat contrary to logic, indicating that the operator is to press "Cancel" to discard changes made and/or to verify the values. Suggest that "Cancel" be used to discard incorrect entries and "Use All" or "Select All" be used to verify values. "Cancel" should not be used to connote nearly opposite meanings.

T0204 and T0206 G2.1, G2.2, G3, G5. As indicated previously, the use of the key "Cancel" to exit from a screen without making any changes is somewhat illogical. Replace "Cancel" with "Use All" or "Select All."

T0207 and T0208 G7. Replace with:

CORRECT. NOW LEARN HOW TO CHANGE VALUES ON THE "NET ACCESS" SCREEN. ON THAT SCREEN, FIRST USE THE ARROW KEYS TO HIGHLIGHT THE ITEM TO BE CHANGED, THEN PRESS THE SELECT SOFTKEY. YOU WILL THEN GO TO ANOTHER SCREEN AND SELECT A SPECIFIC VALUE OR TYPE IN A VALUE FROM THE KEYPAD.

**** PRESS CONTINUE TO PROCEED ****

T0209 G2.1, G2.2, G3, G6. Replace with:

PRACTICE BY CHANGING THE 'GUN KEY TIME (SEC)' ON THE MENU APPEARING ON THE "NET ACCESS" SCREEN. ON THE NEXT SCREEN, USE THE ARROW KEYS TO HIGHLIGHT THIS ITEM, THEN PRESS THE SELECT SOFTKEY.

T0211 G2.2, G6. Replace lines 3 and 4 with:

HIGHLIGHT THE 'GUN KEY ITEM (SEC)' THEN PRESS THE SELECT SOFTKEY.

T0212 G7.

T0213 G2.1, G2.2, G3. Replace with:

CHANGE THE VALUE TO 2.1 SECONDS, ON THE NEXT SCREEN. USE THE ARROW KEYS TO HIGHLIGHT 2.1, THEN PRESS THE SELECT SOFTKEY.

**** PRESS CONTINUE TO PROCEED ****

T0215 G2.2. Consistent with T0211 and T0213, replace lines 4 and 5 with:

HIGHLIGHT 2.1 SECONDS BY USING THE ARROW KEYS, THEN PRESS THE SELECT SOFTKEY.

T0216 G7.

T0217 G2.2, G3, G6, G7. Replace with:

CORRECT. NOTE, HOWEVER, THAT CHANGING THE VALUE OF A SETTING ON THE "NET ACCESS" SCREEN DOES NOT CHANGE THE...

**** PRESS CONTINUE TO PROCEED ****

T0218 G2.2, G3, G6. Insert the word "SOFTKEY" after USE ALL and "SCREEN" after both occurrences of "NET ACCESS".

T0219 G2.1, G2.2, G3. Insert "ON THE NEXT SCREEN" prior to PRESS USE ALL; insert "SOFTKEY" subsequent to that phrase.

T0221 G2.1, G2.2. Delete "ON THE NETWORK ACCESS DISPLAY" and replace with:

ON THE "NET ACCESS" SCREEN PRESS THE USE ALL SOFTKEY.

T0222 G7.

T0223 G2.1, G2.2, G3, G6, G7. Replace with:
CORRECT! NOW, CHANGE THE 'NET ACCESS DELAY TIME (SEC).' SELECT
'NET ACCESS DELAY TIME (SEC)' FROM THE MENU ON THE NEXT SCREEN.
** PRESS CONTINUE TO PROCEED **

T0225 G1, G2.1, G2.2. Delete lines 3 and 4 and replace with:
ON THE NEXT SCREEN, USE THE ARROW KEYS TO HIGHLIGHT 'NET ACCESS
DELAY TIME (SEC)' THEN PRESS THE SELECT SOFTKEY.

(Note: As in other circumstances, the sequence employed in T0223 and T0225 infers that some learning has occurred by this point in the ET sequence, and that the need to repeatedly provide detailed step-by-step instructions for recurring sequences is unnecessary. The logic at this point is that the individual will have learned the sequence needed to "select" a menu option [re T0223]. If he hasn't, the error correction screen [T0225] repeats the more detailed instructions regarding the specific steps required to make the correct selection. It may be that this assumption can be employed earlier in the ET sequence than is presently indicated.)

T0226 G7.

T0227 G1, G2.1, G2.2, G3, G6, G7. Replace ENTER THE VALUE with
TYPE THE VALUE.

Consider adding a screen to more clearly address the use of decimals (and how they are to be dealt with since none are on the keypad), the RETRY SOFTKEY, the ENT key, and the apparent fact that (during normal operations??) values ranging from .5 to 49.5 may be entered (i.e., last line of screen T0228).

T0228 As mentioned in the preceding paragraph, delete confusing reference to possible time ranges.

T0229 G2.1, G2.2, G6. Replace lines 3 and 4 with:

ON THE NEXT SCREEN, USE THE KEYPAD TO TYPE THE VALUE 8.5, THEN
PRESS ENT.

T0230 G7.

T0231 G1, G2.1, G2.2, G3, G6, G7. Replace with:

CORRECT! NOW CHANGE THE 'BLOCK MODE SELECTION.' ON THE NEXT
SCREEN, SELECT THE 'BLOCK MODE SELECTION' OPTION FROM THE "NET
ACCESS" MENU.

** PRESS CONTINUE TO PROCEED **

T0233 G1, G2.1, G2.2, G6. Replace lines 3 and 4 with:

ON THE NEXT SCREEN, USE THE ARROW KEYS TO HIGHLIGHT 'BLOCK MODE
SELECTION,' THEN PRESS THE SELECT SOFTKEY.

** PRESS CONTINUE TO PROCEED **

T0234 G7.

T0235 G2.1, G2.2, G3, G4. Insert ON THE NEXT SCREEN, PRESS THE YES SOFTKEY and delete ON THE NET ACCESS DISPLAY.

Additional explanation regarding the "confirmation" process is needed. Indicate what actual question is asked, where the question appears on the screen, and the availability of only two "values" which "toggle".

Why is the "CONFIRMATION" process limited to the "BAUD RATE SELECTION" menu item? Recommend that the process not be referred to as a CONFIRM procedure; rather describe it as merely a different way of changing the entry for this item. INDICATE may be substituted for CONFIRM.

T0237 G2.1, G2.2, G6. Consistent with previous comment, substitute INDICATE for CONFIRM. Delete NET ACCESS DISPLAY from line 4 and insert BY PRESSING THE YES SOFTKEY ON THE NEXT SCREEN.

T0238 G7.

T0239 G2.2, G3, G6. Substitute SCREEN for DISPLAY.

T0240 G2.2, G6.

T0242 G2.2.

T0301 G2.2, G6. Substitute SCREEN for DISPLAY.

T0302 G2.2, G3, G6. Substitute SCREEN for DISPLAY.

T0303 G2.2, G3, G6.

T0304 G2.1, G2.2, G3, G6. Replace lines 2 and 3 with:

FROM THE NEXT SCREEN, SELECT 'BROADCAST ADRS.'

T0306 G2.2, G6. Do not highlight SELECT.

T0307 G7.

T0308 G1, G2.1, G2.2, G3, G6, G7. Replace with:

CORRECT! NOW, CHANGE THE VALUE OF THE 'BROADCAST ADRS,' ON THE NEXT SCREEN TO J. USE THE ARROW KEYS TO HIGHLIGHT J, THEN PRESS THE SELECT SOFTKEY. SELECT J FROM THE "NET ADDRESS" MENU.

** PRESS CONTINUE TO PROCEED **

T0310 G1, G2.1, G2.2, G6. Replace lines 2-4 with:

CHANGE THE VALUE OF THE 'BROADCAST ADRS' ON THE NEXT SCREEN TO J. USE THE ARROW KEYS TO HIGHLIGHT J, THEN PRESS THE SELECT SOFTKEY.

T0311 G7.

T0312 G2.2, G3, G6, G7. Replace line 1 with:

CORRECT! THE OTHER ADDRESS SETTINGS, THOSE ENDING IN ADRS,...
Replace 'BROADCAST ADDRESS' with 'BROADCAST ADRS.'

T0313 G2.2, G3, G6. Substitute SCREEN for DISPLAY.

T0401 G2.2, G6. Substitute SCREEN for DISPLAY.

Additionally, information regarding the time requirements should be presented earlier in Level II, along with a recommendation that it be addressed first--see T0415, T0416.

T0401.5 G2.2. Consider repositioning this screen to the end of the section, as a "wrap-up" note.

T0402 G2.2, G3, G6. Replace with:

THE "NAVIGATION SUBSYSTEM RESTART" SCREEN SHOWS THE POSITION VALUES CURRENTLY STORED. YOU CAN VERIFY AND ACCEPT THE CURRENT VALUES, ENTER NEW VALUES, OR GET THE POSITION FROM THE NAV, THE BCS, OR THE LAST MOVE ORDERS.

** PRESS CONTINUE TO PROCEED **

Also, the meaning of NAV needs to be clarified.

Recommend introducing the "NAVIGATION SUBSYSTEM RESTART" screen earlier (e.g., after T0401) to allow the soldier to have a more concrete appreciation of its contents. Presently, he has to deal with it in the abstract through four screens before seeing it. If this recommendation is adopted, the last lines of T0401 could be:

THE "NAVIGATION SUBSYSTEM RESTART" SCREEN IS SHOWN NEXT.
FAMILIARIZE YOURSELF WITH IT. WHEN FINISHED, PRESS CONTINUE TO LEARN MORE ABOUT IT.

** PRESS CONTINUE TO PROCEED **

T0403 G2.2, G3. A better description of the broader perspective is warranted prior to T0403 to more adequately indicate that a principal objective of this section is to enter all updated data (or accept that stored) needed to begin the alignment sequence. Revise the present screen to reflect the fact that USE ALL is a command which accepts (and stores) all data shown as well as starting the alignment process (e.g., PRESSING USE ALL ACCEPTS ALL VALUES SHOWN AND STARTS THE ALIGNMENT PROCESS).

T0404 G1, G2.1, G2.2, G3, G6. Replace with:

ON THE NEXT SCREEN, "NAVIGATION SUBSYSTEM RESTART," SELECT 'ALTITUDE'.

T0406 G1, G2.1, G2.2, G6. Change "SELECT ALTITUDE ..." TO: ON THE NEXT SCREEN, "NAVIGATION SUBSYSTEM RESTART," USE THE ARROW KEYS TO HIGHLIGHT 'ALTITUDE', THEN PRESS THE SELECT SOFTKEY.

** PRESS CONTINUE TO PROCEED **

T0407 G7.

T0408 G1, G2.1, G2.2, G3, G6, G7.

1. The word **TYPE** has been used previously to indicate numeric information is to be entered from the keypad. Substitute **TYPE** for **ENTER**.

2. Indicate that, as shown on the "NAVIGATION SUBSYSTEM RESTART" screen during normal operations values from -999 to +9999 may be entered.

3. The system should be consistent in addressing the use of - and + signs, particularly the latter (e.g., see T0142 in the "propellant temperature" screen).

T0409 G5.

1. The directions to **TYPE ALTITUDE -999 to 9999** suggests that another number is to be entered instead of the 400 value indicated (see Comment 2 above).

2. Replace **PRESS ENTER** with **THEN PRESS ENT**.

T0410 G2.1, G6. Replace lines 3 and 4 with:

AT THE NEXT SCREEN, USE THE KEYPAD TO TYPE 400, THEN PRESS THE ENT KEY.

T0411 G7.

T0412 G2.2, G3, G5, G6, G7.

1. Use bold letters (or reverse video) for '**EASTING,**' '**ALTITUDE,**' '**GRID ZONE,**' '**FAST ALN AZ,**' and '**SPHEROID.**'

2. Does the necessity of being approximately correct apply to only '**SPHEROID**' or to any of the position-related values? If it is applicable to other position-related values, so state.

T0413 G2.2, G3, G6. Information provided on this screen is ambiguous and confusing.

1. The statement '**GET NAV POSITION**' GETS THE...FROM THE NAVIGATION SUBSYSTEM is unclear. The soldier is already working in the NAVIGATION SUBSYSTEM. Does this statement refer to information previously stored in the navigation subsystem? If so, insert "**INFORMATION PREVIOUSLY STORED IN**" after "**THE**" at the end of the third line.

2. The last sentence is also confusing. Does "ENTERED" mean the same as "FIRST BEGUN" when initially beginning the process of entering values in the "NAVIGATION SUBSYSTEM RESTART?"

T0414 G2.2, G3, G5, G6. Use bold letters (or reverse video) for 'GET LAST MOVE ORD,' 'EASTING,' 'NORTHING,' 'ALTITUDE,' 'GRID ZONE,' and 'GET BCS RPRT POS.'

T0415 G2.2, G3, G5, G6. Replace lines 1 and 2 with:

THE ALIGN MODE CAN BE EITHER NORMAL ('ALIGN MODE NORMAL') OR FAST ('FAST ALIGN AZ'). YOU MAY CHOOSE EITHER.

T0416 G2.2, G3, G6. Time-relevant statement should be placed closer to preceding time-relevant information. Revise in the following manner:

A STATUS BOX ON THE TOP LINE OF THE DISPLAY SHOWS THE APPROXIMATE TIME NEEDED TO COMPLETE THE ALIGNMENT. PRESSING THE USE ALL KEY STARTS THE ALIGNMENT PROCESS. ONCE STARTED, IT CONTINUES AUTOMATICALLY. YOU CAN LEAVE THE "NAVIGATION RESTART TRAINING" SECTION AND BEGIN WORK ON OTHER SECTIONS OF THE SYSTEM AS IT CONTINUES.

**** PRESS CONTINUE TO PROCEED ****

T0417 G2.2, G3, G6.

T0420 G2.2, G3.

APPENDIX E

LIST OF ACRONYMS AND ABBREVIATIONS

ARI U.S. Army Research Institute for the Behavioral
and Social Sciences

AFCS Automatic Fire Control System

ASARC Army System Acquisition Review Council

ASVAB Armed Services Vocational Aptitude Battery

COS Chief of Section

ET Embedded Trainer

GT General Technical

HIP Howitzer Improvement Package

IOTE Initial Operational Test and Evaluation

PM Product Manager

ROC Required Operational Capability

SGT Sergeant

SSG Staff Sergeant

SFC Sergeant First Class

SME Subject Matter Expert