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Research Report 1437

Training Needs Assessment and Training Technology Transfer in U.S. Army Europe (USAREUR): 1985

William R. Sanders

ARI Scientific Coordination Office in USAREUR
Office of the Technical Director

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

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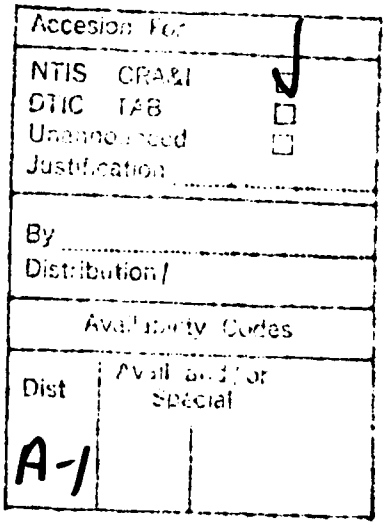

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Armor and Infantry training information needs identified by U.S. Army Europe (USAREUR) training managers are presented. Efforts to respond to these needs with existing ARI products are discussed. Transfer of emerging training products from the ARI Work Program to USAREUR for review is described. Several training device programs currently being previewed for USAREUR input are presented.

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FOREWORD

The training goal for U.S. Army Europe (USAREUR) is to develop a military force technically, physically, and psychologically prepared to fight and win a war. The Army Research Institute for the Behavioral and Social Sciences (ARI) has developed a wealth of information that can aid USAREUR trainers in the development and conduct of this training. Matching past, present, and future ARI research activities with identified USAREUR needs can greatly assist the Army in Europe today and can provide valuable confirmation that ARI's work program is on track--addressing high-priority Army needs.

The Army Research Institute Scientific Coordination Office (SCO) USAREUR serves as the eyes and ears of the Institute in USAREUR. The present report addresses research needs in Armor and Infantry training from the perspective of the Army in Europe. It is the second in a series of needs assessment documents from SCO USAREUR, and should serve as a reference for scientists interested in current thought from the field regarding Armor and Infantry training concerns. Readers are encouraged to join the needs assessment and technology transfer process, directing their questions and ideas to the staff of SCO USAREUR.

EDGAR M. JOHNSON
Technical Director

TRAINING NEEDS ASSESSMENT AND TRAINING TECHNOLOGY TRANSFER IN U.S. ARMY EUROPE (USAREUR): 1985

EXECUTIVE SUMMARY

Requirement:

On October 1, 1984, the Army Research Institute (ARI) Field Unit in the U.S. Army-Europe (USAREUR) was redesignated a Scientific Coordination Office (SCO) with the mission of assessing USAREUR research needs and promoting the transfer of ARI technology to USAREUR.

Procedure:

Much of ARI's extensive work in the areas of Armor and Infantry training has not reached USAREUR. This paper details initial efforts at SCO USAREUR to identify and respond to USAREUR training needs primarily in these two areas. Numerous existing ARI products were provided to USAREUR training managers. ARI products still in draft form were made available to USAREUR trainers to elicit detailed product-referenced feedback for ARI authors, and to allow for the earliest possible transfer of new training ideas. Additional USAREUR training information needs were identified, and referenced against specific ARI products.

Findings:

Specific ARI products provided to training managers to address a particular training area are identified in separate chapter appendixes. (See Appendixes B through H.) In the area of procedural skills for armor and cavalry vehicle crewmembers, USAREUR is requesting ARI M1 Abrams products from the Armor School, and success here will be followed by a push to obtain ARI M2/M3 Bradley products from the Infantry School. Also, several ARI Fort Knox publications addressing gunnery actions to follow under conditions of partial equipment failure were reviewed by USAREUR master gunners and judged to be useful for entry-level training, and for fast train-up purposes.

ARI is well equipped to respond to the need for information on tracked vehicle driver training and performance evaluation. Written materials for non-combat driver procedural tasks and combat skills training and evaluation were provided to USAREUR training managers along with directions for laying out a standard driver training course for day and night driver training and evaluation.

ARI is addressing the long-standing problems associated with paper-based maintenance training and performance aids by exploring electronic information delivery devices. SCO USAREUR activities to date involved presenting these device areas to USAREUR training managers for feedback on how and where they might be used.

The major infantry training issue to emerge was individual marksmanship training, given the restrictions of USAREUR's limited ranges. Additional USAREUR training issues identified were information on the Multiple Integrated Laser Engagement System (MILES), the feasibility of using ARI's Realistic Air Defense Engagement System (RADES) program as a USAREUR training tool, night vision needs, particularly with regard to Combat Vehicle Identification (CVI) at night or under conditions of limited visibility, and information requirements to support USAREUR's upcoming Combat Maneuver Training Complex (CMTC), which will share many characteristics with the National Training Center (NTC).

Utilization of Findings:

Future efforts will involve probing for in-depth understanding. More time will be spent on a smaller set of research efforts. Currently available driver training guides and simulators and specialized training equipment should be examined. Initial contacts have been established so the SCO USAREUR staff can see what driver training technology is currently available off-the-shelf in Europe.

This desire for greater active involvement will likely be reflected in more Technical Advisory Service (TAS) work, and should be seen as an expanding opportunity for involvement of ARI Field Unit and Headquarters content area experts in USAREUR. Such TAS efforts have been carried out in other areas, in support of USAREUR's Warrior Preparation Center (WPC) and Headquarters, Central Army Group (CENTAG), with great success. Future TAS will integrate ARI's work in night training, vehicle identification, and vehicle crewmember position assignment into USAREUR training and personnel practices. USAREUR Air Defense Artillery training needs will receive greater attention.

In the future, more effort will be made to get a reaction to ARI's ongoing and upcoming research efforts. Plans currently call for a systematic USAREUR review of ARI's draft Science and Technology (S&T) Plan. Development of USAREUR needs as S&T requirements sheets will be pursued as a new administrative approach to quickly transferring information on needs to ARI Headquarters.

TRAINING NEEDS ASSESSMENT AND TRAINING TECHNOLOGY
TRANSFER IN U.S. ARMY EUROPE (USAREUR): 1985

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INTRODUCTION

Technology Transfer and Needs Assessment

On October 1, 1984, the Army Research Institute (ARI) Field Unit in the U.S. Army-Europe (USAREUR) was redesignated a Scientific Coordination Office (SCO) with the mission of assessing USAREUR research needs and promoting the transfer of ARI technology to USAREUR. This second paper in the SCO USAREUR series on needs assessment and technology transfer addresses Armor and Infantry training needs identified in USAREUR and the SCO USAREUR information response. The previous paper, Research Needs Assessment and Technology Transfer in USAREUR (Girdler & McLain, 1985), presented a model of technology transfer and discussed operations and plans in USAREUR in command and control and battle simulations. Research needs assessment was described as the process of understanding the mission, resources, organization, and the training and other requirements of USAREUR commands and activities well enough to interface between ARI and USAREUR. Technology transfer was seen as a natural consequence of this knowledge and involves providing or promoting the awareness and understanding of various ARI products and research findings, thus paving the way for eventual fielding and utilization by soldiers and leaders.

This paper will detail initial efforts at SCO USAREUR to identify and respond to needs for Armor and Infantry training information in USAREUR. Efforts were made to address these needs, where possible, with existing ARI products. Emerging products likely to meet USAREUR information needs were identified, obtained in draft or prototype form, and forwarded to appropriate USAREUR training managers for evaluation and/or utilization. This paper will also identify several devices currently in development that are being previewed in USAREUR to obtain feedback.

Much of ARI's extensive work in the areas of Armor and Infantry training has not reached USAREUR. A loss of problem-solving opportunity occurs here when the results of completed and potentially useful ARI research do not get into the hands of the people who could apply this information. This fact represents a loss in potential effectiveness and a lost opportunity for technology transfer, as well as a lost opportunity for needs assessment. The lack of product review and feedback reduces our ability to accurately identify broader research needs and to target future ARI research efforts. Needs assessment opens the door to technology transfer, which leads to feedback--product-based critique and identification of additional requirements framed in terms of the original research.

This initial effort in assessing USAREUR needs and transferring ARI technology has specifically sought to make use of available information that has not reached USAREUR training managers. These efforts have been well received and supported in USAREUR. Training managers found that even older ARI reports were useful, these products serving as a basic framework around which new materials might be developed.

SCO USAREUR has also provided emerging ARI products in draft or prototype form to USAREUR training managers in response to their requests for training information. SCO USAREUR can identify the timeframe in which particular weapon system training issues (e.g., M2/M3 Bradley Reload System) will be addressed by ARI, thus reducing the chance of costly parallel or redundant work being done in both USAREUR and the continental United States (CONUS) simultaneously.

Finally, SCO USAREUR has been working in the area of previewing future ARI products and Joint Service developments in USAREUR. SCO USAREUR previews ARI work in progress to ensure that USAREUR has the opportunity to provide any input necessary on its unique needs to minimize the chance that parallel work is being done both in CONUS and USAREUR, and to develop an interest in ARI work that may later help us obtain the troop support needed for product development or evaluation. Previewing efforts early in a product's development cycle and gathering detailed product-referenced feedback greatly enhances the likelihood that the finished product will be consistent with USAREUR needs, and thus constitute transferable technology.

The work described here represents an effort to accomplish maximum technology transfer in USAREUR to yield a research needs assessment document that can direct future work. The focus was on paper-based and videotape technology (published ARI reports, drafts, briefing materials, videotaped briefings) as products for transfer, because these could be reproduced for dissemination by SCO USAREUR without additional resources. Device-based technology (such as large-scale computerized training management systems) was not actively pursued for transfer because the SCO USAREUR office cannot provide such devices if the demand arises.

Procedure

The procedure followed was to identify areas where ARI has recently produced information products highly transferable to USAREUR, assemble a library selected from the published and draft reports of the past several years, make potential USAREUR users aware of these products, and provide copies of any requested products quickly. Follow-up feedback was obtained on remaining information needs that could be satisfied with an existing ARI product, or that would require a future research effort.

Broad areas where ARI has generated products that are highly transferable were first identified by reviewing ARI Research Highlights, ARI Newsbriefs, and ARI R&D Programs. High "transferability" was determined by whether a product was produced in the past several years, "paper-based" (i.e., not a device), highly applied in nature (ARI Research Reports and Research Products), and provided content material applicable to USAREUR training needs, which were initially inferred by examining the USAREUR 7th Army Training Command (7ATC) organization. Materials were sought that could serve either as training materials for soldiers or as stand-alone training development and evaluation tools for training managers.

SCO USAREUR decided to focus on the large body of applied Armor and Infantry training research carried out within ARI's Training Research Laboratory, specifically that from ARI's (Armor School) Fort Knox Field Unit, (Infantry School) Fort Benning Field Unit, and Presidio of Monterey (POM) Field Unit.

Discussions at 7ATC indicated that there was a sufficient need for ARI Armor and Infantry training products. 7ATC was thus chosen as the primary site for ARI needs assessment and technology transfer efforts. It must be understood that ARI materials cannot simply be "handed off" for piecemeal incorporation by individual USAREUR units as an alternative to Army training products. The USAREUR training community is dedicated to the notion of maintaining the standardization of training between CONUS and USAREUR, and within USAREUR in particular. 7ATC has the authority and the expertise to evaluate and incorporate any new products that meet those USAREUR training needs not addressed by existing Army doctrinal materials. This command is the centralized USAREUR proponent for institutional training, training aids (publications), devices, simulations, and new equipment transition training. 7ATC also operates and schedules the major training areas (MTA).

Results of the initial interviews and briefings established that USAREUR training developers and training managers could use ARI products in these ways:

1. to develop and evaluate USAREUR training programs;

2. to anticipate future developments in training publications or devices;

3. to pull out sections of reports or illustrations to support ongoing training programs;

4. to adopt entire products for USAREUR publication;

5. to feed information back to ARI on product strengths and weaknesses, and USAREUR training developments that could make an ARI product redundant;

6. to identify and initiate contact with CONUS-based personnel working on similar problems; and

7. to provide a framework for describing additional research needs.

A reference "library" of recent ARI published and draft reports in the Armor and Infantry training areas was assembled at SCO USAREUR. This activity involved visits to ARI Field Units (FU) at Fort Knox, Fort Benning, POM, and ARI Headquarters for briefings on past, present, and future work programs, and for collection of research materials. Through these visits, several hundred potentially transferable ARI research products were assembled at SCO USAREUR.

The information exchange activities described in this paper were carried out primarily at 7ATC (Directorate of Training Support (DTS) and Directorate of Training Management (DTM)), at the Combined Arms Training Center (CATC) (Directorate of Individual Training and Bradley Transition Training Team), at the 7th Army NCO Basic Noncommissioned Officer Course Academy, at the 32d Air Artillery Defense Command (32d AADCOM), and at the 3rd Armored Division (3AD) Training Source Assistance Center (TRAC). Feedback was obtained on products provided, additional areas where information was needed were identified, and newly produced products were provided.

A structured interview guide was used to obtain product feedback. (See Appendix A.) This one-page sheet greatly understates the problems involved in getting products reviewed and key topics discussed to reveal USAREUR needs. Training managers enthusiastically requested information keyed to their position responsibilities but frequently did not read it. More often, product feedback was obtained through one-on-one product briefings.

In FY 1986 research needs assessment activities of SCO USAREUR expanded to incorporate a systematic USAREUR review of the ARI FY 1989-FY 1993 Science & Technology (S&T) Plan for comment and confirmation on ARI's future research thrusts.

Direction of This Paper

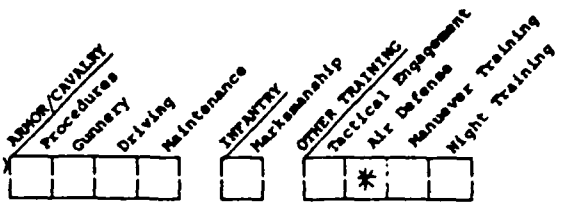
The following sections will describe the USAREUR training management environment and the role of 7ATC with its Training Support and Training Management Directorates. USAREUR needs for training information are presented and discussed. These needs were identified primarily through interviews with training managers at 7ATC and TRAC, Friedburg, through USAREUR briefings and message traffic, and from past ARI studies.

Specific ARI products provided to training managers to address a particular training area are identified in separate chapter appendixes. (See Appendixes B through H.) ARI researchers should look for any opportunities to expand these "information packages" with overlooked materials, and to offer updates to USAREUR training managers as new materials emerge.

Many ARI training products have been provided to USAREUR in the first year of SCO USAREUR's effort. None has been adopted by USAREUR, though several have passed subject-matter-expert (SME) review and are being requested for USAREUR general distribution. The most common situation is that training managers, looking for immediate answers, request ARI documents that simply appear to be related to their responsibilities.

The work that has been carried out with ARI FY 1984 Work Program products is summarized in Figure 1. Applications for the ARI FY 1985 Work Program products are presented in Figure 2. The three broad column headings (Armor/ Cavalry, Infantry, and Other Training), and their sub-headings represent information responsibility areas identified by the 7ATC training managers/developers. Dots indicate where ARI products were provided at 7ATC request to cover these training responsibility areas. Not all ARI products were provided for 7ATC publication and distribution in USAREUR. More commonly, ARI products were provided to give training developers ideas and a start-to-finish structured approach to follow in developing their own training materials or programs. Asterisks indicate where ARI products are being considered for widespread USAREUR publication/adoption as training materials or job aids. The asterisk marked Multipurpose Arcade Combat Simulator (MACS) and Realistic Air Defense Engagement System (RADES) are ARI hardware-based products that were previewed in USAREUR and appear to have high potential for transfer.

FY1984 Research
Program Elements



1.1.1 Development Of Realistic Air Defense Engagement System

1.1.1.0 Realistic Air Defense Engagement System (RADES)

3.2.2 Training Methods For The Combat Arms

3.2.2.1. Training Methods For Armor Skills .....

3.2.2.2. Training Methods For Combat Arms Leaders .....

3.2.3 Developing Training For Soldier Skills

3.2.3.1. Developing Training For Individual And Crew Served Weapons

Basic Rifle Marksmanship Shooter's Book .....

Advanced Rifle Marksmanship POI .....

Multipurpose Arcade Combat Simulator (MACS) ...

Guidelines For The Use Of WEAPONEER .....

Unit Rifle Marksmanship Training Guide .....

3.2.3.3. Target Acquisition & Analysis System (TATTS)/CVI .....

3.3.1 Computer-Based Instructional Systems

3.3.1.1. Model Training Program For Reserve Component Units .....

3.3.1.4. Technology Transfer In Armor Training .....

3.3.2 Technology-Based Aids For Basic Skills Training

3.3.2.2. Hand-Held Vocabulary Tutor .....

3.4.1 Simulation And Training Device Requirements

3.4.1.4. Bradley Fighting Vehicle Systems (BFVS) Training Develop & Operational Effectiveness

Bradley Operations - All Visibility Conditions.

Bradley Procedures Guides: CMDR, GNR, Driver ..

Bradley Revised 25mm Ammo Reloading Procedures.

M1 Unit Conduct Of Fire Trainer Validation ....

4.1.2 Strategies For Team/Crew/Unit Training

4.1.2.1. Small Unit Performance Training Methods

M1 Tank Sustainment Training Materials .....

M60A3 Force Mobilization/Reconstitution Program

4.2.2 National Training Center (NTC) Training & Evaluation

4.2.2.0. NTC Training And Evaluation System

NTC Data Handbook .....

Concepts For NTC Data Analysis .....

Tactical Engagement Sim. After Action Review ..

4.4.2 Managing The Implementation Of New Training Technology

4.4.2.1. Method For Implementing And Evaluating Training Developments

Tactical Engagement Simulation With MILES .....

Checklist For Conducting Training With MILES ..

Figure 1. ARI FY 1984 Program and USAREUR Needs Matrix

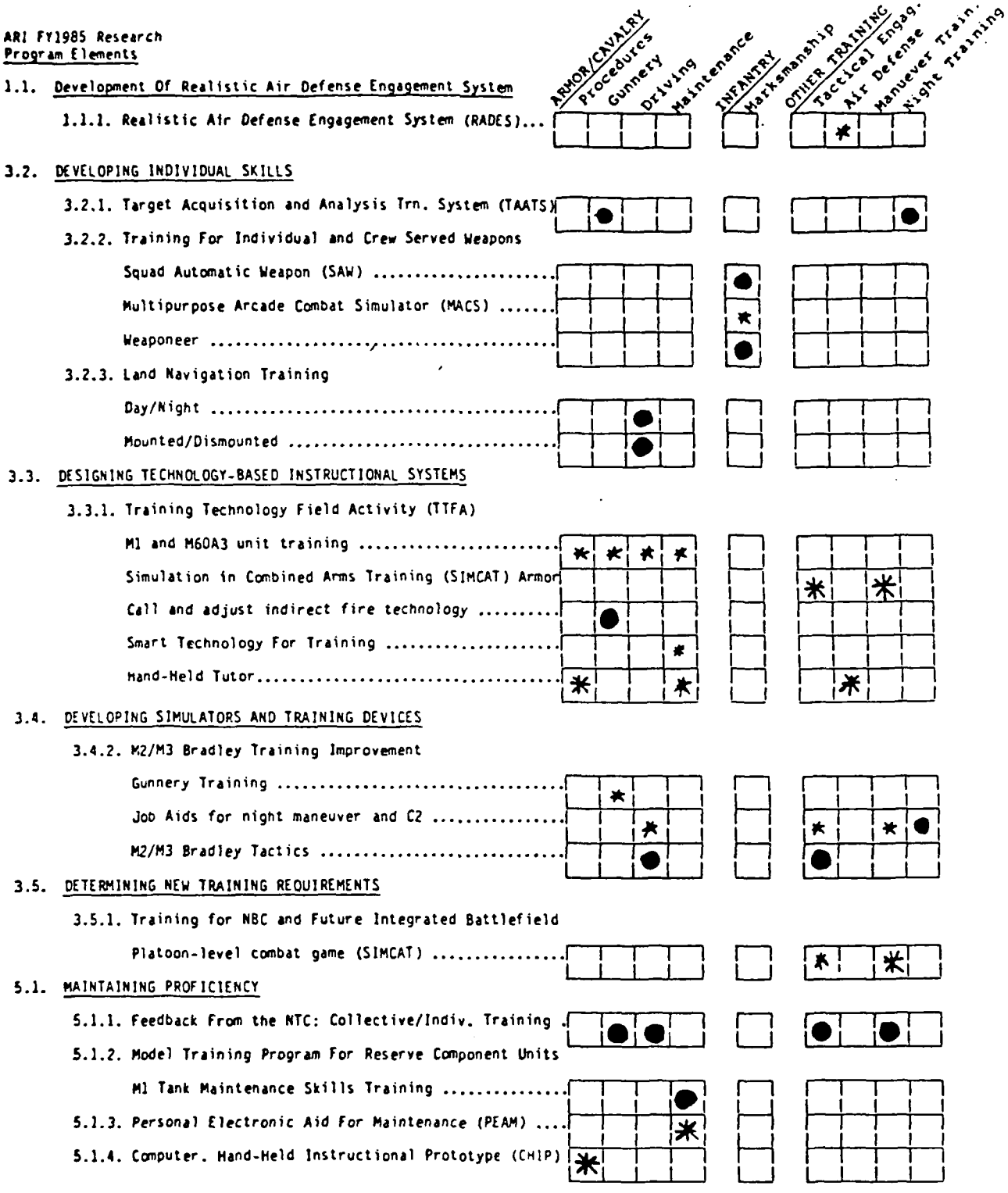


Figure 2. ARI FY 1985 Program and USAREUR Needs Matrix

USAREUR TRAINING ENVIRONMENT

The training environment in USAREUR presents many challenges not faced in the continental United States. New and increasingly complex weapon systems are rapidly being fielded in USAREUR; this fact leads to added demands for training in a geographically limited environment that does not lend itself to either live-fire or maneuver training. The nature of the training environment has many implications for ARI scientists considering USAREUR as a study site. USAREUR provides a unique Army situation that needs to be addressed by ARI. However, lack of space and time resources and the requirement of maintaining a ready-to-fight posture makes USAREUR a much less flexible environment in which to conduct research than the United States.

Unlike those in the United States, USAREUR units are widely dispersed, training areas are sometimes far from the garrison locations of units using them, and the areas are generally extremely limited in size. (All of USAREUR's training areas combined could fit within the boundaries of Fort Hood.) Training time is also very limited. Commander-in-Chief (CINC) USAREUR has estimated that the training time available to battalions ranges from 80 to 95 days per year, and indicated that training programs devised in Army schools must train to proficiency within these time limitations (Brown, 1985).

Demands and resource constraints combine to shape the training, training management programs, and training information needs in USAREUR. For example, training area constraints, such as the restrictions on live-fire and maneuver training, result in the need for both optimal management of available training area time and also an increased need for training devices, particularly those that provide gunnery, marksmanship, and tactical training.

In this chapter, USAREUR's training areas will first be briefly described, followed by a more detailed presentation of USAREUR training management, and 7ATC responsibilities in particular, and needs for training information identified by 7ATC Directorates will also be presented.

USAREUR Training Areas

Availability affects both the quality and quantity of training conducted in USAREUR. Units typically conduct training at their home stations in garrison, Local Training Areas (LTA), and Maneuver Rights Areas (MRA). Combat Arms (CA) units, supported by their associated Combat Support (CS) and Combat Service Support (CSS) units also conduct training in Major Training Areas (MTA).

In home station training, commanders concentrate on individual and small-unit training to develop and sustain skills. Unit commanders are responsible for maximizing the use of training simulators and devices to increase individual and collective proficiency. The home station training environment consists of 226 LTAs (from 1 acre to over 8000 acres in size) scattered throughout USAREUR. The small size of the typical LTA presents physical restrictions on training capabilities.

A Maneuver Rights Area is public or private land used and approved temporarily to conduct a maneuver (excluding LTA and MTA). According to the

Supplementary Agreement to the NATO Status of Forces Agreement (SOFA), Article 45, U.S. forces have the right to conduct these maneuvers and exercises in the Federal Republic of Germany. In MRA training, unit commanders concentrate on developing and sustaining tactical proficiency of battalion or larger units and small units with inadequate LTA. MRA training is used to integrate CA, CS, and CSS units and concepts in exercises using realistic scenarios and distances.

Major Training Areas are permanent, built-up training areas used by U.S. forces. In MTA training, unit commanders focus on gunnery skills, fire and maneuver training, and the integration of CA. The three major training facilities in USAREUR are at Grafenwoehr, Hohenfels, and Wildflecken.

Grafenwoehr Training Area can support the following: Maneuver unit gunnery for individuals, crews, and platoons; the integration of CA; and artillery gunnery at all levels. The Grafenwoehr training area is one of the largest and busiest in USAREUR. This facility has 38 gunnery ranges on 57,000 acres. On any given day, as many as 10,000 soldiers will be firing many different weapons systems. The area runs 363 days a year, excluding only Christmas and Easter. Wildflecken Training Area can support individual qualification, sustainment gunnery, and limited maneuver.

A Combat Maneuver Training Complex (CMTC) is being developed at Hohenfels and will share many characteristics with National Training Center (NTC), Fort Irwin, California. The CMTC will simulate combat at Battalion Task Force level, with synchronization of CS and CSS with maneuver elements and a realistic opposition force (OPFOR) contingent. Full use of Multiple Integrated Laser Engagement System (MILES) equipment will be made, facilitating quality, standardized evaluation, after-action reports (AAR), and take-home training packages.

A good overview of the types of USAREUR training activities carried out in garrison, at LTA and MTA, and at related training limitations is provided by Yates' (1979) report on the status of training within USAREUR units.

USAREUR Training Management

Training Needs Assessment and Technology Transfer in USAREUR requires that we identify where training managers have discretion to use their professional skills and judgment in developing or managing training programs. There is little to be gained, and a great deal to be lost, in providing people with training documents that have little more than interest value. Technology transfer is best executed by identifying the place in the Army system where the decision making and power to act are located. Technology transfer also requires that the provider of new technology first clear his or her efforts through the chain of command before actually reaching the person who has the expertise to judge the merits and utility of a product. By first identifying where an ARI product probably fits in the Army's training management structure, one can optimize the chance of getting these products implemented and incorporated into the system.

USAREUR Training Directive 350-1 describes the basic types of training and levels of responsibility found in USAREUR. This information provides a necessary point of reference for scientists trying to enter the training system

framework to either carry out an assessment of information needs or to introduce new technology. Military training can be divided into three categories: individual training, team or crew training, and unit training. All soldiers require individual training; most need team or crew training; and some must have unit or organizational training. Training management aims at balancing available training resources (i.e., time, facilities, equipment, funds, and people) among the three categories of training. That balance is different for nearly every organization and is difficult to achieve unless training is decentralized to the appropriate lower organizational level. In USAREUR, that level normally will be the battalion or its equivalent. Every command level is involved in training, but it is the battalion commander who will finally apply available resources against the various mixes of the three categories of training.

Commanders conduct training to meet Army Training and Evaluation Program (ARTEP) standards, individual and crew skill standards, and unit mission requirements. Training programs that do not address these standards or requirements will have little chance of being carried out. Management tools available to help USAREUR commanders plan training and allocate training resources are the Commander's Training Management System (CTMS); the Battalion Training Management System (BTMS); the Training Management Control System (TMACS); and the Training Ammunition Management System (TAMS).

A key aspect of the training process is that senior leaders train subordinate leaders who in turn train their subordinates. The first-line supervisor trains those he or she supervises, while this supervisor at the same time is being trained by his or her superior. The commissioned officer typically plans, trains the trainer, and supervises, while the NCO plays a fundamental and critical role in the actual conduct of training.

Seventh Army Training Command

In USAREUR, 7ATC is responsible for the development, dissemination, and integration of Infantry and Armor training programs, among others. This role makes 7ATC a natural vehicle through which to carry out ARI technology transfer training. While 7ATC will thus be a central factor in implementing training progams, it is acknowledged that personnel at all training sites can contribute meaningfully to the assessment of training needs.

The Commander, 7ATC, is responsible for planning, developing, reviewing, documenting, managing, and coordinating training requirements and programs for USAREUR. Within 7ATC, the Directorate of Training Support manages training resources, devices, simulations, audiovisual and training aids (publications), and training facilities. The Directorate of Training Management carries out training program development and evaluation, and acts as the USAREUR Point of Contact (POC) for Army training doctrine information.

7ATC's explicitly assigned duties include acting as USAREUR's action agency for staffing centralized training requirements documents and training plans, reviewing new equipment data for the impact of training concepts, developing new equipment training or transition training strategy, evaluating the adequacy of sustainment training plan execution, and recommending changes. 7ATC's duties also include preparing the training annex to the new equipment Plans of

Distribution, identifying training personnel and resources requirements, providing training documentation for Major Training Area facilities, incorporating new equipment into institutional training programs, and monitoring the incorporation of new equipment into Army Training and Evaluation Programs and Skill Qualification Testing (SQT).

Directorate of Training Support. DTS is tasked to serve as the USAREUR POC for information on emerging and changing training devices technology. Some key training device information areas managed by DTS are the Tank Gunnery and Missile Tracking System (TGMS), Dome Air Defense Trainer, Weaponeer, and MILES. Training simulators managed by DTS include motor skills simulations such as the Unit Conduct of Fire Trainer (UCOFT), Command and Battle Staff trainers such as ARTBASS and Warrior Preparation Center (WPC), and Movement and Maneuver Skills trainers that are currently being developed such as SIMCAT, SIMNET, and TACMASS. DTS is also responsible for audiovisual training aids, and the management of USAREUR's LTA and MTA. The Deputy Director DTS identified five basic areas where training research information was needed:

1. Armor/M1 Abrams Tank Training
2. Bradley Infantry Fighting Vehicle Training
3. Multiple Integrated Laser Engagement Simulation
4. Marksmanship Training
5. National Training Center Lessons Learned

Directorate of Training Management. DTM is responsible for training program development and evaluation. Examples of collective training topics for which DTM is responsible include Air-Land Battle Doctrine, UCOFT, battalion-level training management validation, marksmanship, TMACS program management, infantry issues, the Combat Maneuver Training Complex at Hohenfels, Air Defense Artillery issues, night fighting requirements, tank gunnery, and Armor/Cavalry training strategy. Examples of individual training topics for which DTM is responsible include maintenance issues, driver training, and the Noncommissioned Officer Education System (NCOES) in USAREUR. The DTM Deputy Director and staff identified the following 10 basic areas where training information was needed:

1. Night Vision/Operations
2. Bradley Fighting Vehicle M2/M3
3. Marksmanship
4. Multiple Integrated Laser Engagement System
5. After Action Review (Checklists, Job Aids)
6. Military Operations on Urbanized Terrain (MOUT)
7. Driver Training for Tracked and Wheeled Vehicles
8. National Training Center (data analysis handbooks, etc.)
9. Armor Skills Training
10. Tank Gunnery

In 1985 approximately 50 ARI publications were provided to address these training information needs, which were organized within the three broad categories of Armor/Cavalry, Infantry, and General Skills. Each training information area is discussed in detail in the following chapters.

ARMOR AND CAVALRY VEHICLE ISSUES

The following four chapters will describe Armor and Cavalry vehicle weapons system information needs that have been identified and the SCO USAREUR response. This chapter will address procedural skills sustainment training for vehicle crewmembers and job performance aids. The following chapters will discuss gunnery skills training, driver training, and vehicle maintenance performance and training issues.

The combined Armor/Cavalry topic area was chosen to include Cavalry Infantry Fighting Vehicles such as M2/M3 Bradley as well as traditional armored vehicles such as M60 and M1. Cavalry vehicle developments are discussed along with armored vehicles rather than as an infantry topic because it was found that the formatting and language of training materials were often the key features of the ARI products. ARI Field Units at Fort Benning and Fort Knox have built on each other's work and have developed vehicle crewmember training materials with a common format for both armor and cavalry systems.

A number of problem elements are inherent within the four training areas to be discussed. Procedural skills training for vehicle crewmembers and job performance suffer from a heavy reliance on extremely detailed and, hence, bulky Field Manuals (FM) as both a training and job performance guide. Gunnery training is a problem because there are few places to shoot in USAREUR, and even if there were more, at $300 per training ammunition round ($900 for the next generation M1), the simple approach of training through practice with the actual equipment is prohibitively expensive. The operating costs for driving an M1 tank, according to TACOM (Tank Automotive Command) figures, reflect a cost for fuel, maintenance, and spares at $121 per mile times 10 miles per training hour or $1210 per hour (Fort Knox, 1985). When the lack of available areas in which a 60-ton vehicle can be driven is added to the equation, the result is that there is little opportunity for hands-on driving practice under combat conditions.

Finally, with regard to the maintenance issue, maintenance performance documentation is increasingly voluminous (M1 Abrams tank maintenance manuals currently comprise a 5-foot tall stack), and discussions with trainers and research studies both indicate that maintenance training is basically "on the job experience" (Fuller & Harper, 1982) (Kristianson, undated). An additional USAREUR concern is that much of the Prepositioned Organizational Material Configured in Unit Sets (POMCUS) is maintained by foreign workers who may have difficulties in using English-language maintenance manuals.

During initial discussions of their information needs both DTS and DTM asked for any new information that ARI might have on armor skills training, and anything available on the M2/M3 Bradley Infantry Fighting Vehicle. Discussions of available ARI products and product review by 7ATC training managers followed, resulting in the placement of 7ATC's information needs in a framework of ARI's past, present, and future research thrusts.

In the following chapters the four issue areas of procedural skills, gunnery, driver training, and maintenance will be presented. ARI information provided in response to identified needs will be discussed, and a full listing of ARI materials for each issue is in the separate appendixes. Additional areas that have not been addressed by currently available ARI products will be identified.

Crewmember Procedural Skills

Procedural Skills Information Needs. The first topic area, procedural skills performance and training issues, emerged as a major area of need identified by 7ATC trainers. Procedural skills are those skills necessary for basic equipment operation in a noncombat environment, including both pre- and postoperation maintenance checks, but not tactics or battle drills. One problem is that crewmembers may be relying on memory alone to carry out routine tasks, rather than using the highly detailed vehicle manuals for routine job performance. (For the M1 Abrams, this is TM-9-2350-255-10, Operator's Manual for Tank, Combat, Full-Tracked, 105MM, M1.)

As operator procedures guides, FM have several limitations. Modern armor and cavalry vehicle weapon systems require soldiers to learn, retain, and perform a large number of complicated sequential tasks. The vehicle operators' manuals provided for this purpose are typically massive documents of several hundred pages. The size of these documents dictates that there can be only one provided per vehicle; this problem limits utilization by crewmembers who will each need the manual at the same time for preventive maintenance checks and start-up/shut-down activities. An additional problem is that of updating FM to meet constant equipment improvement changes.

As a training tool, the FM also has limitations for the same reasons stated above. Furthermore, FM do not provide directly for trainee testing and performance record keeping. Armor and Cavalry crew skills sustainment training in USAREUR is typically the responsibility of the vehicle commander, and 7ATC training managers suggest that perhaps 90% of this training is from the FM.

Procedural Skills Information Response. The limitations of the operators' manuals as job performance guides have been previously identified for the M1 Abrams (Vaughan, Silbernagel, & Goldberg, 1982) and the M2/M3 Bradley (Salter & Morey, 1983). ARI's Fort Knox Field Unit has developed a comprehensive set of tank sustainment training materials for the M60A3 (Kraemer, 1985) and for the M1 Abrams (Silbernagel, Vaughan, & Schaefer, 1982). These materials represent a comprehensive Reserve Component training package that may be well suited to USAREUR's highly turbulent personnel environment. The materials address basic crewmember equipment operation procedures (Procedure Guides), gunnery training scenarios (fire commands, degraded mode gunnery), and multiple laser range finder returns. The Procedure Guides contained within this comprehensive training package will be discussed in this chapter, while the training booklets of gunnery scenarios and field exercise training materials will be presented in the later chapter specifically addressing tank and cavalry vehicle gunnery.

ARI's crewmember Procedures Guides have been developed for the M1 Abrams tank commander (TC), driver, gunner, and loader, and for the M2 Bradley Fighting

Vehicle commander, gunner, and driver. The booklets can fit into a soldier's pocket and are bound to allow for easy updating as procedures or equipment changes. The guides include critical information on emergency procedures, proper use of the vehicle subsystems, and preventive maintenance checks. A major goal in designing these materials was to provide each crewmember with a position-specific guide that, in addition to being technically correct, is more convenient to use than the technical manuals on board each vehicle. These materials serve as job performance aids and do not attempt to address skills sustainment training.

The problem today is thus not one of identifying the need, but rather that of getting existing materials to those who need them. While the training materials that can satisfy many of the procedural skills training needs for vehicle crewmembers exist, adoption of these materials remains the key problem. M1 guides were first available in draft form in 1981. M2/M3 Bradley guides were developed at the request of the U.S. Army Infantry School and were in final draft form in December 1983. At this time, however, neither product has been adopted as an Army publication.

Initial discussions at 7ATC confirm the validity of the problems identified several years ago and establish that these problems persist today. Procedural skills guides are still needed as a supplement to FM. For this reason, ARI materials were offered for 7ATC evaluation. A battalion set of the M1 guides was distributed earlier in USAREUR and enthusiastically accepted. However, since the materials were not formally adopted by the Armor School Directorate of Training Development (DOTD) or by USAREUR, the M1 guides were gone within a year; each crewman who had one took it with him when he transferred or rotated. Currently SCO USAREUR is working through the 7ATC Chief of Staff to have the Armor School DOTD formally approve the M1 Guides for full-scale publication and release in USAREUR.

Reaction at 7ATC to the M2/M3 Bradley Procedure Guides was very positive. The New Equipment Training Branch (NET), Infantry, officer reviewed the materials and recommended that 7ATC obtain them for USAREUR. This action is on hold until M2/M3 Bradley gunnery doctrine is finalized and the actions to acquire the M1 guides are completed. The ARI operator guides material for both M1 and M2/M3, as well as the overview document describing their development, are listed in Appendix B.

Future Actions to Address Procedural Skills. ARI's FY 1985 R&D Program element 3.3.1 (Research to Support Training Technology Field Activities (TTFA)) calls for the development of M1 tank study guides and M60A3 materials for NCO use in conducting unit training. New developments here, with possible Computerized Hand-held Instructional Product (CHIP) information delivery device applications, are being followed by SCO USAREUR.

The next step in the technology transfer process, which has already been initiated, is the review of these materials by training managers at TRAC. TRAC are located on installations throughout Germany and are specifically designed to support home station training of a particular USAREUR Training Management Area's tenant units. TRAC responsibilities include the management of all training support resources to include operation and scheduling of training facilities, such as ranges and simulation devices.

7ATC is heavily involved in identifying and addressing the training support requirements of new equipment entering USAREUR. TRAC are more involved with the day-to-day home station training requirements of their tenant units, and might therefore be more aware of training needs for older equipment and be better able to identify previous ARI training research products that could still be quite useful. By working with both 7ATC and TRAC, SCO USAREUR will be better able to cover the full spectrum of USAREUR training needs (for example, examining training material requirements for both the M1 Abrams tank as well as the older M60A3).

Optimizing Training Device Mix. ARI has developed a valuable document that might serve as a prototype for identifying and matching crewmember training task requirements and emerging training technology--Analysis of Training Requirements for the Basic Noncommissioned Officer Course for M1 Tank Commanders (19K BNCOC) (Drucker, Hannaman, Melching, & O'Brien, 1985). This document should help USAREUR training managers to optimally use available training devices and materials and to most effectively make decisions on the acquisition of training devices. In an environment rich in training devices such as exists now, a document can describe and integrate these varied bits and pieces into a "big picture" of present and future resources that will be very valuable to practitioners. This big picture document should be a necessary prerequisite for planners deciding on additional device acquisitions. The need for a M2/M3 Bradley version of this document is being investigated.

Crewmember Turbulence. Crew turbulence is very high in USAREUR. In tank battalions of approximately 50 crews each, the master gunners recently indicated that over the preceding 4-month period, only from 4 to 12 TC and gunner teams had remained together. Commanding General, 7ATC, has identified this as an important area to investigate to determine when crewmember turbulence is unavoidable (in non-COHORT units) such as in separation from the Army, end of tour, or medical out, and when crewmember turbulence is the result of discretionary actions on the part of unit commanders.

Summary. ARI had developed comprehensive armor crewmember skills training and evaluation materials for the M60A3 tank (Kraemer, 1985) and the M1 Abrams tank (Vaughan et al., 1982), which were provided to USAREUR training managers in response to specific requests. These materials provide for the training of basic noncombat procedural skills, combat-related skills for each crew position, and gunnery-related non-live-fire skills sustainment training and evaluation. Noncombat procedural skills materials developed for the M2/M3 Bradley (Salter & Morey, 1983) were also provided to USAREUR training managers. USAREUR 7ATC has directed a request for the ARI-developed M1 Procedure Guides to the Armor School, Fort Knox. Success in obtaining M1 Abrams materials through the Armor School will be followed up with similar actions to obtain M2/M3 Bradley materials through the Infantry School at Fort Benning.

ARMOR AND CAVALRY VEHICLE GUNNERY

The previous section described routine equipment maintenance checks and operations training. It identified job aid crewmember procedures guides and individual crew position training and evaluation materials presently available

from ARI. In this section, tank and cavalry vehicle gunnery needs are discussed, ARI products offered for review are identified, and future research needs are suggested.

Gunnery Training Information Needs

Written Gunnery Skills Sustainment Training Materials. Only the global area of Tank Gunnery was identified in initial discussions of 7ATC information needs. The critical area of Target Acquisition and Analysis (TAATS), and Combat Vehicle Identification (CVI) (ARI FY 1984 Work Program element 3.2.3.3 and FY 1985 element 3.2.1) will be presented in the later discussion of needs in Night Vision/Night Operations.

The need for interesting, pocket-sized personal gunnery training materials has been recognized by ARI and confirmed by the master gunner's contention that 90% of armor crewmember training currently comes out of the Field Manual. While FM serve as comprehensive reference materials, they are less well suited for dry-fire sustainment training of gunnery skills due to their size, information format, lack of provision for student evaluation and achievement records, and absence of lesson plans.

The Need for Gunnery Simulation Trainers. In response to the high costs of live-fire gunnery training, a number of training devices have also been developed. These include subcaliber firing devices, MILES laser equipment, and gunnery simulators such as MK60, MK1, and UCOFT. A major challenge to training managers is the integration of these varied devices into a coordinated cost-effective training program. Without an overall view of each weapon system's critical training tasks, training devices available now and in the future, and associated instructional programs, staffing, and maintenance information, this all-important training technology in support of hardware cannot be provided. Without an orientation toward this full range of training tasks, it is easy to become hardware oriented, as opposed to training oriented, in seeking solutions.

An element of major importance in this discussion of training devices and program management is that of Programs of Instruction (POI). When too much emphasis is placed on training hardware, systems can be fielded in USAREUR without an accompanying POI. This problem can sometimes occur where the hardware and POI are separate products developed by two different groups. USAREUR training managers pointed this problem out during the first working session with ARI SCO USAREUR and identified several systems in USAREUR for which no adequate POI existed.

With regard to training program management, it is necessary to identify the support requirements that training devices demand in terms of Instructor/Operators (I/O), and whether maintenance requirements can be performed by soldiers alone, or will require civilian maintenance technicians. Maintenance considerations and POI and I/O requirements are key elements of training systems that have not always been linked to particular devices. POI requirements may also be a more critical factor in USAREUR, where training device proponents and manufacturers' representatives sometimes are not available to answer questions or provide training managers with technical advice.

Unit Conduct of Fire Trainer. Fielding the UCOFT is one of the most important recent training events in USAREUR. The introduction of this gunnery skills training device will be briefly presented because of its potential and because some training program management questions have been identified. The UCOFT is a computer-driven gunnery simulator for tanks and Bradley fighting vehicles. It is a training device for vehicle commander and gunner teams that accurately replicates/duplicates the fighting compartment of a vehicle and allows for engagement of enemy targets produced through computer-generated imagery. The system provides advanced tank commander/gunner practice in target engagement at home station without using either ammunition or fuel. The UCOFT is the first of an entire family of vehicle training simulators being considered for development.

Potential cost savings associated with UCOFT are tremendous, provided transfer of training to live-fire performance can be demonstrated. However, armor battalions still have misgivings about gaining UCOFT at the price of cuts in training ammunition. As UCOFT is fielded in USAREUR, the present allocation of 134 main gun rounds per tank is being reduced to realize savings attributable to UCOFT training value. For example, for units with UCOFT training equipment, crews might now fire calibration three times per year (3 rounds each), three Table VIII qualifications (25 rounds each), and 15 rounds during a company live-fire exercise, a total of 99 main gun rounds per year. The per tank reduction by 35 rounds represents a savings of $8,000 for current 105MM ammunition, and $22,000 for the next M1's 120MM ammunition. This means a per battalion savings of $473,000, or $1,295,000, respectively (Armor Conference White Paper, 1984a).

USAREUR began receiving UCOFT in January 1985 with the arrival of two M1 tank trainers at the Combined Arms Training Center (CATC) in Vilseck, West Germany. Armor, cavalry, and mechanized infantry battalions and squadrons throughout USAREUR will be receiving UCOFT. The Army plans to field 266 UCOFT, each of which costs about $2.4 million. Sixty-seven of the systems will be configured for M1 training; 40 for M1A1; 120 for the infantry and cavalry versions of the Bradley fighting vehicle; and 39 for the M60A3 tank. The trainers will be fielded in the same priority as the new weapon systems. Current plans are to provide each armored battalion or mechanized battalion equipped with the Bradley with at least one UCOFT.

UCOFT Gunnery Device Concerns. An Army Times article (April 29, 1985) presented an interview with a master gunner who had been trained as a UCOFT instructor and operator. While no training system problems were identified in the newspaper/magazine article, an ARI SCO USAREUR interview with this master gunner surfaced some concerns.

One potential shortfall for UCOFT is in the military I/O staffing arrangement. At Vilseck CATC two NCOs staff the evaluator's station, instead of the one position prescribed by the manufacturer, General Electric. The NCO interviewed at Vilseck stated that there is too much for just one person to do at the systems twin TV instructor/operator monitor station. The I/O's job is critical, because a mistake in conducting a training session on the UCOFT could break the realism of the simulation, greatly diminishing the training value.

A second concern is the question of who should serve as I/O. A recent Armor magazine article (Griffin & Kuma, 1985) coauthored by the UCOFT project manager in Training Devices Division, Directorate of Training and Doctrine, U.S. Army Armor School, addresses UCOFT operator selection and training. The Armor magazine article refers to units sending their "key trainers for the UCOFT Instructor/Operator Course (2 weeks)" and that "at the unit level, the instructor/operators (I/O) (the platoon sergeants, master gunner and platoon leaders)" act as the instructor/operators. The concern expressed at Vilseck is that these NCOs are typically busy running their units, and that the time required for UCOFT training and duty might be too much. A suggested solution is to consider using other unit personnel as I/O.

ARI may wish to examine this question of civilian versus soldier I/O more closely for long-term recommendations based on a knowledge of where training device technology is going in the future. The UCOFT system deployment and support seems very well thought out and very effective. Again quoting from the Armor article, it is clear that the UCOFT managers are concerned with the I/O staffing question.

> An important point to be made here is that we [Griffin and Kuma, UCOFT NCO evaluators] are sensitive to the 'operator' issue and the concerns being expressed by FORSCOM and USAREUR regarding not only UCOFT, but other simulation systems scheduled for fielding during the next 5 years. The need for a civilian (or somebody other than a battalion asset) as a training simulator operator/maintainer/ manager in Armor battalions is being thoroughly investigated. This individual would work with the battalion S-3 and master gunner to coordinate, schedule, and to some degree, operate the battalion's training systems.

Another area for attention with UCOFT is the matter of the computerized scoring feedback provided to the tank commander and gunner team. It appears that while both will actually be firing the weapons, only the scores for the gunner and the gunner/tank commander team are fed back. SCO USAREUR sa the "stubby pencil" approach to reevaluating the machine-produced performance data to determine how the tank commander did with his gunnery. It is a tedious process the way it is currently done at Vilseck, and it is unlikely that many I/O would go to the trouble. The bottom line is that UCOFT I/O at Vilseck think that a lack of feedback exists for tank commander gunnery results, and that this lack is a problem that needs to be corrected.

ARI Response to Needs: Written Gunnery Materials

As part of the technology transfer effort, ARI SCO explored the possibility of adopting ARI products as training aids to assist the tank commander in his training role. These products present an overview or checklist of gunnery material presented in an interesting and easy-to-use training format.

Since 1982, ARI has drafted a number of gunnery training products for the M60A3 and M1 tank. Under FY 1984 Research Program element 4.1.2.1 (Small Unit Performance Training Methods), materials were developed to support rapid-train-up programs. Under ARI's FY 1984 Computer-Based Instructional Systems subelement

3.3.1.4 (Technology Transfer in Armor Training), efforts are underway to incorporate some of these materials into a hand-held computerized information delivery device (CHIP/TUTOR). The ARI gunnery-related products provided to 7ATC for review are listed in Appendix C. By identifying initial interest areas, providing ARI materials for review, and soliciting feedback, several characteristics that made products desirable were confirmed, and possible ARI future applications were identified.

Ten M1 and M60A3 gunnery sustainment training booklets were offered to DTS and DTM for review and identification of additional training needs. Two M1 booklets were identified as filling a present USAREUR training need M1 Tank Gunnery Target Hand-Off Practice (Goldberg, 1982a) and M1 Tank Gunnery Target Tracking and Leading Practice (Goldberg, 1982b). These pamphlets were reviewed by the 7ATC master gunner and by master gunners at 2d Armored Cavalry Regiment, 2d Armored Division (Forward), and 3d Infantry Division. The gunnery booklets were so highly thought of that one review copy was "secretly borrowed" from 7ATC for immediate xeroxing by a reviewer. The consensus was that these materials would be useful for entry-level training and for fast train-up purposes.

The positive characteristics of these two booklets need to be identified, because they can serve as a model for future applications to different systems (e.g., Bradley). While the standard tank gunnery manual FM 17-12 (1978) is an 11-1/2" by 9-1/2" document of approximately 100 pages, the M1 tank gunnery booklets developed by ARI are each only 5-1/2" by 7" in size and 15 to 25 pages in length. DTS reviewers were particularly pleased with the M1 target hand-off booklet's "score sheet" format, which provides for a record of trainee progress.

7ATC Feedback on Materials Provided. DTM also reviewed a separate set of six M1 gunnery training booklets (Kraemer, 1984a), which teach fire commands and degraded mode gunnery, and provided useful feedback. The DTM tank gunnery master sergeant who reviewed the materials explained that the ARI M1 tank gunnery booklets are valuable because each explains "why" a crewmember needs to respond in a certain way, whereas the Army Field Manuals do not. The ARI materials also provide for trainee testing at several points within each booklet so that crewmembers might quickly "test-out" on material they already know and devote their time to areas where they need more training.

The publications that address actions to follow under conditions of partial equipment failure, M1 Tank Degraded Mode Gunnery: M1 Gunnery Systems (Kraemer, 1984b), and M1 Tank Degraded Mode Gunnery: Non-Immediate Engagements (Kraemer, 1984b), and the booklet, M1 Tank Gunnery Multiple Returns (Kraemer, 1984c), were seen as valuable tools for the tank commander who is the primary crew trainer. One caution is to use care in illustrating training products. Some of the illustrations in the booklets could be interpreted as tactical mistakes, where a tank improperly exposes itself to enemy fire. This impression would naturally detract from the training value of the information being presented.

An equivalent package of M60A3 Gunnery Booklets (Kraemer, 1983) was offered to DTS for review but was declined. The materials had been developed in May 1982 and might now represent the problem of "new information for old systems." It was believed that alternative, piecemeal solutions--training materials and checklists--had been made up by M60A3 personnel in USAREUR so that new ARI M60A3 gunnery materials no longer filled a need for training information.

Additional reviews are currently underway from training managers at lower organizational levels (TRAC) where M60A3 will be training for several more years.

In summary, most ARI materials were well received in terms of their easy-to-use size, the inclusion of a rationale behind the procedures, illustrated content, integrated lesson tests, and trainee progress "score card" format. It appears that most interest lies in training materials for new equipment. This fact works strongly against the adoption of M60A3 materials, and somewhat less so against M1 Abrams materials. M2/M3 Bradley materials should thus offer the best opportunity for direct ARI technology transfer to USAREUR. Bradley may also be a good target for revised materials originally developed for M1 Abrams and M60A3, such as crewmember rapid-train-up materials.

Future Actions

Briefing of ARI Products "On the Way." ARI SCO USAREUR briefs ARI's on-going research for a number of reasons. Briefings or information packages are presented to generate USAREUR interest, acknowledge the existence of specific problems or research needs, and identify the corresponding solutions that are on the way. This reduces the chance of parallel USAREUR/CONUS efforts to address the same problem. It might also create a USAREUR "pull" resulting from interest to get a product through the Army technical review system. As a Major Army Command (MACOM), USAREUR sits on Training and Doctrine Command (TRADOC) panels that prioritize R&D projects. Awareness of and support for ARI efforts may help to promote projects across the institute.

DTS and DTM staff members were briefed on ARI gunnery research studies in progress, such as FY 1984 Research Program element 3.4.2 (M2/M3 Bradley Training Improvement). Staff members were particularly eager to receive emerging Fort Benning M2/M3 Bradley information (FY 1984 element 3.4.1--Bradley Revised 25mm Ammo Reloading Procedures). This preview briefing occurred 7 months before the actual delivery of the ARI research product to 7ATC. Training managers were also made aware that the ARI FY 1985 R&D Program (element 3.4.2--M2 Bradley Training Improvement) calls for new developments in gunnery training, job aids for night maneuver and Command and Control (C2), and Bradley tactics.

There are several important features of this research preview briefing process: It allowed USAREUR training managers to review and confirm, or comment on, the nature and direction that the research was taking. This review occurred early enough in the research process to suggest any needed modifications while the research teams were intact and data were being collected. We think this tactic promoted the receptiveness of USAREUR training managers.

Previewing ARI studies encourages a user mindset conducive to the identification of needs. Preview briefs of work in progress or planned can generate interest in ARI's broader program and encourage USAREUR training managers to think in terms of "Can you do this?" instead of asking only "Do you have something now that answers this question?" Previewing and knowledge of ARI's research program should allow USAREUR training managers to incorporate ARI's work into their planning. In this way, previewing can save USAREUR and ARI from engaging in costly redundant or parallel efforts to address the same question.

DRIVER TRAINING FOR TRACKED AND WHEELED VEHICLES

Skills training for tracked vehicle drivers in USAREUR suffers from few available training areas, lack of Programs of Instruction for hands-on practice, and high operating costs. This section discusses USAREUR driver training needs and the information provided to address these needs. A full listing of the materials provided appears in Appendix D.

Driving Training Information Needs

Current driver training programs using actual tanks must neglect many critical aspects of the driver's job, especially driving at the higher speeds the new equipment was designed to deliver, due to safety and cost considerations. Relatively little training can be carried out in off-road, cross-country, urban, and city surroundings because of the maneuver damage impact, demands on fuel, and vehicle maintenance, as well as the high safety risk to personnel and equipment. The result of these constraints is that hands-on driver training is severely limited. In one discussion with an M1 tank commander it was estimated that drivers have as little as 3 hours of hands-on driving experience during Advanced Individual Training (AIT) in CONUS.

One problem stated by USAREUR training managers is that too many graduates of CONUS tracked and wheeled vehicle driver training programs arrive in USAREUR without the basic required driving skills. This is not, therefore, a problem unique to USAREUR. It appears instead that there is a need both in CONUS and USAREUR for improved tracked vehicle driver training programs, which might include driving course layouts and performance evaluation standards, and perhaps driver training simulator devices. As a partial solution to this problem in USAREUR, 7ATC DTM previously developed a Program of Instruction for wheeled vehicle drivers, and for the drivers of the M113 tracked vehicle. The following section will discuss currently available ARI materials that might be used as is or modified to develop more effective driver training programs. The role of driver training simulators will also be presented.

Driver Training Information Provided

In response to the perceived problems and request for training information, SCO USAREUR responded with a "package" of driver training materials developed by ARI Fort Knox, Fort Benning, and ARI USAREUR for both tracked and wheeled vehicle drivers. Tracked vehicle driver training materials provided to DTM were taken from several ARI studies. The M1 Abrams and M2/3 Bradley weapons systems Operators Guides to basic start-up/shut-down operations and preventive maintenance checks were provided along with the rapid-train-up materials for the M60A3, which included driver training evaluation. These were provided with the comment that they might be particularly valuable to M60A3 prepositioned equipment sites as it is always uncertain whether all of the previously trained troops will reach the tremendously valuable asset of POMCUS equipment in time.

Skills sustainment materials for hands-on driver training are not abundant. One earlier study based on the M60A1 system (O'Brien, Harris, Osborn, & Healy, 1979) was provided to 7ATC with the recommendation that this report provides the

format and approach from which materials for more modern systems can easily be produced as "spin-offs." Here, the M60A3 technology being transferred is essentially an established "approach" to follow in developing a training program--rather than the finished product itself. 7ATC should have the expertise and resources to update materials when the need is seen as great enough to warrant staffing this solution.

Assessment of driver training effectiveness requires quantification of behavior against established standards of performance. An ARI Fort Knox Field Unit draft publication, Field Driving Test Situations for M1 Tank Drivers (Burroughs, Campbell, Campbell, & Knerr, 1983) was provided to 7ATC in response to the stated need for driver training improvement. This document provides both reliable measures of driving ability and also a simple driving course setup that might be particularly useful in garrison and Local Training Areas. A very important element of this driver training evaluation course is that provisions are outlined for night driving training.

Driver Training Simulators. There is a clear need to find an acceptable driver training simulator for tracked vehicles. The cost impact of such a driving simulator has already been established (Armor Conference White Paper, 1984a). Assuming a 50% crewmember turbulence (turnover) rate and a 350 mile per tank per year driver training program (30 hours actual vehicle use), it was estimated that a battalion could save almost $2.5 million per year in fuel and maintenance costs. An effective driver trainer costing $2.5 million would thus amortize itself in only 1 year. Directorate of Training and Doctrine Training Devices Division, Fort Knox (1985) cites a TACOM figure of $121 per hour per mile operating cost for an M1, so that at the normal speed of 10 MPH, the operating cost per hour amounts to $1210.

The Army does not now have a driver trainer, and an off-the-shelf foreign-made trainer might be considered. Initial interest in obtaining more information about the German Army's tank driver trainer equipment has been conveyed to the German Defense Ministry through the Data Exchange Agreement program. Examples of tanks specifically modified for driver training and driver-compartment-only simulators are available now. The SCO USAREUR staff has been invited to visit the tank driver trainer sites of both German and Dutch Army research organizations.

Summary. ARI is well equipped to respond to requests for information on tracked vehicle driver training and performance evaluation. Written materials for noncombat driver procedural tasks and combat skills training and evaluation were provided to the Directorate of Training Management, 7ATC, along with a description of how to lay out a standard driver training course for day and night driver training and evaluation. Given the high dollar cost of hands-on driver training, there is a great need to explore currently available driver training simulators and specialized training equipment. Initial contacts have been established for the SCO USAREUR staff to see what is available off-the-shelf in Europe.

ARMOR AND CAVALRY VEHICLE MAINTENANCE

The Deputy Secretary of Defense has estimated that the Department of Defense (DOD) currently has 900,000 individuals around the world working to maintain $200 billion worth of weapons and equipment at an annual expense of more than $40 billion. It is obvious that the training and performance of maintenance skills is of critical importance. Poorly performed maintenance results in costly losses, both in terms of wasted manpower resources and the unnecessary replacement of parts. As an example of the problem, Dressel and Shields (1979) found a 42% false removal rate for tank turret parts submitted for direct support maintenance over a 1-year period. These falsely removed items account for 30% of all downtime in the direct exchange shop. The undesirable trends found in maintenance field studies may stem in part from both the complexity of the Army's equipment and the limitations of paper as the medium for delivery of technical information. While the increasing complexity of equipment is perhaps inevitable, some nonpaper alternatives for the delivery of technical maintenance information are being developed.

Maintenance Research Needs

ARI is addressing the long-standing problems associated with paper-based maintenance training and performance aids by exploring electronic information delivery alternatives. SCO USAREUR is presenting several of these devices to maintenance managers in USAREUR for feedback on how and where they might be used. The following section presents a discussion of maintenance problems, both Army-wide and in USAREUR. Potential applications of future or emerging ARI products are discussed.

Levels of Maintenance. Different types of maintenance activities and information needs occur at various levels in the Army's maintenance structure. These differences must be recognized and considered in examining sites for evaluation and/or application of ARI's emerging products. USAREUR maintenance activities occur at four levels: Organizational, Direct Support (DS), General Support (GS), and Depot. Across these levels, maintenance involves progressively more complex activities. Organizational maintenance involves preventive maintenance performed by tank commanders and drivers at the platoon level, and mechanics at the company and battalion levels, using -10 maintenance manuals. Direct Support maintenance involves repairs performed by technical specialists in division support command, at the division level, using -20 series manuals. The next highest level of maintenance is General Support, which covers major repairs and overhaul of major components at Corps level and uses -30 maintenance manuals as well as the -10 and -20 manuals. At the Depot level, maintenance activities take the form of rebuilding and overhauling equipment. Here, the most detailed maintenance manuals (-40 series) are used.

Within the general topic of USAREUR vehicle maintenance, research issues were identified for maintenance carried out at Direct Support level and above, at the Organizational level, and for battlefield maintenance needs. Some problems peculiar to each of these three situations will be presented, and possible applications of future ARI technology will be identified and discussed. It should be noted that a Training Effectiveness Analysis (TEA) study is already underway by TRADOC's systems analysis division (TRASANA) to determine the

adequacy of DS/GS maintenance procedures for the M1 and M2/M3 weapon systems, and to determine actions needed to improve maintenance procedures. This study involves both CONUS and USAREUR and will be discussed at the end of this section.

Direct Support and Above Level Maintenance: USAREUR's Language Need

Using the current M1 Abrams tank technical manuals, a relatively simple procedure to troubleshoot and repair the thermal imaging sight requires over 25 references in five different volumes--a difficult, frustrating procedure for any Army mechanic to follow (Hartung & O'Neil, undated). The limitations of paper as the medium for delivery of technical maintenance information is becoming a critical and highly visible problem in USAREUR where much depot-level and POMCUS maintenance is carried out by foreign nationals. Beyond the Army-wide problem of dealing with unwieldly maintenance manuals, the particular problem in USAREUR is that these workers may speak and/or read little English. The Army is faced with the situation where complex manuals are written in English and used in depot maintenance facilities by mechanics with only marginal English-language skills. It is extremely unlikely that the Army can afford to translate and continually update even one set of M1 manuals that could consist of thousands of pages of detailed material.

To find appropriate solutions to the maintenance language issue, several key considerations must first be addressed. A first requirement is that of identifying the number of people for which alternative maintenance information sources must be provided. How many workers are there in each foreign-language group that needs help with English-language maintenance materials? Is this demand primarily for reading skills, speaking skills, or equal emphasis on both? If few people need training, the development of highly technical solutions could be prohibitively expensive.

Defense Management Journal (Martin, 1985), reported that in FY 1983, the U.S. Army Depot in Mainz, Germany, awarded six educational contracts to German, Belgian, and British firms to develop new sources of overseas depot-level maintenance by giving subcontractors the technical skills needed to perform U.S. maintenance. This educate-the-worker approach represents one way of dealing with the language problem that must be weighed against the cost of other alternatives. It should be kept in mind as a cost-determining factor that foreign maintenance personnel, Germans in particular, characteristically stay in their jobs for many years. This fact reduces the problems associated with frequent training of a transient work force. Technological solutions to these language needs will be discussed later in this section within the presentation of ARI training and job performance technology currently being developed.

Language Training for Americans in USAREUR. As an off-shoot of maintenance applications for language technology, it should also be remembered that there is a constantly rotating group of 200,000 soldiers and 300,000 dependents and American civilian workers in USAREUR. This group could greatly profit from enhanced German-language instructional technology. Current language training is essentially "school house." In a recent survey only 25% of the soldiers and spouses in USAREUR indicated that they "could speak German well" (Ozkaptan, Sanders, & Holz, 1986). The size of this group and the problem of constant turnover would would seem to justify even costly technological developments. As a final

digression, attention might also be paid to identifying the communication needs likely to occur between adjacent NATO forces and the development of a limited needs-specific language training program with appropriate instructional technology.

Organizational Maintenance Issues

A valuable source of USAREUR maintenance information is the study produced by ANACAPA Sciences, Inc. (Fuller & Harper, 1982). This report documents and summarizes information obtained from seven USAREUR combat battalions on specific organizational maintenance issues. One key conclusion from the report was that organizational maintenance problems were generally similar to those found in CONUS. Maintenance of wheeled vehicles was emphasized as their primary problem, due in part to the age of the fleet and in part to high operational usage. Quality of operator maintenance was pinpointed as a prime factor affecting maintenance effectiveness. This again attests to the potential utility of ARI's M1 Abrams and M2/M3 Bradley crewmember Procedures Guides with their maintenance checks orientation.

The second major finding in the ANACAPA study was that maintenance training was not being conducted. The emphasis in USAREUR was instead on mission-related operations and performance of maintenance necessary to support mission readiness. Little, if any, time was allocated for maintenance training, and available classroom training resources were not used. Units reported that they provided on-the-job training (OJT) in maintenance, but the ANACAPA study reports that this was really on-the-job experience (OJE). The persons engaged in OJE did not receive feedback on their performance. Systems were not being used to "track" or keep records of an individual's performance of maintenance tasks beyond half-hearted attempts to maintain job books.

It would appear that a cyclical response to evaluation demands, lack of individual training capability, and inability to effectively evaluate and track soldier training progress might underlie many maintenance training problems. The impact that emerging ARI instructional technology might have in correcting some of these problems will be discussed later in this section.

Battlefield Maintenance Needs

The Deputy Director, Directorate of Training Management, has specifically requested information and ideas in the area of battlefield maintenance and vehicle "cannibalization" techniques. It must be recognized that combat maintenance is dramatically different from peacetime maintenance and will place a new set of demands on personnel. Key repair versus recovery decisions will be based on the initial report of battle damage. Night operations will be more frequent and application of field-expedient fixes to equipment will take on increased emphasis. A new demand for spares will occur as the need for repair parts will be based on combat damage rather than normal wear. The performance of maintenance will also shift from preventive to mission-essential criteria.

An Armor Conference White Paper (1984b) details a number of requirements associated with successful combat maintenance. This paper points out that forward support and Division 86 doctrine require crew members and maintenance

personnel to be proficient in combat maintenance skills that have not been fully defined, much less taught or practiced. It is argued that resident training and practice in the field currently focuses on those skills directly related to the peacetime environment. The White Paper states that emphasis should be placed on the following fundamental tasks:

1. Loading required equipment, crew members, and personal gear on authorized vehicles;

2. Conducting recovery operations back to the brigade support area, with (existing M88A1) battalion assets;

3. Assessing battlefield damage and repairing it;

4. Providing maintenance for continuous day and night operations; and

5. Using labor- and time-saving equipment.

7ATC training managers are well aware that the ability to quickly repair and return combat fighting systems to the battlefield will be critical to sustaining the combat force. The one ARI Fort Knox publication SCO USAREUR offered to address battlefield maintenance discussed field-expedient maintenance experiences of M60-Series tank crewmen (Witmer, 1983). This document may be of value because it identifies eight generalizeable approaches to making field-expedient repairs that would apply to a broad range of weapon systems. The five fundamental tasks listed above can serve as training needs statements for work that 7ATC and/or ARI might carry out.

Applications of Emerging Maintenance Technology

Recognizing the above needs, SCO USAREUR has identified some potential applications of ARI's emerging maintenance performance and training technology. This research includes the development of device/hardware innovations to improve unit functioning and performance and training capabilities. Three computer-based ARI products currently in development will be introduced in this discussion of maintenance performance and training: Hand-Held Tutor (HHT) and Computerized Hand-Held Instructional Product (CHIP), Personal Electronic Aid for Maintenance (PEAM), and Model Training Program for Reserve Component Units (MTP-RC). Following each product description, possible applications will be discussed.

The Hand-Held Tutor (HHT) and Computerized Hand-Held Instructional Product (CHIP). The HHT (TUTOR) is a lightweight, portable, user-friendly functional vocabulary tutor developed under ARI's FY 1984 Program element 3.3.2 (Technology-Based Aids for Basic Skills Training). This device combines both display and voice synthesis technologies. Initial prototypes have been used to teach field artillery vocabulary and mathematics to soldiers. Additional plug-in program modules are being prepared for individual skills training for the M1 Tank (Procedural Guides) and the Combat Engineer MOS 12B NCO program. The FY 1985 3.3.1 Program element calls for TUTOR applications as an Air Defense Artillery (ADA) training device. Current ARI work with the CHIP will add the capacity to store and retrieve student performance data, along with other product improvements. The CHIP is being developed as a joint service project, managed under ARI's FY 1985 5.1.4 Program element.

One problem identified earlier for maintenance at the division level and above is the need for developing language translation capability, either in the worker alone, or in the worker's equipment. Maintenance performance and training at this level have the advantage of bringing many mechanics together at a centralized location for job activities that would allow for more costly maintenance job aids and training aids. The HHT could be a useful addition to the traditional "school house" technical vocabulary training situation, and might be useful on the job as an English-to-German technical vocabulary translator. These are both universal, non-MOS-specific or weapon-system-specific, applications that might be accomplished through a single new plug-in program cartridge.

Considering applications of TUTOR and CHIP at the Organizational maintenance level, it will first be necessary to establish whether the need exists in USAREUR for a device to help soldiers develop or sustain their technical vocabulary skills. The follow-on development of the CHIP with its expanded capability to retain information on training performance might serve several identified USAREUR training requirements. The previously described ANACAPA study pointed out both lack of feedback on performance, and lack of recordkeeping on student performance, and hence trainer accountability, as key maintenance training problems in USAREUR at the Organizational level. The CHIP is designed to incorporate student feedback and to store performance data.

For battlefield-expedient maintenance needs, both TUTOR and CHIP technical vocabulary capability would not appear to be applicable, other than as home station training aids with a battlefield maintenance training application cartridge.

The Personal Electronic Aid for Maintenance (PEAM). The Personal Electronic Aid for Maintenance is a compact, hand-portable, device that presents maintenance information at the field site. The PEAM is being developed under ARI's FY 1985 5.1.3 Program element. The PEAM design integrates flatpanel thin-film visual displays, speech synthesis and recognition, and solid-state mass memory technologies. PEAM can aid maintenance personnel by providing step-by-step performance information, which is available in various levels of detail to suit the needs of both novice and experienced personnel. The interchangeable plug-in mass memory cartridge for this device can hold over 175,000 words and 300 graphics related to the maintenance task. A digital database in the memory unit and the use of an advanced authoring language allows rapid development and transfer of technical updates of maintenance information.

With regard to maintenance applications at the division and above, the PEAM might be developed to include an English-to-German/French written response dictionary and with more effort a verbal translation capability as well. Here, the PEAM might be configured with a language "computer chip" that would perform its normal function of "reading" the text aloud from the viewing screen and additionally provide the equivalent German/French word from a limited technical vocabulary. The plug-in maintenance text module's capability will naturally be optimized in an environment where the greatest number of different systems are being worked on--the maintenance depot. By integrating PEAM at any maintenance site, we might also be moving toward maintenance generalists capable of working with a single information delivery device on a broad range of systems.

Initial discussion with 7ATC indicates that PEAM would undoubtedly be an asset to Organizational-level maintenance if only as an up-to-date source of FM-type information because of its easy electronic update capability. The PEAM should fit well in USAREUR's environment with its high personnel turnover where mechanics may be expected to vary greatly in their experience and thus differ in the level of detail for maintenance information needed.

Looking at battlefield-expedient maintenance needs, there could be some very useful applications for PEAM at the battlefield damage site. A host of likely battle damage scenarios and checklists of expedient field-repair actions could be stored in "battle damage" memory modules for a full spectrum of vehicles. This could be particularly useful for battlefield vehicle retrieval units that could face a number of different battlefield service situations with many different vehicles.

Computer-Based Training: Model Training Program for Reserve Component Units (MTPRC). The U.S. Army is implementing computer-based instruction (CBI) into its maintenance training system. The Armor School at Fort Knox, for example, planned to deliver 15% of its resident training on computer-based systems by the end of 1985 (Graham et al., 1985). The Model Training Program for Reserve Component Units is being developed by the Fort Knox FU under FY 1985 Program element 5.1.2. The MTPRC uses MicroTICCIT courseware and is one example of a computer-assisted training or instructional development system--an integrated hardware, software, and courseware development system designed for efficient production, delivery, and management of computer-based training (CBT). Currently, the system is set up to train M1 tank maintenance skills for turret and hull mechanics. The primary objective is to train soldiers to use standard training manuals to troubleshoot simulated M1 tank systems.

The MTPRC MicroTICCIT-based CBI systems might offer advantages for individualized training at the division level and above. While not a job performance aid, the MTPRC offers an individualized training and progress reporting and recording capability that could naturally be valuable in developing a maintenance manpower pool with established capabilities. Again, an easy-access dictionary capability might be necessary for USAREUR maintenance depot applications, and a logical capacity to develop for future applications in other countries.

For Organizational-level maintenance by mechanics at battalion and company level, MTPRC-type information terminals should be very valuable, particularly for their Computer-Managed Instruction (CMI) system and student training management capacity. It may not be too extreme to say that "you only get what you measure." MTPRC's ability to manage soldier maintenance training activities and to produce well-formatted training status or progress reports could result in more individualized training actually being accomplished. Required skill levels might be both attained and maintained more effectively using the MTPRC model as a constant indicator of training status, rather than training up cyclically to meet annual individual testing needs, after which training falls off to meet other demands.

The MTPRC's training management capability may be able to start to correct the problem of cyclical maintenance performance where units may ignore maintenance to address a more urgent requirement that will be formally evaluated. Absence of

effective training management with continual trainee feedback and performance monitoring should not only result in cyclical training up for tests, but more important should result in cyclical skill levels. The institutionalized system of annual Army performance measures may quite likely result in an odd set of cyclical personnel and equipment capabilities. Before SQT, soldiers will be at their peak in individual skills, while equipment will not have been attended to for the SQT train-up period. As an example of this, during field testing of PEAM it will be necessary to consider where units would be in their train-up/neglect cycle. Will M1 fire control system operational status be an issue for the potential subject units, or will some other train-up activity cause them to neglect this?

The MTPRC-based maintenance training has students troubleshoot simulated M1 tank systems. A major problem in battlefield maintenance training is that of not being able to introduce a host of major damage effects into a real vehicle. With an MTPRC-type system, battlefield damage situations might be programmed in for training.

Future Maintenance Directions

This chapter has primarily discussed ARI's emerging technology that might address USAREUR maintenance needs. USAREUR is getting an early preview of upcoming technology and will continue to have an opportunity to provide input through initial field testing of CHIP and PEAM. Maintenance Training Effectiveness Analyses being carried out in USAREUR could represent an additional opportunity for insight into USAREUR's maintenance training and performance needs.

Actions Supporting PEAM Needs Assessment. ARI SCO USAREUR is previewing PEAM in USAREUR at the earliest stages of development, so that any corrections or modifications can be quickly introduced. A videotape of this device and information materials were briefed to 7ATC (principals and staff members) who indicated general agreement with the project's goals and did not see any foreseeable problems with its field testing. The Deputy Director, Training Support, reacted by saying that the concept is good, and that development support is on track, the key factor being that the appropriate Army School (in this case, the Army Logistics Center and Ordnance School) has been brought in as a co-sponsor of the project.

A field test of PEAM that will address maintenance of the M1 turret fire control system is anticipated in USAREUR. The field test, supported by ARI SCO USAREUR, is scheduled to take place in 4th quarter 1986. SCO USAREUR will arrange necessary troop support and provide information to interested parties ahead of the field test by using a PEAM videotape and written briefing materials.

Actions Supporting CHIP Needs Assessment. Work is continuing on identifying USAREUR training needs for input into a preproduction CHIP prototype. Under current plans, SCO USAREUR anticipates receipt of 25 to 50 CHIP prototypes for evaluation in 2d quarter FY 1987. Currently, SCO USAREUR is working through the appropriate USAREUR chain of command for individual training issues. Information-gathering sessions have been held at USAREUR's Directorate of Individual Training, and at the USAREUR NCO Academy. Through these efforts some possible applications common across several specific MOS have been identified in areas that presently constitute a problem in USAREUR.

Maintenance Training Effectiveness Analyses. There appears to be a great opportunity for ARI researchers to learn more about the maintenance system in general, and equipment-specific problems in particular, from the current activities of Training and Doctrine Command. TRADOC's Systems Analysis Activity will be carrying out Maintenance Post Fielding TEAs for several major Army weapon systems in the near future. These studies should provide maintenance performance and training data very useful to the ARI Field Units at Fort Benning (M2/M3 Bradley) and Fort Knox (M1 Abrams). The TEA will analyze the impact of procedures, personnel, and equipment on the performance of maintenance activities. Previous work exploring M1 maintenance in USAREUR has been done by the ARI Field Unit Fort Knox (Kristiansen, undated) and this TRASANA work can provide both an M1 Abrams update and an expansion to training information for M2/M3 Bradley.

Data for the study will be collected both in CONUS and USAREUR. The study schedule calls for in-progress reviews for M1 Abrams and M2 Bradley in November 1985, with emerging results being briefed in April 1986 and a final report in December 1986. Objectives of the Abrams and Bradley studies will be to determine the adequacy of the DS/GS maintenance procedures and to identify any actions necessary to improve them. Specifically, TRASANA expects to identify problems in maintenance training, procedure problems, and on-site solutions. TRASANA will seek to identify differences between CONUS and USAREUR in-garrison maintenance procedures and differences between actual field training exercise (FTX) and garrison maintenance procedures of USAREUR units.

A Commercial Utility Cargo Vehicle (CUCV) TEA will also be carried out to assist in the identification of critical DS/GS procedures and their adequacy, to improve CUCV training effectiveness. The expected results of the analysis will be to identify problems and critical tasks in maintenance training that affect internal DS/GS procedures, and the on-site solutions to training and procedural problems, as suggested by systems maintainers. As with the Abrams and Bradley TEA, ARI might greatly benefit from following this information, as it addresses both internal DS/GS maintenance system procedures, and also individual equipment maintainer problem identification and suggested solutions.

INFANTRY TRAINING ISSUES

USAREUR needs in Infantry training were identified through an ongoing series of briefings and discussions with training managers that took place primarily at 7ATC and 3d Armored Division (3AD) Training Resource Assistance Center and that were referenced against ARI's past, present, and future research products. It should be remembered that 7ATC has USAREUR-wide training management and support responsibilities, while the TRAC at Friedberg supports 3AD and provides SCO USAREUR with a "division-level" perspective of training needs. Additional insight as to what specific training needs have existed in USAREUR in the past was provided by a previous ARI FU USAREUR report, Status of Unit Training within USAREUR Units (Yates, 1979).

The major area of interest that emerged in the Infantry arena was individual marksmanship training, which will be discussed below in terms of both completed and emerging ARI products provided to meet USAREUR's information needs. ARI products that will be available to meet marksmanship needs in the future will also be discussed.

Marksmanship Training Needs

Training managers at 7ATC and TRAC were most concerned with rifle marksmanship, primarily with the M16A1 rifle and Squad Automatic Weapon (SAW). Marksmanship needs were identified in terms of live-fire training restrictions, written training materials, and marksmanship trainer/simulator devices. A full listing of publications and products provided to address marksmanship needs is presented as Appendix E.

Trainers stated that there is a great need in USAREUR for additional rifle live-fire practice at realistic distances. Currently, troops zero their weapons and do their marksmanship qualification training on 25-meter ranges. At this range, a soldier is not required to estimate target distance and make sight elevation adjustments. Trainers have observed that soldiers who can successfully qualify on the 25-meter range often cannot hit targets at a reasonable engagement range of 300 meters. This is a problem because the current M16A1 rifle is considered to have an effective range of 460 meters, while the improved M16A2 is said to have an effective lethal range of about 800 meters according to Green Book 1985-1986 (Army, 1985). Simply put, the soldier does not appear to be able to fully utilize the capabilities of the current M16A1 because of underdeveloped rifle marksmanship skills, and there may be an even greater discrepancy between rifle capability and marksmanship skills with the improved M16A2.

One simple solution to this problem might be to greatly expand live-fire training at a range of 300 meters. However, the limiting factor is that in Germany there are only about 16 rifle marksmanship firing ranges where a soldier can practice engaging a target at 300 meters. There are simply not enough 300-meter ranges available to allow for training through live-fire practice. Several ARI publications and marksmanship trainer/simulators were suggested as approaches to improving marksmanship skills.

Marksmanship Information Provided

ARI has produced a number of marksmanship training products under the FY 1984 3.2.3.1 and FY 1985 3.2.2 (Training for Individual and Crew Served Weapons) Program elements. These products, including an M16A1 training guide for the individual soldier, materials for marksmanship trainers, a videotaped briefing describing a new training device "on the way," and even recent Army Field Circulars that had not yet reached 7ATC through the distribution system, were provided to the USAREUR training managers for evaluation.

M16A1 Rifle Information. ARI Fort Benning has produced a Basic Rifle Marksmanship Shooter's Book that was very well received at 7ATC and TRAC. This pocket-sized guide to the M16A1 rifle is designed to serve as a reference to read and study if a soldier has questions concerning Basic Rifle Marksmanship (BRM) training. This guide also provides a marksmanship performance record section to allow a soldier to keep track of his training performance.

While this "Shooter's Book" was intended for initial-entry use, USAREUR trainers have seen it as a guide to marksmanship trainers. At the time this Shooter's Book was being reviewed, Fort Benning temporarily provided a

Marksmanship Training Unit to 7ATC for "train the trainer" classes on how to teach USAREUR soldiers the basics of marksmanship. The Deputy Director, Training Management Directorate, at 7ATC stated that he would like to have enough copies of the booklet to distribute to each of the students in this marksmanship trainers class. Deputy Director, Training Support Directorate, indicated that this booklet will be recommended for publication in USAREUR.

Squad Automatic Weapon (SAW). Marksmanship training for the Squad Automatic Weapon (SAW) is a controversial subject and a current project responsibility in DTM's marksmanship training area. The weapon may not have the maximum effective engagement range that it was designed to have. FC 23-10 Basic Marskmanship Training Bipod Mounted Squad Automatic Weapon (SAW), produced by ARI Fort Benning, was requested by 7ATC and reviewed. The following additional information needs were identified:

1. How should a SAW training range be set up--with how many targets of what type, and at what ranges?

2. A plan for ammunition requirements is needed.

3. The FC 23-10 does not provide basic minimum/maximum effective range information.

4. A Field Manual for the M14 (FM 23-8 M14, dated 1974) was offered as a model of the content areas that need to be addressed for SAW. Is a SAW Field Manual scheduled to answer these questions?

Marksmanship Trainer/Simulators

Marksmanship part-task trainer/simulators can be a valuable addition to training programs. They provide a capability for training in units where adequate live-fire ranges are not available and for training with weapons such as hand-held rockets, for which ammunition costs are high. These trainer/simulators can be superior to live fire in providing opportunities to diagnose and correct performance problems. The Weaponeer and MACS both address rifle marksmanship training and will be discussed below.

Weaponeer. Weaponeer is an indoor remedial rifle marksmanship device that realistically simulates actual field firing of the M16A1 Rifle. It is used to isolate and correct soldier deficiencies identified during rifle marksmanship instruction. It is not a rifle marksmanship trainer. 7ATC DTS and the Director of TRAC specifically requested training program information for the Weaponeer system to fill a gap in the Weaponeer remedial rifle marksmanship program in USAREUR. USAREUR trainers were dissatisfied with the training program materials originally fielded with the equipment and were using the device more as a trainer than for the diagnostic purpose for which it was intended. 7ATC has stated that the Weaponeer devices were originally fielded in USAREUR without the necessary Program of Instruction training support materials that would permit soldier trainers to use it.

The Weaponeer fielding problem is not unique but rather typifies the more general problem of focusing on equipment solutions to training problems and

failing to integrate this equipment into coherent training programs. (Again, the equipment provider may have no responsibility for training materials, which may be provided by a totally separate source.) In addition to training devices, USAREUR needs well-tested standardized POI for any devices that are fielded. To get the maximum training benefit from the equipment, USAREUR also deserves a clear explanation of what the device is meant to train. USAREUR does not have the time or the resources to develop POI for training devices. 7ATC trainers cited several other examples of fielded equipment for which they need POI. The availability of a POI is a routine question when trainers examine new devices being offered.

Multipurpose Arcade Combat Simulator. The MACS is an example of ARI work that will be available soon. MACS is a low-cost part-task simulator/trainer for light infantry weapons, with other applications possible. Different targets and backgrounds are presented on a TV monitor by computer graphics, and a specially designed long-distance light pen and trigger switch "shoot" the targets. With the proliferation of microcomputers and software, the costs of this equipment are being greatly reduced. MACS represents one low-cost (approximately $1,000) application of computers to marksmanship training/simulation technology. Unlike the Weaponeer, MACS is not dedicated only to the M16A1 Rifle, but with its "multipurpose" capability can instead be adapted very easily to a variety of weapon systems.

The system basically consists of a demilitarized weapon (currently the M16A1 Rifle or an expended M72A2 Light Antitank Weapon), a microcomputer system, a light pen that can be attached to a variety of weapons, and a TV screen. The trainee shoots at targets appearing on the TV screen from a distance of 10 feet. The system provides immediate visual and auditory feedback of hit/miss locations. The system allows for training in rifle sight range adjustment, the effects of wind, and moving target engagement, all of which are not available in the Army's standard 25-meter qualification range training.

A MACS videotape was presented to the DTS staff. This ARI prototype training simulator was well received, and 7ATC requested that arrangements be made to immediately acquire the system. The videotape was duplicated by 7ATC for future reference. It appears that the requirement for AR 18-1 purchase approval prevented the direct transfer of this ARI training technology to 7ATC for evaluation/adoption. ARI SCO USAREUR has made preliminary contact for a demonstration in USAREUR of this equipment by the ARI Field Unit personnel responsible for the project.

The MACS training technology was viewed by SCO USAREUR as an opportunity to preview an ARI product to an audience of training leaders and potential users in USAREUR while it was still in development. One advantage is that USAREUR has an opportunity to decide whether the system accurately reflects a training need and whether any modifications might be introduced to enhance its effectiveness. 7ATC's only real concern with the MACS device was that it should be fielded as a complete training package with a well-developed POI that soldier trainers could use on their own.

A second purpose in previewing the MACS device was that it lets USAREUR training leaders anticipate the solution to a training problem in advance,

possibly eliminating redundant parallel efforts by USAREUR, and allowing them to consider this system when planning for training device acquisitions.

As a future effort, a MACS demonstration might be conducted in USAREUR. Another valuable activity could be to identify and prioritize software development for MACS to expand its capabilities to any USAREUR-specific needs that might be identified. Software has been developed for the M16A1 rifle, M203 grenade launcher, and the M72A2 LAW. Other potential MACS applications that could be investigated include the M60 Machinegun, M249 SAW, .50 Caliber Machinegun, M2 Bradley M231 Firing Port Weapon, M203 Grenade Launcher, M202A1 Incendiary Rocket Launcher (FLASH), Dragon, TOW, Pistols, and Mortars.

ADDITIONAL USAREUR TRAINING ISSUES

Four additional areas that do not fit under the categories of either Armor or Infantry training were identified. MILES information needs will be presented in terms of MILES exercise management, precision gunnery applications, and Air Defense Artillery training. Second, Air Defense Artillery training with the Realistic Air Defense Engagement System will be discussed. Third, Night Vision/ Night Operations issues will be presented in terms of USAREUR's stated training needs, night training products currently available, and some USAREUR recommendations for future product development. As a final issue area, the development in USAREUR of a Combat Maneuver Training Complex has raised many data acquisition, analysis, and feedback questions that can best be addressed by examining the ARI Presidio of Monterey work with the National Training Center (NTC) at Fort Irwin, California. In the following sections, each of the four areas will be discussed to identify central concerns, ARI products offered for evaluation will be identified, and possible future actions will be presented.

Multiple Integrated Laser Engagement System

The MILES family of training systems employs eye-safe lasers and microelectronics to realistically simulate the firing capabilities of a full spectrum of direct-fire weapons. Small battery-operated laser transmitters allow the weapon operators to fire coded invisible laser pulses, which distinguish range and kill power, in place of using live ammunition. Two battalion sets of MILES are being procured for each active Army division.

The Army has a huge investment in training with MILES, and USAREUR is earmarking millions of dollars for the acquisition of additional MILES equipment, particularly for the New Combat Maneuver Training Complex at Hohenfels. At 7ATC, the Directorate of Training Support is responsible for the acquisition and support of this equipment. The Directorate of Training Management will manage its integration into training programs and program evaluation. Discussions and meetings with the Commander and Training Managers at 7ATC lead to the identification of MILES exercise management and precision gunnery applications as immediate and future information needs. A number of ARI products were provided to the 7ATC and staff to address these needs. A full listing of these materials appears as Appendix F.

MILES Exercise Management. Getting the maximum training benefit out of MILES can be difficult. While the equipment is fielded and technically supported successfully, more effort needs to be directed towards methods of managing tactical engagement simulation exercises. The step-by-step procedures for conducting a MILES exercise need attention.

The ARI product, Checklist for Preparing, Monitoring, and Reviewing Training Exercises with MILES (Fobes, 1984), was specifically requested from a list of publications available at SCO USAREUR by DTS, DTM, and Director, TRAC. This guide with a checklist approach was viewed as highly usable in USAREUR. A full review of available and upcoming documents must be carried out before making any decisions about adopting this document for publication at 7ATC, however. This ARI product provides an easy-to-use approach essential to effective information gathering, recording, and feedback that is not available in the recently distributed "Infantry: MILES Controller's Guide" Training Circular 25-6-2 dated December 1984. Delivery of the ARI document coincided with a MILES briefing for the Commander, 7ATC. The briefing addressed concerns over device misuse in light of the recent USAREUR decision to commit several more millions of dollars to the acquisition of MILES equipment.

As further evidence of the need for MILES training management support, 7ATC has hired a MILES trainer (a contractor for LORAL Electro-Optical) for 1 man-year to work with battalion S3 personnel on how to conduct MILES training. The contractor will be located at Hohenfels and will circulate to other USAREUR locations. While MILES hardware has been effectively fielded in USAREUR, there is still room for more effective management of training exercises through the use of guidelines. MILES usage is expanding in USAREUR and may also require assistance from ARI for evaluating its training capability in future applications such as precision tank gunnery and Air Defense Artillery training.

MILES Precision Gunnery. Under an upcoming Tank Weapon Gunnery Simulation System (TGWSS) program, enhancements to MILES will allow precision gunnery techniques to be taught and exercised, in addition to simple hit or miss determinations and tactical training applications. This improvement will include the capability to determine where laser strikes occurred on a target so that participants can adjust fire and refine gunnery or marksmanship techniques. During the MILES status briefing at 7ATC, the Commander stated that MILES was to be considered for use as a gunnery trainer, as well as for maneuver training. He added that the 7ATC staff would need to evaluate the utility of MILES as a gunnery trainer compared to other alternatives.

Immediately following the briefing, the ARI product Comparative Training Capabilities and Test Concepts for Selected Tank Gunnery Training Devices (Melching & Healy, 1982) was provided to the training manager responsible for this action. The document presents a study that compares the capabilities of MILES, Tank Gunnery Subcaliber Trainer (TELFARE), and SAAB BT-41 systems with Dry Fire training. The recipient acknowledged the timeliness of the document, which provides one approach to carrying out any additional MILES gunnery assessment.

Air Defense Artillery Training with MILES. Particularly in the area of ADA, where a single missile may cost hundreds of thousands of dollars, the nonavailability of resources to support training has made the need for training

devices inevitable. Training managers from USAREUR's 32nd Air Defense Artillery Command (32 AADCOM) have indicated that ground/air engagement exercises using the Multiple Integrated Laser Engagement System Air Ground Engagement Simulation/Air Defense (MILES AGES/AD) system is a very valuable training experience for ADA teams and crews. MILES AGES/AD may represent a major training direction that ARI could support. This system will be discussed below, along with possible applications to Radio-Controlled Miniature Aerial Targets (RCMAT).

MILES AGES/AD is a training device that provides a realistic training environment with real-time hit/kill feedback for Vulcan, Stinger, and Chaparral weapon systems. The system essentially consists of MILES laser transmitters and receivers, which are attached to real ADA weapon systems and aircraft, and allows for engagement simulation. MILES AGES/AD equipment will be used primarily in conjunction with the OH-58, UH-1, and AH-1 helicopters for training purposes.

Training managers at 32 AADCOM stated that there are several key features supporting the utility of MILES AGES/AD in ADA training in USAREUR: The device is part of the existing MILES equipment support system rather than representing a separate training device with additional equipment support requirements for USAREUR. MILES AGES/AD is seen as allowing soldiers to double up on training, and as adding training capability to aircraft that are normally included in field exercises anyway. Finally, by giving both aircraft and ground elements the capability of engaging each other with MILES, many ADA skills, such as position selection and cover and concealment techniques, are trained. One shortcoming in this approach is that a key factor in ADA effectiveness, Identification Friend or Foe (IFF), is not trained. Overall, MILES AGES/AD equipment offers a valuable addition to the tracking and engagement exercise skills currently taught in USAREUR's Dome Trainers and moving target simulators.

Trainers at 32 AADCOM have also expressed interest in the work being done to incorporate a MILES AGES/AD capability in RCMAT. Problems associated with fielding these systems, which greatly limit their utility in USAREUR, were cited by the trainers. RCMAT are seen as fair-weather training devices, and USAREUR's climate is quite often inhospitable. Hard winters, frequent rain, and overcast skies in Germany will make the use of RCMAT difficult. Training areas are very limited. The ADA trainers identified Grafenwoehr, Wildflecken, Baumholder, and Hohenfels training areas as the most likely places where RCMAT might be used. Trainers noted, however, that these areas are already very heavily used and that the RCMAT training would represent a new set of requirements for these already over-burdened sites. Finally, the introduction of MILES AGES/AD-equipped RCMAT was viewed as imposing additional personnel and maintenance requirements that are hard to meet with USAREUR resources.

Realistic Air Defense Engagement System

RADES is a Forward Area Air Defense (FAAD) human factors test and measurement bed, developed under the FY 1984 (1.1.1.0) Program element. In RADES, crews and teams operate FAAD weapon systems (Redeye, Stinger, and Chaparral) against subscale RCMAT-type fixed-wing targets, and against nonflying pop-up rotary-wing targets in an outdoor environment. RADES measures whole-task performance for the individual operator and for the team/crew collectively. Data are gathered

in such critical tasks as search, detection, acquisition, track, identification, ranging, fire, and command and control.

A RADES briefing with videotaped material was presented to key training managers at 32 AADCOM to elicit feedback on whether RADES might be a likely concept for use in USAREUR. While RADES offers whole-task performance information that other ADA simulations do not, it was viewed by 32 AADCOM trainers as not being appropriate for USAREUR's training environment. RADES shares those problems identified above for all RCMAT-type simulations, and appears to require a great deal of operator training and highly specialized maintenance support that is very costly to provide in USAREUR. USAREUR's Dome Trainer is far from a total ADA training solution, teaching fewer skills than ARI's RADES. However, the Dome Trainer is a relatively simple system to maintain; it provides for precision scheduling of year-round training, and it requires only a few soldiers as instructor/operators dedicated to the operation of the system. These factors combine to make the simple part-task Dome Trainer more desirable than the acquisition of a new and more complex full-task ADA skills trainer.

RADES utility as an ADA system development tool was acknowledged by the ADA trainers. It was suggested that the National Guard's (NG) dedicated target detachment (164th Target Detachment, Florida NG, and 200th Target Detachment, New Mexico NG) might be sites where RADES could be effectively used as a training system. These locations offer better weather conditions, and their specialized ADA support mission could allow them to incorporate RADES personnel and maintenance requirements.

Night Vision/Night Operations

The U.S. Army has a great potential advantage over adversaries in its ability to fight at night and under conditions of limited visibility because of the capabilities of its night vision equipment. Actual combat effectiveness, however, will be a function of both the equipment and training. Extensive training is essential for developing night-time equipment, tactical, and support operation skills. USAREUR leaders are well aware of this training need. USAREUR Training Regulations 350-1 (1983) states that "night training at Major Training Areas (MTA) should be routine and receive even greater emphasis than day training," and that "night training in Local Training Areas (LTA) and Maneuver Rights Areas (MRA) should become the norm." The overall need here is for effective training on the use of night vision equipment, to include Combat Vehicle Identification (CVI) skills, and for new/innovative ways to conduct night training. This section will discuss USAREUR night vision/night training issues that have been identified, and some currently available training materials that address these issues. Additional training needs that have been raised in USAREUR in the area of CVI will be presented.

Night Vision Issues. 7ATC identified night vision as an important needs area and sought background information before a major leader trainer's conference. ARI SCO looked for available information and provided several research products produced by ARI Fort Hood Field Unit under ARI FY 1984 (3.2.2.3) and FY 1985 (3.2.1), Target Acquisition and Analysis System (TAATS)/Combat Vehicle Identification program elements. (See Appendix G.) A recent ARI Field Unit Fort Benning publication produced under FY 1984 Program element 3.4.1.4., Review

and Analysis of Bradley Infantry Fighting Vehicle Operations Under All Visibility Conditions (Rollier, Salter, Perkins, Gary, Strassel, Lockhart, Kramer, & Hilligoss, 1984), was particularly useful for its treatment of the night vision/ limited visibility topic area and its discussion of devices.

At the Major Leader Trainer's Conference (May 16-17, 1985) Night Vision/ Operations was presented as one topic area needing more discussion of training needs. The Night Vision and Electro Optics Laboratory representatives presented a briefing that addressed Infrared (IR) target signatures and IR training aids. Night Vision Lab summarized the current training needs situation by saying that the thermal identification and recognition problem is a key training issue; a better understanding of both sight operation and target thermal characteristics is necessary if soldiers are to effectively detect potential targets and engage only threat forces.

Night Vision Training Technology Available. Several products are currently available to address the training need: the Forward Looking Infrared Report (FLIR) videotape, the Infrared Recognition and Target Handbook (IRTH), and the Combat Vehicle Identification-Thermal (CVI) training program. The FLIR videotape describes the performance of Tank Thermal and TOW Night Optic equipment under various conditions. These conditions include clear night performance, target cue, clutter, light and heavy fog, snow, and smoke and artillery fire.

The IRTH presents actual infrared sight images of friendly and enemy vehicles at various distances. In discussing the utility of this handbook for training, a 7ATC master gunner concluded that, for reasonable main gun engagement distances, the images are fine for detecting and engaging targets. However, these images were too poor to allow for discrimination between friend and foe, given the multiplicity of vehicles on the battlefield and the great similarity between our NATO allies' and enemies' equipment configurations. The master gunner concluded that a great deal of the night engagement shoot/don't shoot decision may have to be based on whether the target vehicle's direction of travel represents that of a friend or an attacker, and by maintaining effective communications between friendly vehicles. Naturally, training on the thermal image of a threat force formation could be a valuable addition to simple direction of travel cues.

CVI is a problem because many NATO combat vehicles look similar to those of potential enemies. This situation is even more of a problem at night and during periods of limited visibility. The ARI Fort Hood Field Unit's Target Acquisition and Analysis Training System research program was conceived to provide a logical framework within which to conduct research and to test and develop training programs and devices. TAATS has produced a series of interrelated CVI training programs. The first program, called the Basic CVI Training Program, presents photographs of vehicle scale models in open terrain that does not obscure or mask the vehicle. The Advanced CVI Program shows these scale models in hull or turret defilade. The Basic Thermal CVI Training Program presents the photographs with appropriate color patches painted on to represent infrared (IR) images as viewed through the Tank Thermal Sight and Thermal Integrated Sight. Each CVI program was developed to provide a controlled, standardized training package that is also flexible to respond to particular user needs.

ARI's Fort Hood Field Unit has produced the Basic CVI Training Program adopted as the standardized vehicle identification training program for the Army (Graphic Training Aid 17-2-9). The Thermal CVI Training Program has also been officially adopted (GTA 17-2-10), and the Advanced CVI Training Program was also approved by TRADOC pending available funding as of March 1984 (Shope et al., 1984).

Future Night Vision Needs. The Commander, 3d Infantry Division (3ID), expressed a need for development of a "Thermal Signature Vehicle Recognition Training Program" because available training materials were viewed as not meeting 3ID's needs (May 1985 message). He stated that Interim Thermal Combat Vehicle Identification (T-CVI) slides do not compare with actual vehicle signatures seen through the thermal sights of M901 ITV, M1 Abrams, and the M2/M3 Bradley. The Thermal Training Viewer (TTV) was considered to be an excellent training aid for individual instruction, though groups larger than squad size would require more than one TTV to maximize training time.

Commander, 3ID, identified three additional training needs for a Thermal Signature Vehicle Recognition Training Program. First was a thermal signature 35mm slide package for unit trainers: This package should present NATO and Warsaw Pact combat vehicles in a tactical environment, during different seasons, and at distances of 300, 500, 1000, 1500, and 2000 meters. Both classified and unclassified versions of these slides should be available. (ARI authors have pointed out that if 30 vehicles with five views of each were considered, and only three different conditions of temperature, ambient light, visibility--snow, rain, fog--at four ranges--1000, 1500, 2000, and 2500 meters--the number of images needed for training would be 16,200.) Innovative and creatives ideas are needed to address this problem.

The second need should be videotape instruction material that identifies the thermal signatures of vehicles as seen through the thermal sights of the M1 and M2/M3. As a third training item, a Bessler cue-see training program for individual soldier training was requested.

ARI SCO USAREUR will track progress on the Thermal Target Projector training device and Battlefield Identification Friend or Foe (BIFF) Simulator. Model Armor (1/8 scale) applications for night vision, M2 Bradley Sight Image Adjustment, and M2 Bradley Search Strategy projects at ARI Fort Benning will also be watched.

There may be reason to reexamine night vision instructional technology. If a slide program approach requires a great number of individual slides, is there an alternative approach? What information synthesis do we expect when we show the same vehicle at different distances, temperatures, or angles? If a soldier can be trained to understand a few principles that affect sight pictures and to extrapolate this to other vehicles' basic thermal pattern, then perhaps we could train with only a few images that reveal hot spots for each vehicle. This reflects the FLIR program approach, where the emphasis is on teaching principles.

As a future SCO USAREUR activity, basic information should be obtained to determine the status of Infantry night training being conducted in USAREUR and to identify any additional needs for training program development that ARI

might address. Discussions with Night Vision and Electro Optics Laboratory personnel suggest that there may be a great need for improvement in the operation of Infantry soldiers' night vision equipment and night operations training.

Combat Maneuver Training Complex

7ATC is currently developing an extensive, fully instrumented Combat Maneuver Training Complex at Hohenfels that will share many characteristics with the National Training Center at Fort Irwin, California. The CMTC will provide stressful, realistic training experience, approximating actual combat at Battalion Task Force level. There will be synchronization of Combat Support and Combat Service Support with maneuver elements, and a realistic opposition force contingent. Full use of MILES equipment will be made, facilitating quality and standardized evaluation. Range instrumentation will be designed to enhance valuation, after-action reviews, and take-home training packages. Lessons learned from NTC development with regard to designing the range instrumentation to fit specific assessment needs rather than simply trying to "measure everything" will be of great help to CMTC designers.

CMTC Issues. Development of the new CMTC places a requirement on DTM staff members to develop effective maneuver training and evaluation programs using MILES technology in an instrumented range environment. USAREUR must make maximum use of the lessons learned from NTC and also ARI's current work to develop methods for better integration of NTC and home station training.

One training requirement that must be addressed by DTM is that of feeding performance information back to participating units. While the National Training Center at Fort Irwin can afford to do a 3-hour after-action review following each action, CMTC cannot. This is due to extreme time constraints being designed into the system to accommodate the greatest number of units. DTM is, instead, working to develop a program for effectively feeding information back to participating units in four 15-minute sessions during pauses in the course of the exercises. A number of other needs will be driven by the requirement to support the new CMTC Hohenfels training area. The Commander 7ATC tasked DTM to "Determine the calculus of battle" at CMTC (i.e., to identify vehicle location and MILES hitkill data). This is seen by the Commander as the key to feeding maneuver performance back to units.

ARI Products Provided. DTM requested any information that ARI SCO USAREUR had on NTC and AAR. Materials provided described how data is collected and analyzed at NTC, as well as current ARI work being done to enhance the integration of NTC and home station training. ARI products describing the development of AAR were also provided. A full listing of these products appears in Appendix H.

The ARI product National Training Center Data Handbook (Fobes, 1984a), developed under ARI FY 1984 Program element 4.2.2.0 (NTC Training and Evaluation System System), provided DTM with an overview of NTC data collection procedures and descriptions of the various types of digitized information. It also includes a description of audio and video recordings available from engagement simulation and live-fire exercise histories. DTM was also given the Concepts for NTC Data Analysis (Banks, 1984) report that addresses the use of instrumentation and the digital data record in support of training analysis, feedback, and lessons learned.

Both of these documents should be quite useful in responding to the 7ATC Commander's "Calculus of Battle" requirement.

Reactions of DTS to these reports was very positive. According to the CMTC Project Manager, these products were definitely of value in providing a framework and vocabulary to address the issues of measurement, analysis, and feedback at CMTC before the instrumented system is developed. Lessons learned at NTC have thus been directly transferred through ARI publications to the appropriate decision makers at CMTC USAREUR in time to make a difference.

The CMTC Project Manager was informed that a contract had been let by ARI for additional research at NTC. The technical objectives for this contract are (1) development of methods for assessment of training benefits attributable to the NTC; (2) development of methods for better integration of NTC with home station training; and (3) development of methods for applying NTC findings to training development, doctrine development, and readiness assessment. These research needs are shared by USAREUR, and as a result the CMTC Project Manager initiated coordination with NTC research representatives working through ARI SCO USAREUR, which has been provided with the CMTC contractor's reports and which will follow developments with the FY 1985 Program element 5.1.1 (Feedback from the NTC: Collective and Individual Training). An additional opportunity that may develop will center around USAREUR applications of products emerging from the FT 1985 3.2.3 (Land Navigation Training (TRACER)) Program. This program will address both day and night operations and mounted/dismounted soldiers.

SUMMARY AND FUTURE DIRECTIONS

Much of ARI's extensive work in the areas of Armor and Infantry training has not reached USAREUR. This paper has detailed initial efforts at SCO USAREUR to identify and respond to USAREUR training needs primarily in these two areas. Numerous ARI products have been provided to USAREUR training managers. Other ARI products still in draft form were made available to USAREUR trainers to meet existing training needs and to elicit detailed product-referenced feedback for the ARI authors.

Summary

Specific ARI products provided to training managers to address a particular training area are identified in separate chapter appendixes. (See Appendixes B through H.) An overview of where needs assessment and technology transfer efforts addressed new or emerging products from ARI's FY 1984 and FY 1985 Work Program is presented in Figures 1 and 2, respectively.

Armor and Cavalry Vehicle Crewmember Procedural Skills. USAREUR training managers initially indicated that while there is a need for the M2/M3 Procedure Guides, this need no longer exists for M1 materials. During later presentations of the M1 Guides, there was renewed interest in this ARI product, and negotiations are currently underway to obtain a battalion set of these materials for a thorough USAREUR field evaluation. USAREUR has not taken any action toward publishing the M2/M3 Guides as a USAREUR Graphic Training Aid. If the field test of the

M1 Guides occurs and meets with success, then the M2/M3 Guides will be pushed for a similar evaluation. Successful transfer of the Procedure Guides is being sought first, to be followed up by efforts to field evaluate the other ARI products that make up the complete M1 Abrams sustainment training package.

Armor and Cavalry Vehicle Gunnery. The ARI Fort Knox publications that address gunnery actions to follow under conditions of partial equipment failure M1 Tank Degraded Mode Gunnery: M1 Gunnery Systems (Kraemer, 1984b), and M1 Tank Degraded Mode Gunnery: Non-Immediate Engagements (Kraemer, 1984b), and the booklet M1 Tank Gunnery Multiple Returns (Kraemer, 1984c) were judged to be valuable tools for the tank commander who is the primary crew trainer. The booklets Target Hand-Off Practice (M1) (Goldberg, 1982a) and Target Tracking and Leading Practice (M1) (Goldberg, 1982b) were reviewed by USAREUR master gunners, and were judged to be useful for entry-level training, and for rapid train-up purposes.

Driver Training for Tracked and Wheeled Vehicles. ARI is well equipped to respond to information on tracked vehicle driver training and performance evaluation. Written materials for noncombat driver procedural tasks and combat skills training and evaluation were provided to USAREUR training managers along with directions for laying out a standard driver training course for day and night driver training and evaluation applications.

Armor and Cavalry Vehicle Maintenance. ARI is addressing the longstanding problems associated with paper-based maintenance training and performance aids by exploring electronic information delivery devices. SCO USAREUR activities involve presenting these device ideas to USAREUR training managers for feedback on how and where they might be used.

Infantry Training Issues. The major interest area that emerged in the Infantry arena was individual marksmanship training within the restrictions of USAREUR's limited ranges. Both completed and emerging ARI products were provided to USAREUR training managers to meet their information needs. USAREUR training managers were provided with an M16A1 "Shooter's Book" training guide for the individual soldier, guides for unit marksmanship trainers, and a videotaped briefing of the new Multipurpose Arcade Combat Simulator under development. USAREUR training managers would like to have enough Shooter's Books to provide one to each student in the marksmanship trainers class as a "train the trainer" tool. This booklet is being considered for USAREUR publication.

Additional USAREUR Training Issues. Four additional USAREUR training issue areas that do not fit under the categories of either Armor or Infantry training were identified. MILES information needs were one issue raised by USAREUR training managers. The need for information on managing MILES exercises was met with the ARI product Checklist for Preparing, Monitoring, and Reviewing Training Exercises with MILES (Fobes, 1984b). ARI scientists obtained USAREUR feedback on ARI's Realistic Air Defense Engagement System program and will continue to brief RADES as as a training tool to additional groups of USAREUR trainers.

7ATC identified Night Vision as an important information needs area, particularly with regard to Combat Vehicle Identification at night or under conditions of limited visibility. Products from ARI Fort Hood's CVI program

were provided as background information in this area, since the Fort Hood CVI program has already been adopted as the standard CVI training product. ARI Fort Hood's Interim Thermal CVI product was also discussed. USAREUR is seeking a revised CVI and Thermal CVI program of instruction. ARI SCO USAREUR is approaching this requirement as a technical advisory effort, and will seek to incorporate lessons learned from the ARI Fort Hood CVI products and from ARI Fort Knox's long-range target identification research.

7ATC is developing an extensive, fully instrumented Combat Maneuver Training Complex at Hohenfels that will share many characteristics with the National Training Center at Fort Irwin, California. ARI SCO USAREUR provided 7ATC with the products Concepts for NTC Data Analysis (Banks, 1984) and National Training Center Data Handbook (Fobes, 1984a) from ARI's NTC Training and Evaluation System work program. Arrangements have been made to obtain draft ARI NTC products for USAREUR CMTC team review as they are produced.

Future Directions

Future efforts will involve deeper probing for an in-depth understanding of needs. More time will be spent on a smaller set of research efforts. Vehicle crewmember Procedure Guides and sustainment training materials will continue to be proposed for USAREUR adoption. Available driver training simulators and specialized training equipment should be examined. Initial contacts have been established for the SCO USAREUR staff to see what driver training technology is available off-the-shelf in Europe.

This desire for greater active involvement will likely be reflected in more Technical Advisory Service (TAS) work and should be seen as an expanding opportunity for involvement of ARI Field Unit and Headquarters content area experts in USAREUR. Such TAS efforts have been carried out in other areas, in support of USAREUR's Warrior Preparation Center (WPC) and Headquarters Central Army Group (CENTAG), with great success. Future TAS will integrate ARI's work in night training, vehicle identification, and vehicle crewmember position assignment into USAREUR training and personnel practices. USAREUR Air Defense Artillery training needs will receive greater attention.

In the future, more effort will be made to get a reaction to ARI's ongoing and upcoming research efforts. Plans currently call for a systematic USAREUR review of ARI's draft Science and Technology (S&T) plan. Development of USAREUR needs as S&T requirements sheets will be pursued as a new administrative approach to quickly transferring information on needs to ARI Headquarters.

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APPENDIX A

STRUCTURED PRODUCT FEEDBACK GUIDE

PRODUCT FEEDBACK

Product Number _____

1. What are your major work areas or responsibilities?

2. Did you have a chance to read this report?

3. Did you request the report for a current project or for general information?

4. Will the information help you with a current project?

5. Do you want more information in this area?

6. If you want more information, what type of information do you want?

7. Was any information in the report inaccurate or out of date?

8. Should another specific system or topic area be looked at in the same way, that is, using the same research approach?

APPENDIX B

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