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Research and Development Program 2.2

**FY 1993
Science and Technology
Program**



United States
**Army
Research
Institute**

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93-00820



REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE November 1992	3. REPORT TYPE AND DATES COVERED Final 1992 to 1993		
4. TITLE AND SUBTITLE FY 1993 Science and Technology Program			5. FUNDING NUMBERS PE - 65801 PR - MM15 TA - N/A WU - N/A	
6. AUTHOR(S) ARI Corporate Authors				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, Virginia 22333-5600			8. PERFORMING ORGANIZATION REPORT NUMBER ARI Research and Development Program 2.2	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Point of Contact: Dr. James A. Bynum				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for Public Release; Distribution is Unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This document describes ARI's FY 1993 exploratory development (6.2) and advanced development (6.3A) efforts in support of the Army's Soldier-Oriented Research and Development in Personnel Performance and Training (SORD-PT) Program. ARI's comprehensive program of research and development has been extensively revised during the last year in light of changing world conditions, the new DOD science and technology strategy, the Army science and technology investment strategy, Project RELIANCE agreements, and, the Armed Services Training and Personnel Systems Science and Technology Evaluation and Management (TAPSTEM) Committee guidance.				
14. SUBJECT TERMS Technology Base Research and Development Manpower			15. NUMBER OF PAGES 120	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED			18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	
			19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	
			20. LIMITATION OF ABSTRACT UNLIMITED	

**U. S. ARMY RESEARCH INSTITUTE (ARI)
FOR THE BEHAVIORAL AND SOCIAL SCIENCES**

**FY 1993
SCIENCE AND TECHNOLOGY
PROGRAM**

NOVEMBER 1992

" The force America needs for decisive victory, for securing her interests and fulfilling her responsibilities, is created by training quality people to a razor's edge, developing them into competent leaders, and equipping them with the best materiel in the world."

**General Gordon R. Sullivan
Chief of Staff, U. S. Army
AUSA 1992-1993 Green Book,
October 1992**

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FOREWORD

This document describes ARI's FY 1993 exploratory development (6.2) and advanced development (6.3A) efforts in support of the Army's Soldier-Oriented Research and Development in Personnel Performance and Training (SORD-PT) program. ARI's FY 1993 basic research program will be documented elsewhere. The full ARI program also includes a research-based study and analysis program (6.5-funded) which is documented in ARI R&D Program 3.2, *FY 1993 Research-Based Personnel and Training Study and Analysis Program*, August 1992.

U.S ARMY INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

ARI, a field operating agency of the DA DCSPER, is the lead laboratory and developing agency for manpower, personnel and training R&D. ARI's science and technology program is executed under the supervision of the DA Deputy Chief of Staff for Personnel (DCSPER), who receives broad guidance from the Assistant Secretary of the Army for Manpower and Reserve Affairs (ASA(M&RA)) and the Assistant Secretary of the Army for Research, Development and Acquisition (ASA(RDA)).

As specified in AR 70-6 and AR 70-8, the DCSPER directs and monitors the planning, programming, budgeting and execution activities of ARI in the conduct of its comprehensive R&D program. The Director of ARI, under the staff supervision of the Assistant DCSPER (ADCSPER), exercises management oversight responsibility for planning and execution of the ARI R&D program. As a developing agency, ARI's program is governed by DCSPER guidance and the provisions of AR 70-1, AR 70-6 and AR 70-8.

INTRODUCTION

Sixty percent of the Army's total obligational authority (TOA) is personnel related. To help assure a good return on this investment, ARI's science and technology strategy is to develop behavioral science data, technologies and products that support the Army's investment in human capital and that maximizes human effectiveness in combat, combat support and combat service support systems.

ARI executes its strategy through comprehensive programs in Manpower and Personnel R&D and Training Systems R&D. These programs are founded on two premises: that a high quality, well-trained soldier is the basic element of land warfare; and that these quality soldiers can and must be trained to proficiency to function as individuals or members of warfighting crews, teams and units.

The ARI Manpower and Personnel R&D program supports the Army's move to a smaller, higher quality force. To make the best use of the enlistee's unique skills and abilities, ARI's research will improve the match between the soldier and his/her job. This research program will help improve retention of quality soldiers who will become tomorrow's leaders. Leader development research provides the basis for effective career development for the new generation of leaders. Senior Army leaders are also emphasizing that Tomorrow's Army will be a different Army; it will not be business as usual on a smaller scale. ARI research to enhance organizational design will help increase productivity and support this transition.

The Army's primary peacetime mission has always been training. ARI's Training Systems R&D program stresses the development of empirically-derived principles of effective training to achieve high quality warfighting performance. This also stresses the demonstration of individual and collective training strategies, based on advances in the cognitive sciences, that make the most cost-effective use of emerging synthetic environments. Research will produce guidelines for the design and use of a new generation of cost-effective simulators and training devices that possess only the minimum physical fidelity required to accomplish specific training objectives and soldier/unit performance goals.

The ARI Science and Technology Program was extensively revised during the last year because of changing world conditions, the new DoD science and technology strategy, the Army science and technology investment strategy, Project RELIANCE agreements, and the Armed Services Training and Personnel Systems Science and Technology Evaluation and

and Management Committee (TAPSTEM) guidance.^{1 2}

As a point of departure, ARI FY 1992 Science and Technology Program accomplishments are presented in Table 1.

¹ Project RELIANCE and TAPSTEM are discussed in more detail in Appendix A.

² The MANPRINT-in-Systems-Integration R&D mission and functions were transferred from ARI to the Army Research Laboratory (Provisional) on 1 October 1992.

Table 1: MAJOR FY 1992 ACCOMPLISHMENTS

MANPOWER AND PERSONNEL RESEARCH AND DEVELOPMENT

<u>Exploratory Development (6.2)</u>	<u>Advanced Development (6.3A)</u>
<ul style="list-style-type: none">● Completed biographical data instruments for predicting officer attrition● Identified non-cognitive personal characteristics for predicting performance of soldiers with low Armed Forces Qualification Test (AFQT) scores● Completed preliminary evaluation of the effects of coaching on temperament and spatial relations selection measures	<ul style="list-style-type: none">● Completed a physical training handbook to help prepare new recruits for the Special Warfare Center and School to pass rigorous physical selection criteria● Completed new first-line civilian supervisor selection tools for use by Civilian Personnel Offices (CPO)● Completed analyses of the impact of downsizing on Army families● Demonstrated a training course for senior general officers for use at the Army War College

TRAINING SYSTEMS RESEARCH AND DEVELOPMENT

<u>Exploratory Development (6.2)</u>	<u>Advanced Development (6.3A)</u>
<ul style="list-style-type: none">● Established and demonstrated Simulator Training Research Advanced Testbed for Aviation (STRATA)● Defined parameters for near-, mid- and far-term virtual environments for simulation of the dismounted soldier● Field tested new procedures for identifying soldier and unit performance problems during night operations● Identified the training implications of combat vehicle command and control systems ("C² on the move") based on company-level simulations● Developed a preliminary collective skill acquisition model	<ul style="list-style-type: none">● Demonstrated cost-effective tank gunnery training strategies, representing a mix of "live fire", individual training devices and team simulators● Empirically demonstrated the relationship between home station training and effective unit performance at Army Combat Training Centers (CTC)● Developed predictive collective (unit) skill retention models for estimating retraining requirements for unit warfighting tasks

SCIENCE AND TECHNOLOGY PROGRAM

ARI's new program structure is summarized in Table 2 and discussed below. The ARI science and technology program consists of tasks, science and technology objectives and technology demonstrations. The relationship between the tasks, S&T objectives and technology demonstrations is shown in a series of six program roadmaps. The individual S&T tasks comprising ARI's exploratory development (6.2) and advanced development (6.3A) programs are described in detail in Appendices B And C, respectively.

Table 2. ARI PROGRAM STRUCTURE	
<p style="text-align: center;"><u>MANPOWER & PERSONNEL R&D</u></p> <p><u>Human Resource Development (1.1)*</u></p> <p style="padding-left: 20px;">Leader Development (1.1.1)</p> <p style="padding-left: 20px;">Organizational Performance (1.1.2)</p> <p style="padding-left: 40px;"><u>Selection & Classification (1.2)</u></p> <p style="padding-left: 20px;">General Selection & Classification Techniques (1.2.1)</p> <p style="padding-left: 20px;">Specialized Selection & Classification Techniques (1.2.2)</p> <p style="padding-left: 20px;"><u>Manpower & Personnel Policy Research (1.3)</u></p> <p style="padding-left: 20px;">Recruitment, Retention & Reenlistment (1.3.1)</p> <p style="padding-left: 20px;">Manpower & Personnel Modeling (1.3.2)</p>	<p style="text-align: center;"><u>TRAINING SYSTEMS R&D</u></p> <p><u>Unit Collective Training Technologies (2.1)</u></p> <p style="padding-left: 20px;">Training Strategies for Synthetic Environments (2.1.1)</p> <p style="padding-left: 20px;">Unit Training Strategies (2.1.2)</p> <p><u>Land Warfare & Rotary Wing Training (2.2)</u></p> <p style="padding-left: 20px;">Task Training Fidelity Requirements (2.2.1)</p> <p style="padding-left: 20px;">Combat Skills Training Methods & Strategies (2.2.2)</p> <p style="padding-left: 20px;">Foreign Language Tutoring Technologies (2.2.3)</p> <p style="padding-left: 20px;">Safety Training Technologies & Strategies (2.2.4)</p>

* Numbers in parentheses relate to the elements of the new program structure. S&T tasks have been given four digit identifiers to indicate their place in the program structure.

Manpower & Personnel R&D: Investing in a Smaller, Quality Force

Human Resource Development. A smaller Total Army must have well-qualified, trained, confident leaders at all levels, including those in the civilian work force. Empirical research will lead to the demonstration of organizational models that will optimize the utilization of group processes and decision-making skills. Research on the most effective means to develop leaders will produce simulation strategies for enhanced training in

utilization of group processes and decision-making skills. Research on the most effective means to develop leaders will produce simulation strategies for enhanced training in leadership, mission planning, and decision-making skills.

Selection and Classification. This research program will address new, improved, technology-based predictors of individual performance. Psychometric and computer-assisted testing technologies will be advanced to improve the accuracy of selecting soldiers for new "high technology" MOSs, and for identifying and measuring critical combat skills. These new technologies will also determine which personal characteristics can compensate for lower mental aptitude in achieving effective job performance.

Manpower and Personnel Policy Research. This research program expands the application of state-of-the-art survey and database technology to Army manpower and personnel research issues, and develops new technology to provide more timely information to policy makers. The Army family research program will be concluded, and analyses and recommendations on such issues as downsizing and home-basing delivered to sponsors. Research on the application of life course theory to human resource development will be directed at career, family and retention issues, with implications for human resource policies, programs and practices.

Training Systems R&D: Training for Future Combat

Unit Collective Training Technologies. Part of the research in this program is directed at the unique contributions that behavioral science can make to the effective exploitation of synthetic environments for training in a resource-constrained environment. Although most attention on synthetic environments and distributed interactive simulations (DIS) technology has been focused on computer hardware and software, the training-effectiveness of DIS-based training innovations may rest in large measure on the training strategies, performance measurement techniques, and performance feedback methods that are the products of this "behavioral technology" research program. The research products of this program support related efforts of the Simulation, Training & Instrumentation Command (STRICOM) and the Training and Doctrine Command (TRADOC). This includes virtual reality-based training strategies for individual combatants in association with STRICOM. It also includes behavioral science input to the development and validation of TRADOC's comprehensive Combined Arms Training Strategy (CATS).

Land Warfare and Rotary Wing Training. In addition to the development of unit training strategies, research is directed at guidelines for cost-effective strategies for individual soldier and small group (team/crew) training. This program of research focuses on land warfare and rotary wing training (i.e., training for mounted, dismounted and air operations). Research will permit empirical determination of the lowest level of simulation fidelity required to meet critical aviation training objectives. Technologies based on recent advances in cognitive sciences will be used to demonstrate "intelligent tutors" for the acquisition and retention of foreign language skills that can be important for meeting contingency missions anywhere in the world. A focus on critical small group warfighting skills addresses training requirements and solutions for such critical warfighting issues as night operations. In this period of decreasing training resources, this program also addresses the question of where training should be provided -- in the "school house" or in the field.

OBJECTIVES AND PLANS

Major FY93 Planned Accomplishments

Table 3 shows major planned accomplishments for FY93. The task descriptions in Appendices A and B contain detailed information for planned FY93 accomplishments for each on-going or newly-initiated task.

Table 3: PROJECTED MAJOR FY 1993 ACCOMPLISHMENTS

MANPOWER AND PERSONNEL RESEARCH AND DEVELOPMENT

<u>Exploratory Development (6.2)</u>	<u>Advanced Development (6.3A)</u>
<ul style="list-style-type: none"> ● Complete prototype command and control (C2) staff process model designed to enhance command staff organizational performance ● Develop technology for identifying Military Occupational Specialties (MOS) where soldiers with low AFQT scores can perform effectively ● Complete preliminary structural models of enlisted and officer career development in a downsized environment ● Complete biodata instruments for predicting enlisted attrition 	<ul style="list-style-type: none"> ● Validate new selection tests for predicting second tour performance ● Provide specifications for simulation technology to enhance warfighting thinking/decision-making skills ● Complete civilian survey longitudinal database to monitor the Army civilian climate ● Complete supervisor job-task analysis inventory ● Preliminary recommendations for technology-based procedures for command staff structure redesign

TRAINING SYSTEMS RESEARCH AND DEVELOPMENT

<u>Exploratory Development (6.2)</u>	<u>Advanced Development (6.3A)</u>
<ul style="list-style-type: none"> ● Complete training needs assessment for information integration/distribution tasks on dynamic future battlefield ● Demonstrate training scenarios for use with virtual environments ● Develop prototype brigade-level unit performance indicators 	<ul style="list-style-type: none"> ● Demonstrate Unit Performance Assessment System (UPAS) software and user's guide ● Complete Commander's Battle Staff Training Handbook for mounted maneuver operations ● Complete performance assessment methodology and guide for observers/controllers at the Joint Readiness Training Center (JRTC) ● Validate inflight training techniques and cockpit resource management strategies to reduce pilot-induced errors ● Select Navy "school house" training technologies for improving Army classroom training

Science and Technology Objectives

The ARI science and technology program addresses soldier-oriented systemic issues, which are defined as "persistent and pervasive problems that do not have a specific weapon system focus, although they do have major effects on battlefield performance and effectiveness." (*Army Science and Technology Master Plan (ASTMP)*,1993)

The ARI S&T program is focused on priority Army problems by six Science and Technology Objectives (STO), established in the ASTMP. A STO is "a specific, measurable, major technology advancement to be achieved by a specific fiscal year consistent with the funding available...." The ARI program includes six STOs which are shown in Tables 4 and 5.

Table 4: SCIENCE AND TECHNOLOGY OBJECTIVES

Manpower and Personnel R&D

V-B-1: SOLDIER ASSIGNMENT. Develop improved methods, by FY94, for selecting and assigning quality soldiers to each job to increase combat effectiveness that can potentially help reduce attrition by 15% and improve performance by as much as 10%. By FY 94, develop methods to empirically determine MOS restructuring options in terms of manpower, personnel and training impacts. Develop by FY96 improved selection procedures for Special Operations/Low Intensity Conflict (SO/LIC) forces, that can potentially reduce attrition by 25%. By FY96, develop techniques to improve soldier-job match.

V-B-9: LEADERSHIP AND COMMAND STAFF TRAINING. A power-projection Army demands that combat leaders and staffs be able to operate effectively and efficiently in a rapid-paced environment across the spectrum of conflict. By FY95, demonstrate prototype method to improve command group readiness training that requires fewer support personnel. By FY96, demonstrate simulation technology for development and assessment of leader conceptual and cognitive skills. By FY98, demonstrate simulation-based training strategies to optimize brigade through corps command performance.

Table 5: SCIENCE & TECHNOLOGY OBJECTIVES

Training Systems R&D

- V-B-5: SIMULATION FIDELITY.** Determine, by FY95, the least expensive fidelity requirements for training critical individual skills, safety procedures and unit combat tasks. This information will be used for upgrades of the existing inventory of simulators and for specifying acquisition requirements for future aviation simulators. Demonstrate by FY98, technology for training Commanders and Special Forces teams in virtual environments.
- V-B-6: FOREIGN LANGUAGE SKILL TRAINING.** Future Army contingency missions require that selected leaders and soldiers at every level can receive effective language training rapidly. By FY95, demonstrate a portable computer-based tutor for foreign language training incorporating recent advances in cognitive learning theories with training delivered by powerful, but affordable, "notebook" size computer systems.
- V-B-7: UNIT TRAINING STRATEGIES:** Combat training readiness for a wide spectrum of conflicts is a top priority for the Army. Training conducted at the various Combat Training Centers (CTC), such as the National Training Center (NTC), represents the standard of excellence which all unit training should aim to achieve. Since units can visit a CTC at the most once a year, most unit training must take place at home station. The Combined Arms Training Strategy (CATS) for units seeks to provide the guidance home station training leaders need to achieve training excellence with constrained budgets and time. The purpose of this research is to design the most cost-effective home station training management strategies for the entire range of possible missions and especially those involving rapid deployment for contingency operations. By FY93, demonstrate a performance and training feedback system for Close Combat Tactical Trainer (CCTT). By FY94, provide training strategies for Reserve Component (RC) units, including an armor gunnery training strategy optimized for RC use, to compensate for limited training time. By FY95, demonstrate a computer-based program for training battlefield commanders to accurately "visualize" dynamically changing conditions. By FY96, validate training strategies for combined arms training using the CCTT, including ADA and signal operations. By FY97, complete a preliminary CATS prototype. By FY98, demonstrate a validated CATS which provides detailed guidance for selecting the proper mix of individual and collective training resources -- to include operational equipment and "live fire" -- to meet specific mission training objectives.
- V-B-8: COGNITIVE AND COLLECTIVE SKILL RETENTION.** To ensure a combat-ready force, individual cognitive skills and collective skills must be maintained. For individual skill training: a) By FY94, skill decay models for critical cognitive skills will be validated; b) By FY95, classroom instructional strategies for improving cognitive skill acquisition, largely based on technologies transferred from Navy research under Project RELIANCE, will be demonstrated at appropriate schools. For collective training: BY FY95, a validated crew/team task performance model for predicting collective skill acquisition and decay will be demonstrated.

Technology Demonstrations

Following DoD and Army guidance, the ARI S&T investment strategy stresses the conduct of technology demonstrations to speed the maturation of advanced technologies. Planned tech demos are listed in Table 6 and described in detail in Appendix D.

A description of the DoD Key Technology Area (#11 Human-System Interface) and the two DoD Technology Thrusts related to the six STOs and the nine proposed tech demos is presented in Appendix E.

Table 6: ARI TECHNOLOGY DEMONSTRATIONS

#	Tech Demo Title	Objective	Date
1	Developing Warfighting Leaders	To demonstrate innovative leadership assessment and development technology	FY98
2	Selection & Classification for High Performing Soldiers	To demonstrate in an operational context the utility of new initial entry enlisted selection and classification (S&C) procedures for better soldier-job matching	FY97
3	Selecting the Warrior	To demonstrate in a simulated combat environment the utility of new S&C tests for predicting combat performance	FY97
4	The Special Forces Warrior	To demonstrate technologies to enhance SOF recruiting from within the Army and improve retention	FY96
5	Individual Combatant Training in Virtual Environments	To demonstrate individual training strategies and mission rehearsal techniques using "virtual reality" technology for key individuals and SOF high performance teams	FY98
6	Unit Performance Assessment System (UPAS)	To demonstrate use of UPAS in a distributed interactive simulation (DIS) environment for timely/accurate feedback (e.g., AARs)	FY94
7	Battlefield Visualization	To demonstrate a training program & job aids to help command staffs "visualize the battlefield" for improved decision making	FY95 FY98
8	Simulator Training Research Testbed for Aviation	To demonstrate fidelity levels needed to support aircrew training at the lowest reasonable cost	FY95
9	Advanced Language Learning	To demonstrate virtual reality "immersion" training techniques for language skill development	FY95 FY99

ARI Science & Technology Roadmaps

As previously described, STOs represent major, high priority S&T objectives. The nine tech demos just described will provide the opportunity for testing R&D products in a field setting. The six ARI science and technology roadmaps shown in Figures 1 to 6 are intended to reflect how the accomplishment of task milestones will lead to tech demos where STO products are tried out in coordination with the potential user.³

³ The four digit number and words in all capitals on the left side of each roadmap are the Task Number and short Task Title for the ARI research tasks leading to the accomplishment of the STO objective.

ROADMAP FOR V.B.1 SOLDIER ASSIGNMENT

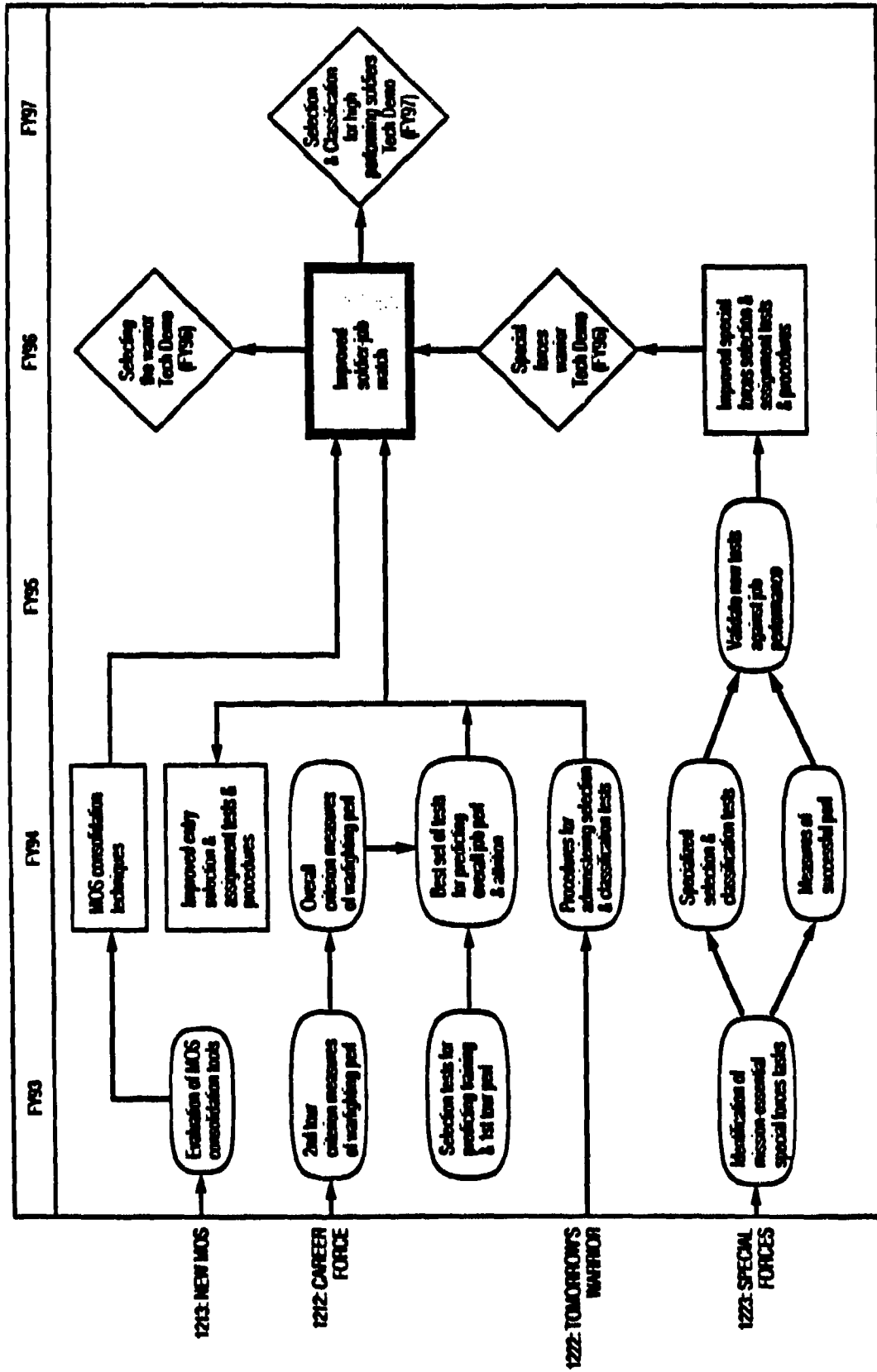
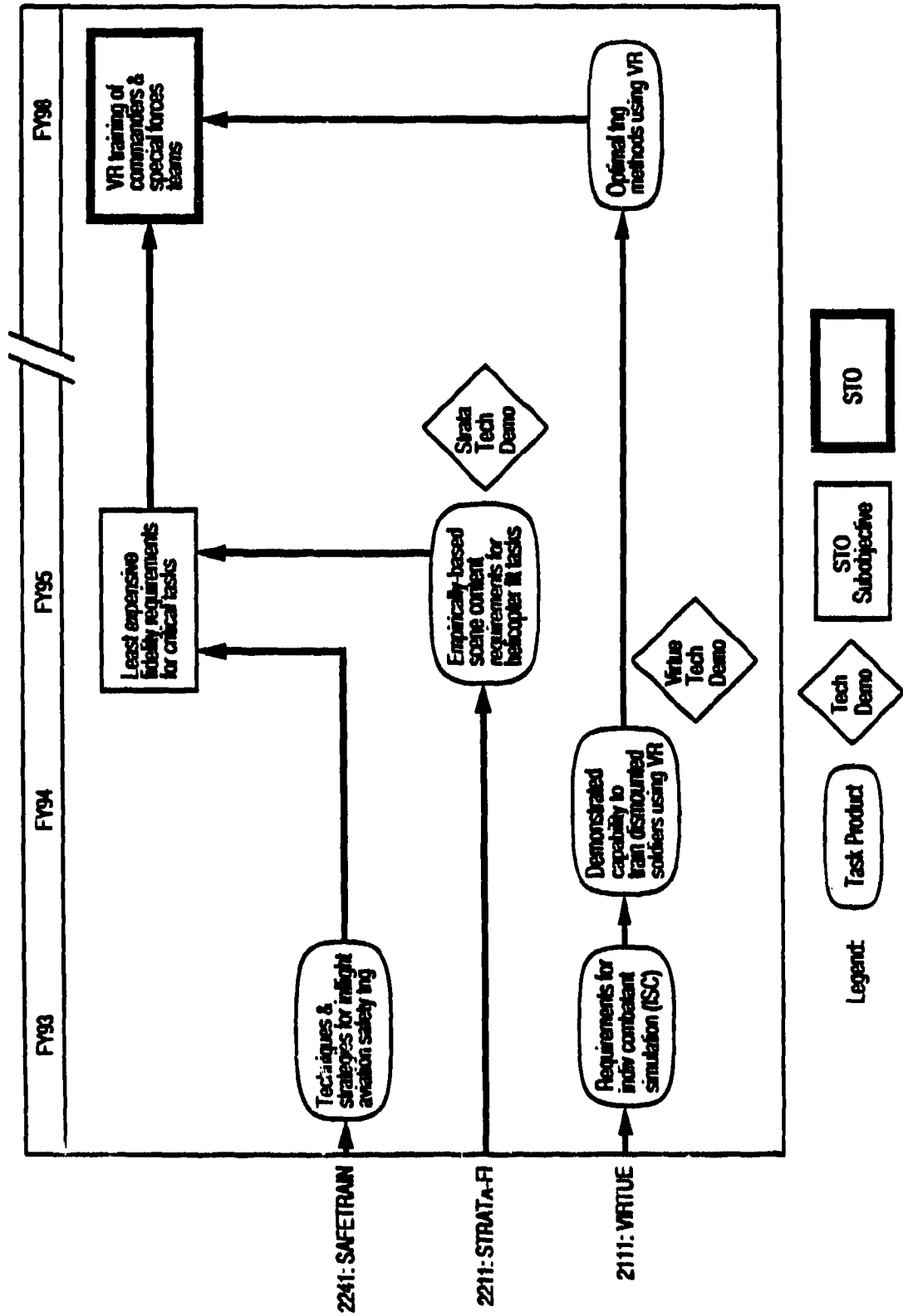


FIGURE 1

ROADMAP FOR V.B.5: SIMULATION FIDELITY



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FIGURE 2

ROADMAP FOR V.B.6: FOREIGN LANGUAGE SKILL TRAINING

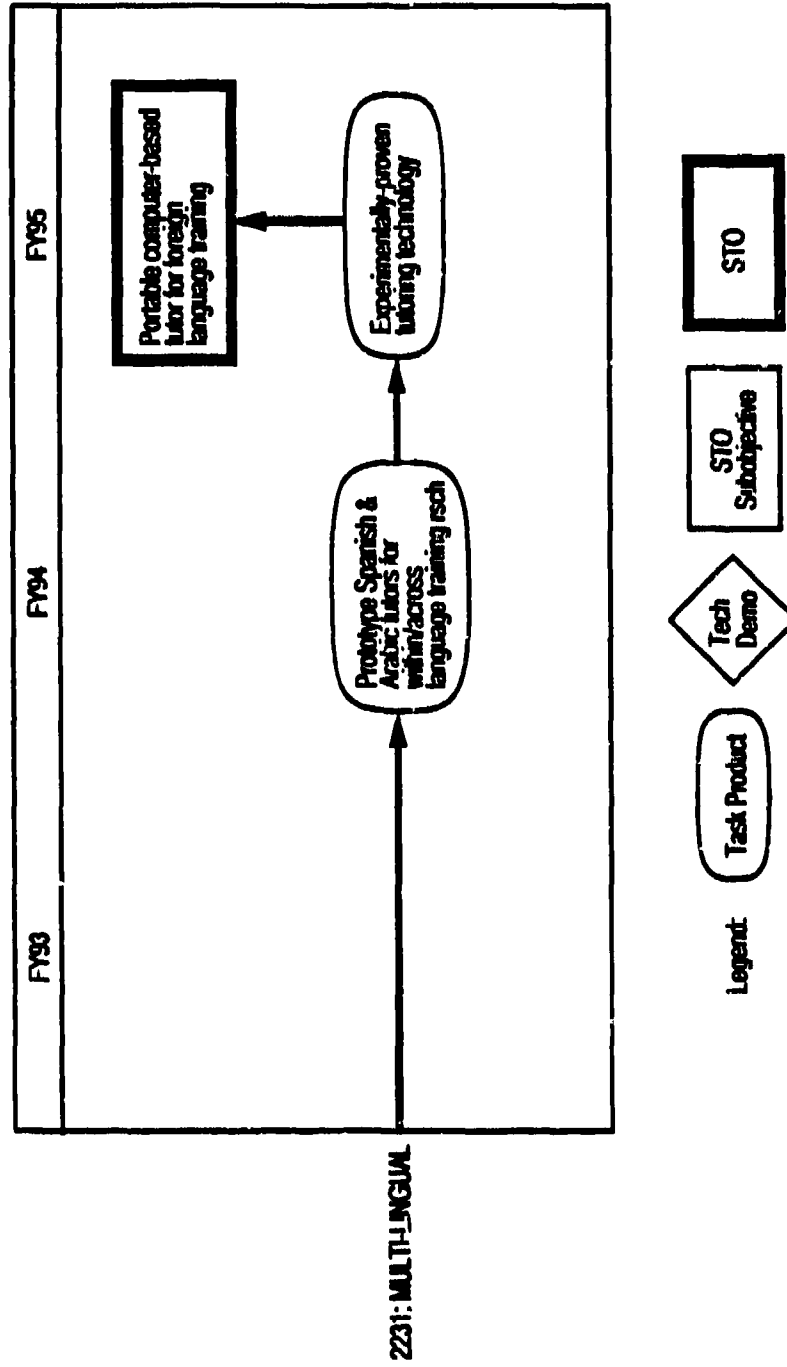
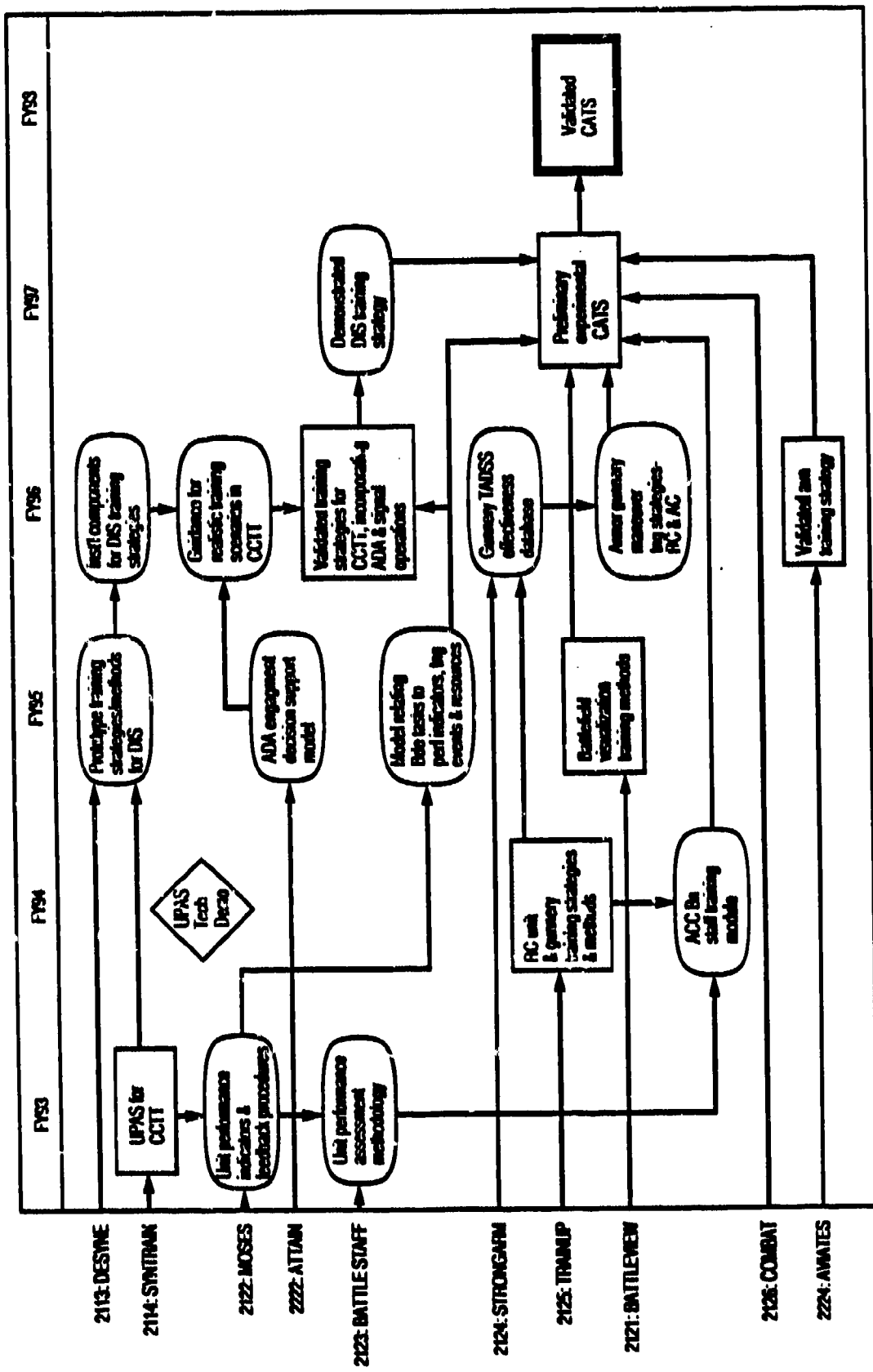


FIGURE 3

ROADMAP FOR V.B.7: UNIT TRAINING STRATEGIES



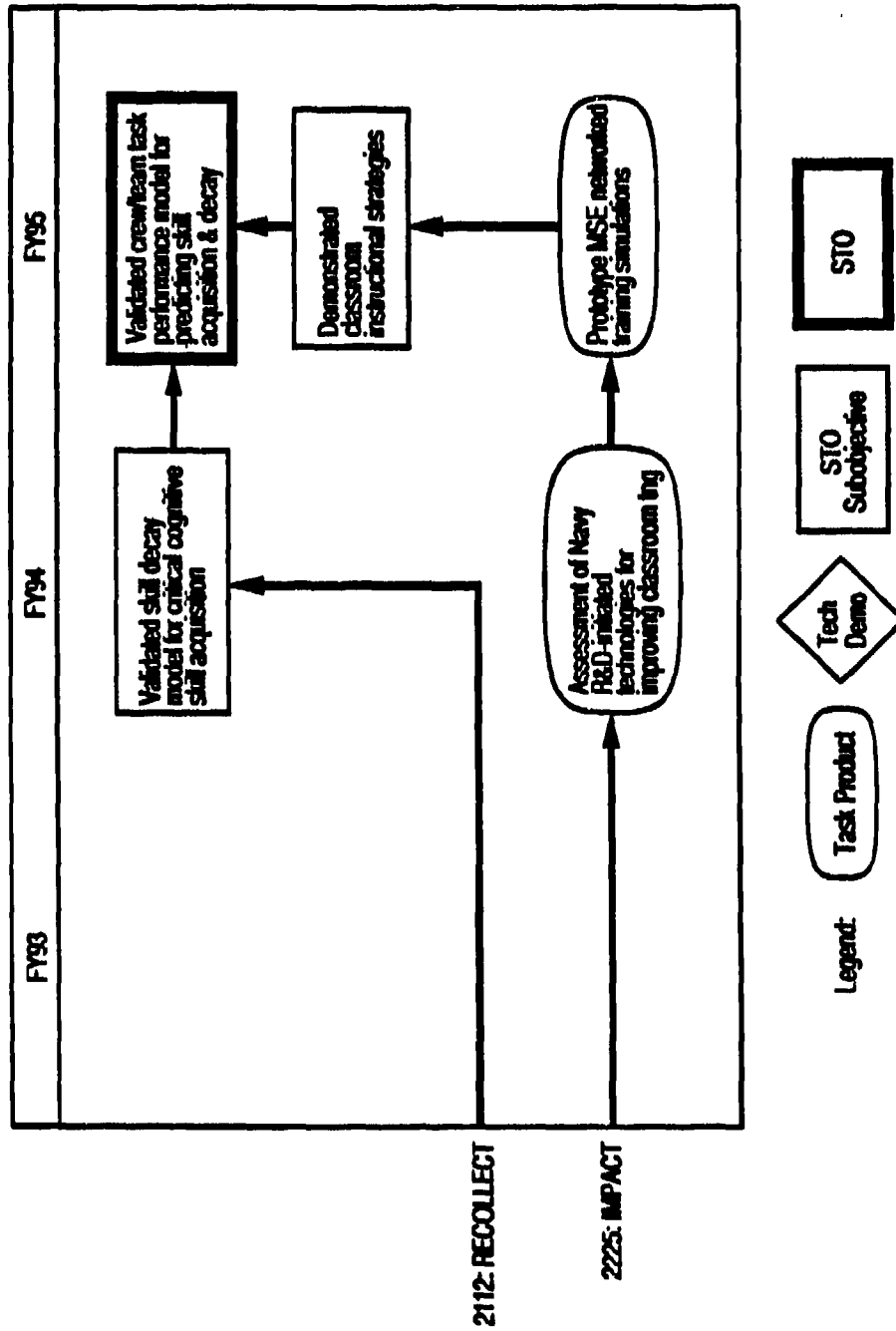
Legend:



FIGURE 4

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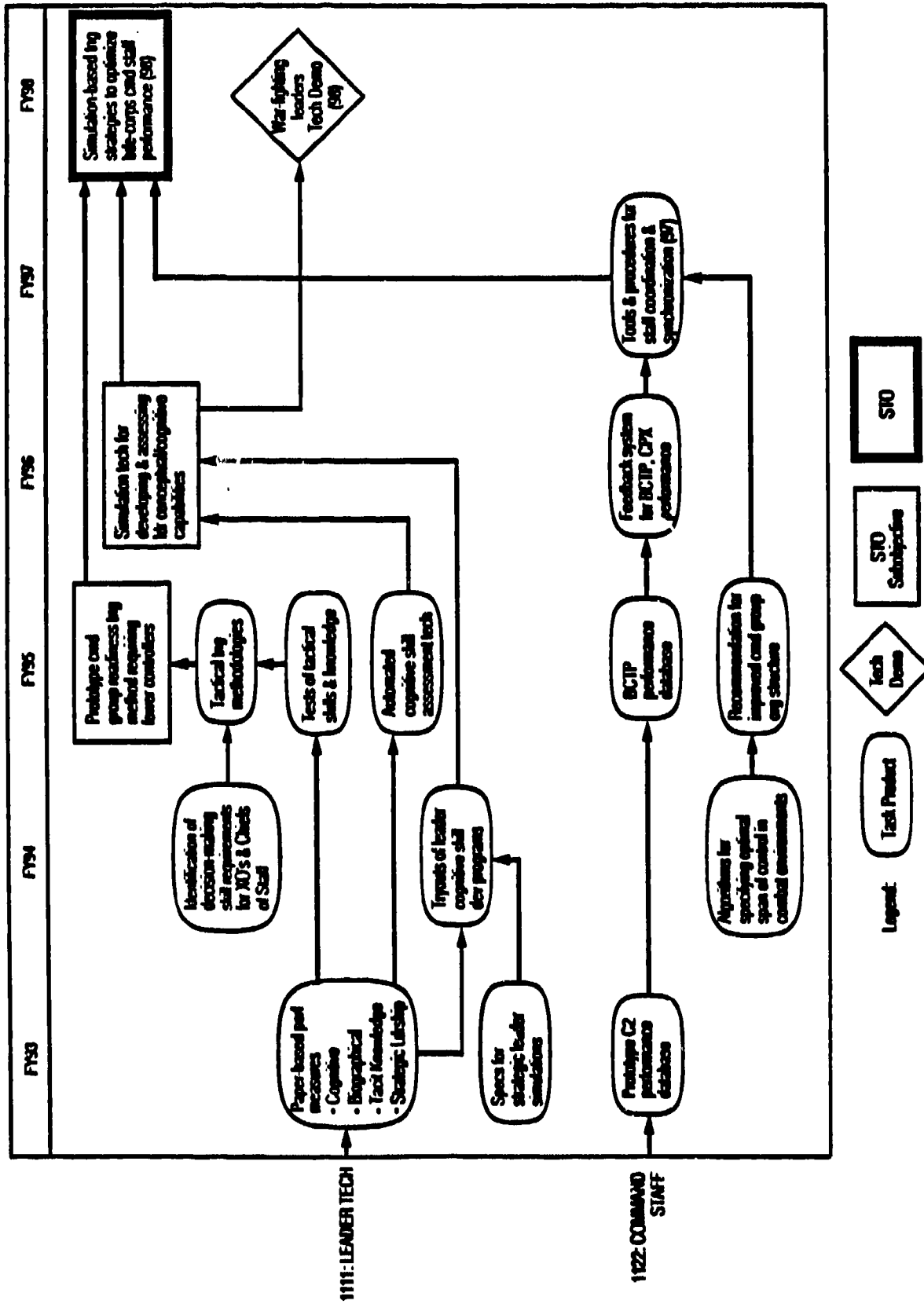
ROADMAP FOR V.B.8: COGNITIVE & COLLECTIVE SKILL RETENTION



SEP 92

FIGURE 5

ROADMAP FOR V.B.9: LEADER & COMMAND STAFF TRAINING



SEP 92

FIGURE 6

APPENDIX A

PROJECT RELIANCE AND TAPSTEM

Project RELIANCE was a tri-service project to improve the DoD RDTE system by reducing redundant capabilities and eliminating unwarranted duplication, while gaining efficiency through collocation and consolidation of in-house work where appropriate. Project RELIANCE analyzed the Services' programs in manpower and personnel and in training systems. The research subareas within these two program areas for which a service would be the primary R&D location were laid out in the Tri-Service Science and Technology Project Reliance Strategy Report of April 1991. The manpower and personnel and training systems research subareas are shown in the table below. Implementation of Project RELIANCE agreements was initiated by the Armed Services Training and Personnel Systems Science and Technology Evaluation and Management (TAPSTEM) Committee which serves as the integrating management mechanism for research and development programs in manpower and personnel and training systems.

Table A-1. TRI-SERVICE S&T RELIANCE		
SERVICE LOCATIONS FOR MANPOWER & PERSONNEL AND TRAINING SYSTEMS TECHNOLOGY BASE R&D		
ARMY	NAVY	AIR FORCE
<ul style="list-style-type: none"> • Selection and Classification <ul style="list-style-type: none"> - (Service Unique Applications) • Human Resources Development <ul style="list-style-type: none"> - Leader Development - Family Programs • Unit Collective Training <ul style="list-style-type: none"> - Distributed Interactive Simulation - Tactical Engagement Simulation • Land Warfare/Rotary Wing Training 	<ul style="list-style-type: none"> • Selection and Classification <ul style="list-style-type: none"> - (Service Unique Applications) - Computer-based Entrance Testing • Force Management & Modelling • Productivity Measurement/Enhancement • Sea Warfare Training • Training Devices & Features • Classroom Instruction 	<ul style="list-style-type: none"> • Selection and Classification <ul style="list-style-type: none"> - (Service Unique Applications) - Basic Abilities Testing - Job Structures & Requirements • Air Crew Training Effectiveness • Intelligent Computer-Aided Training

APPENDIX B

Exploratory Development

The following data elements are used to describe the exploratory development (6.2) tasks included in ARI's FY93 research and development program:

TASK TITLE
OBJECTIVE
APPROACH
PROGRESS
FY93 MILESTONES
PROJECTED TECHNOLOGY
START DATE/END DATE
FY93 FUNDING
PROGRAM ELEMENT/PROJECT
DIVISION
TECHNICAL AREA/FIELD UNIT
POC
SCIENCE & TECHNOLOGY OBJECTIVE (STO)
OSD KEY TECHNOLOGY AREA
OSD SCIENCE & TECHNOLOGY THRUST

The ARI exploratory development program includes an Innovative Ideas from Industry (I³) Program. The goal and objectives of this program are shown on the following page.

Innovative Ideas from Industry (I³) Program

GOAL AND OBJECTIVES

To stimulate faster development of innovative ideas for making significant improvements in personnel and training performance. Specific objectives of this program are to:

- Foster innovation in the development of new technologies in the behavioral and social sciences
- Reduce the time required to mature these technologies

APPROACH

Innovative ideas are solicited from the private sector through a broad agency announcement (BAA) for the research leading to the development of new technologies in the behavioral and social sciences (and related disciplines). Individual efforts under this program range from one to two years. Preference is given to short-term proposals and to proposals that represent high-risk/high-gain initiatives (i.e., novel, state-of-the-art approaches to critical problems). Joint university/industry partnerships are encouraged.

TECHNOLOGY OBJECTIVES

While the I³ program considers all proposals in all areas of manpower, personnel and training exploratory development, the FY93 the program is focusing on the following areas:

Collection and Analysis of Survey Data. Technologies to improve the development, administration and analyses of opinion and attitude surveys that will: reduce the time needed for collection and analysis of survey data, improve the accuracy of attitude and opinion estimates, and develop new ways to develop survey items.

Occupational Analysis and Job Structures. Technologies for grouping jobs (Military Occupational Specialties) together that: are based on fully-developed conceptual or theoretical underpinnings, can be demonstrated to have the required reliability, are flexible, and do not require excessive personnel and/or fiscal costs to carry out.

Models for the Redesign of Organizations. Technologies that advance the state-of-the-art in our understanding of organizations, communications and management to maintain organizational effectiveness and improve their versatility while optimizing their size.

Team Perfect Performance: Technology for achieving and measuring error-free performance in teams and crews.

Training for Mission Rehearsal. Technologies for the development of training strategies for mission rehearsal and tactical engagement simulation that exploit advances in distributed interactive simulation (DIS), including networking and virtual reality. Experimental investigations will include critical parameters for simulation fidelity and methods for measuring transfer-of-training as a function of time.

Techniques for The Analysis of Unit Performance Data: Application of advanced analytic techniques, such as chaos and catastrophe theories and concept of neural networks, to maximize the utility of the data from instrumented training conducted at the National Training Center (NTC).

FY93 Exploratory Development (6.2) Tasks

1. MANPOWER AND PERSONNEL R&D

1.1 HUMAN RESOURCE DEVELOPMENT

1.1.1 Leader Development

1111: LEADER TECH: Leader Skill Assessment and Development Technologies

1.1.2 Organizational Performance

**1121: GROUP WORK: Technologies for Enhancing Command-Staff
Organizational Performance**

1.2 SELECTION AND CLASSIFICATION

1.2.1 General Selection and Classification Techniques

1211: QUALITY SOLDIERS: Alternative Selection and Evaluation Techniques

1.2.2 Specialized Selection & Classification Techniques

1221: JOB MATCH: Determining Minimal Entry Qualifications

1.3 MANPOWER AND PERSONNEL POLICY RESEARCH

1.3.1 Recruitment, Retention and Reenlistment

**1311: LIFELINE: The Life Course Approach to Human Resources Development
Processes**

1.3.2 Manpower and Personnel Modeling

1321: PROFILES: Personnel Survey and Database Technologies

TASK TITLE: LEADER TECH: Leader Skill Assessment and Development Technologies (1111)

OBJECTIVE: Develop and evaluate emerging technologies for leader development and assessment which could improve the capabilities of future Army leaders.

APPROACH: This research will explore new technologies to assess the relative contribution of the various characteristics that define the highly effective Army leader as the leader develops through his or her career. A number of different approaches will be explored, to include biographical data, cognitive assessments, and assessment of tacit leadership knowledge. New instruments will be developed and tried out on cross-sectional samples of officers at different stages in their careers. These data will be correlated with measures of leader performance and other aspects of job performance. Models of leader development at successive, critical stages in an Army career will be developed. New technologies to facilitate the growth of leader skills, to include cognitive skills and tacit leadership knowledge, will be developed and evaluated.

PROGRESS: New Start

FY93 MILESTONES:

Principles for using simulation technology to enhance creative (unstructured) problem solving

Initial version of biodata instruments

Initial version of self-development strategic leadership instrument

Complete computer-based cognitive skill assessment tool

PROJECTED TECHNOLOGY:

FY95

Techniques for training "expert" patterning and thinking skills necessary for tactical decision-making

Automated conceptual and cognitive skill assessment techniques

FY96

Simulation technology for enhancing the development of conceptual and cognitive skills at Senior Service College level

Validated leader assessment instruments

FY97

Validated theory of adult development for use in guiding development and training decisions

FY98

Simulation-based training strategies to optimize brigade-corps command staff performance

Model of the leader development process across organizational levels

War fighting leaders tech demo

FY99

Guides for developing tacit leadership skills

START DATE: FY93

END DATE: FY99

FY93 FUNDING (\$000): \$1356 PROGRAM ELEMENT/PROJECT: 62785
A790/A791

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Leadership and Organizational Change Technical Area
Strategic Leadership Technical Area
Fort Leavenworth Field Unit

POC: Dr. Zita Simutis, (703) 274-8844; DSN 284-8844

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.9. Leadership and Command Staff Training

OSD SCIENCE AND TECHNOLOGY THRUST:

- #6 - Synthetic Environments
- #8 - Sharpening the Warriors' Edge

TASK TITLE: GROUP WORK: Technologies for Enhancing Command-Staff Organizational Performance (1121)

OBJECTIVE: To understand better the factors influencing command group processes and products, by exploring (1) techniques and tools for assessing the performance of staff elements and command-staff groups; and (2) methods and procedures for enhancing the performance of these elements and groups.

APPROACH: This research will focus on command-staff groups involved in the leadership of combat units, brigade through corps. A particular concern will be the problems of a dispersed staff, where neither the commander nor principle staff members have face-to-face contact with subordinates. Observation and data collection in realistic CPXs and data from small-scale laboratory experiments will provide insights on the principal factors limiting effective group performance. Candidate changes in group development, structure, stability, procedures, and supporting tools will be prioritized on the basis of expected impact and feasibility. Selected interventions will be implemented and evaluated in laboratory experiments. Computer modeling techniques will also be explored to evaluate their potential use in predicting the impact on performance of changes in group structure, composition, size, and procedures.

PROGRESS:

Recommendations for small-group instruction in problem solving

Conceptual model of C2 staff process based on behavioral data

FY93 MILESTONES:

Model of C2 staff processes: prototype and requirements definition

Identification of techniques used by commanders to develop C2 skills within their staffs

Leader development in WARSIM 2000: Identification of ts requirements

PROJECTED TECHNOLOGY:

FY95

Computer modeling tools for assisting in the design of staff groups

FY96

Recommended procedures to support distributed staffs

Validated of computer modeling predictions on the impact
of changes in staff size and composition on performance

START DATE: FY92

END DATE: FY96

FY93 FUNDING (\$000): \$372 PROGRAM ELEMENT/PROJECT: 62785 A790

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Leavenworth Field Unit

POC: Dr. Stanley Halpin, (913) 684-4933; DSN 552-4933

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: QUALITY SOLDIERS: Alternative Selection and Evaluation Techniques (1211)

OBJECTIVE: To increase the Army's selection and classification capability through (a) new methods for measuring performance-related aptitudes; (b) improved prediction of leadership and performance under stress; and (c) increasing the validity of temperament and psychomotor/spatial tests.

APPROACH: New measures of performance-related aptitude, leadership, and stress tolerance will be developed and evaluated. Measurement error will be addressed by research on developing improved directions to test takers and control of test-related faking and coaching.

PROGRESS:

FY91

Preliminary evaluation of usefulness of biographical data for predicting attrition of officers

FY92

Preliminary evaluation of coaching effects on temperament and spatial measures

FY93 MILESTONES:

Evaluation of biodata for predicting in-service attrition of enlisted personnel

Initial evaluation of a methodology for selecting classification-efficient predictor measures

Evaluation of coaching effects on temperament and spatial measures

PROJECTED TECHNOLOGY:

FY94

Software, users' manuals for computer-based testing software

Methods for addressing coaching effects on temperament and spatial measures

Measures of cadet leadership potential

Improved biographical measures of adaptability of officers and enlisted personnel

FY95

Improved test composites for classification of enlisted personnel

New measures of performance related aptitude, leadership, and stress tolerance

START DATE: FY90

END DATE: FY96

FY93 FUNDING (\$000): \$1015 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Selection and Classification Technical Area

POC: Dr. Michael Rumsey, (703) 274-8275; DSN 284-8275

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: JOB MATCH: Determining Minimal Entry Qualifications
(1221)

OBJECTIVE: To improve selection and classification for enlisted soldiers scoring below the mean on the current measure used for initial selection, the Armed Forces Qualification Test (AFQT).

APPROACH: Identify measurable individual characteristics, such as spatial aptitude, that can help predict performance of soldiers with average to below average cognitive aptitude. At the same time, identify Army Military Occupational Specialties (MOS) that can be performed effectively by soldiers with average to below average cognitive aptitude. Then, determine the best composite for predicting performance of the soldiers, and determine how to set minimum entry standards on these composites for individual MOS.

PROGRESS:

FY91

Developed detailed analysis plan

FY92

Selected 22 MOS for intensive study

Preliminary identification of characteristics that predict performance of soldiers with low AFQT scores

FY93 MILESTONES:

Conduct expert judgment study of validity of predictor measures for soldiers with low AFQT scores

Complete validity analyses using SQT scores, survival time and attrition as criteria

PROJECTED TECHNOLOGY:

FY95

New selection techniques for soldiers with low AFQT scores

START DATE: FY91

END DATE: FY95

FY93 FUNDING (\$000): \$421

PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Selection and Classification Technical Area

POC: Dr. Michael Rumsey, (703) 274-8275, DSN 284-8275

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: LIFELINE: The Life Course Approach to Human Resources Development Processes (1311)

OBJECTIVE: To test the applicability of the emerging technology of life course theory to the investigation of major Army human resource development issues such as the continuing effects of combat on survivors and the effects of downsizing on displaced personnel.

APPROACH: The approach is two-fold. First, apply the life-course paradigm to understand how military experiences have influenced career and family development and commitment to the Army. This will be done through re-interpretation of existing data, extension of previous data collection efforts, and new data collections. This first application will also test how well the life course approach can be applied to the military experience. Second, use the life-course paradigm to further investigate the processes that produce changes in career and family development and what might be done to alleviate stresses associated with Army organizational changes. Longitudinal follow-up surveys to the Army Family Research Program will provide data as well as a basis for further development of the model.

PROGRESS: New Start

FY93 MILESTONES:

Complete research plan outlining application of life course approach to career and family development

Assessment of life course theory applied to the military experience

Develop preliminary structural models of career and family development in a downsizing environment

PROJECTED TECHNOLOGY:

FY94

Structural models of career and family development within a downsizing environment (subset of general model)

First longitudinal follow-up survey to the 1991 Army Family Research Program data collection, incorporating data from the National Survey of Families and Households

FY95

Analysis of longitudinal survey results

FY97

Structural models of Army career and family development

FY99

Second longitudinal follow-up survey

START DATE: FY93

END DATE: FY99

FY93 FUNDING (\$000): \$510 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Leadership and Organizational Change Technical Area

POC: Dr. Paul Gade, (703) 274-8293; DSN 284-8293

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: **PROFILES: Personnel Survey and Database
Technologies (1321)**

OBJECTIVE: To develop improved technologies and methods for assessing the impact of Army personnel decisions as well as other factors (psychological, economic, etc.) on soldiers' attitudes and opinions. This will include the design and development of new technologies for storing and retrieving manpower and personnel research findings. Results of this research will also lead to the development of new technologies to provide faster and more accurate research-based information to manpower and personnel policy makers.

APPROACH: Based on thorough reviews of the literature and of commercially available software, experimental surveys will be conducted to look at innovative ways to improve the collection, storage, analysis, and reporting of policy-relevant information from personnel. While these surveys will contain content relevant to Army personnel policy and leadership issues, the emphasis of this work is on enhancing methods used to collect, analyze, and report such information. Technologies to link existing research and operational databases for rapid data retrieval will be developed. Standardized specifications for creating new, linkable databases will be developed.

PROGRESS: New start

FY93 MILESTONES:

Initial literature and product review of software for survey information collection, analysis, interpretation, and reporting

Initial cost and errors model for surveying military personnel

Diagnosis of issues in credibility and confidentiality of surveys, and development of plan for their experimental investigation

PROJECTED TECHNOLOGY:

FY94

Measurement models developed from existing surveys

FY95

Feasibility assessment and prototype architecture for master database of Army personnel surveys

FY96

Handbook of normed scales for measuring key military personnel attitudes

FY97

New Army survey delivery systems

START DATE: FY93

END DATE: FY97

FY93 FUNDING (\$000): \$468 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Manpower and Personnel Policy Research Technical Area

POC: Dr. Timothy Elig, (703) 274-5610; DSN 284-5610

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

FY93 Exploratory Development (6.2) Tasks

2.0 TRAINING SYSTEMS R&D

2.1 UNIT COLLECTIVE TRAINING STRATEGIES

2.1.1 Training Strategies for Synthetic Environments

2111: VIRTUE: Virtual Environments for Combat Training and Mission Rehearsal

2112: RECOLLECT: Acquisition and Retention of Collective Skills in Synthetic Training Environments

2113: DESYNF: Technology for Designing Collective Training in Synthetic Environments

2.1.2 Unit Training Strategies

2121: BATTLEVIEW: Visualization of the Battlefield

2122: MOSES: Military Operational Simulation and Evaluation Systems

2.2 LAND WARFARE AND ROTARY WING TRAINING

2.2.1 Task Training Fidelity Requirements

2211: STRATA-FI: Simulation Fidelity Requirements for Cost-Effective Aviation Training

2.2.2 Combat Skills Training Methods and Strategies

2221: TANTAMOUNT: Technologies for Advanced Mounted Warfare Training

2222: ATTAIN: Air Defense Artillery (ADA) Crew Training Technologies

2223: NIGHTFIGHTER: Training Technologies for Night Operations

2.2.3 Foreign Language Tutoring Technologies

2231: MULTI-LINGUAL: Advanced Technologies for Mastering Foreign Languages

2.2.4 Safety Training Technologies and Strategies

No Exploratory Development (6.2) Tasks

TASK TITLE: VIRTUE: Virtual Environments for Combat Training and Mission Rehearsal (2111)

OBJECTIVE: To demonstrate, under controlled laboratory conditions, principles of behavioral science that exploit the emerging technology known as virtual reality (VR) for training and mission rehearsal.

APPROACH: Develop laboratory facility and conduct experiments to determine the most cost-effective methods for immersing soldiers in visual and auditory environments. Touch, force feedback, realistic weapon simulations, and whole-body movement will be included as components of virtual environments, as the technology matures. The work will be conducted in cooperation with the Navy Training Systems Center (NTSC) Virtual Environments Training Technology Program. Experiments on training, mission planning, and mission rehearsal methods for commanders, dismounted soldiers, and the Special Operations Forces (SOF), will be conducted in conjunction with either a Distributed Interactive Simulation (DIS) training site or a SOF training site.

PROGRESS:

FY92

Developed scenarios for use with VR environments

Defined parameters for near-, mid-, and far-term virtual environment interface capabilities

FY93 MILESTONES:

Establish and demonstrate VR environment research facility

Document existing behaviorally-based requirements for individual combatant simulation (ICS)

PROJECTED TECHNOLOGY:

FY94

Demonstrate capability to train individual team members using VR

FY95

Specify fidelity requirements for individualized team training

FY97

Optimal methods for training individual team members using VR

FY98

Commander and special forces team training and performance assessment methods for use with VR

FY00

Training strategies for use with VR

START DATE: FY92

END DATE: FY00

FY93 FUNDING (\$000): \$462 PROGRAM ELEMENT/PROJECT: 62785 A790

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

STRICOM/Orlando Field Unit

POC: Dr. Stephen Goldberg, (407) 380-4690; DSN 960-4690

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.5. Simulation Fidelity

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: RECOLLECT: Acquisition and Retention of Collective Skills in Synthetic Training Environments (2112)

OBJECTIVE: To model the development (from initial skill acquisition to skill mastery), performance proficiency, and retention of critical collective tasks performed in synthetic environments, particularly at the crew and small unit level. Such a model will have great utility for designing unit training programs to cope with reduced training budgets..

APPROACH: Previous research in skill acquisition and retention has focused on individual skills. Increased reliance on simulation for crew training and the planned networking of simulators for unit-level training requires the modeling of the major variables underlying collective skill acquisition. Collective tasks performed by crews and platoons will be categorized into sets of previously learned skills, such as perceptual-motor, procedural, and problem solving. M1A1 tank crews and platoons will be the initial focus. The Bradley Fighting Vehicle, and possibly an air defense system, will also be analyzed to assess the generalizability of the classification method. Non-intrusive observation, structured interviews, and performance data generated by SIMNET will be collected and analyzed. A process model will be developed that predicts the performances (response times and error type) for critical collective tasks, in terms of underlying skills/knowledge. Skill acquisition parameters in the model will project growth patterns of crew and platoon performance. The model will be refined to include company level behavior and demonstrated in conjunction with the Louisiana Maneuvers '94. Using the Mobile-SIMNET, data will be collected to track crew performance over differing periods of non-use (skill retention), so that skill retention parameters in the model can be set.

PROGRESS:

FY92

Defined the critical variables for collective skill acquisition and retention, and developed preliminary collective skill acquisition process models

FY93 MILESTONES:

Test of the model's predictive accuracy for selected crew and platoon tasks

PROJECTED TECHNOLOGY:

FY95

Quantitative process model of crew performance

FY97

Empirically verified model of the acquisition and retention of collective skills in synthetic training environments

START DATE: FY92

END DATE: FY97

FY93 FUNDING (\$000): \$545 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Automated Instructional Systems Technical Area

POC: Dr. Robert Seidel, (703) 274-8838; DSN 284-8838

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.8. Cognitive and Collective Skill Retention

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: DESYNE: Technology for Designing Collective Training in Synthetic Environments (2113)

OBJECTIVE: To design strategies and associated methods for collective training of crews and teams in real-time synthetic combat environments (e.g., Close Combat Tactical Trainer, CCTT).

APPROACH: The emergence of Distributed Interactive Simulations technology provides a unique opportunity to conduct research on individuals and teams/crews under controlled, yet realistic conditions of simulated combat. Initial experiments will be conducted to determine which training features of the CCTT facilitate skill acquisition, as measured by rate and level of skill development. Subsequent research will examine the utility of various tactical knowledge training methods within CCTT exercises. Specific research issues include: (a) methods for pairing expert crews/teams with novice crews/teams during exercises to enable imitation of effective tasks performance procedures and mentoring by experts; (b) methods for generating collective training scenarios to address specific key training needs, (e.g., varying performance difficulty level by varying the enemy threat and/or the time provided to plan and prepare); (c) instructional features (e.g., pacing, sequencing, use of massed vs. spaced practice, and type of feedback); and (d) the use of "shared mental models" to train collective tasks. Automated tools and guidelines will be developed and demonstrated that transfer the knowledge gained from these experiments to the operational designers of collective training scenarios.

PROGRESS:

FY92

Model of the expert training designer and developer (i.e. description of tasks and procedures used by experts)

FY93 MILESTONES:

Conduct experiments on instructional strategies and methods for facilitating the acquisition of collective/individual skills in DIS environments (e.g., how long should training sessions run for skill acquisition or for skill maintenance?)

PROJECTED TECHNOLOGY:

FY95

Prototype training strategies and methods that improve acquisition of collective and individual skills in DIS environments (e.g., rules for rapid learning to high levels of skill mastery)

FY96

Recommended instructional dimensions for DIS training strategies (e.g., task complexity, pacing and massing vs spacing of practice)

FY97

Demonstration of fully comprehensive DIS training strategy and associated methods

START DATE: FY92

END DATE: FY97

FY93 FUNDING (\$000): \$445 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Automated Instructional Systems Technical Area

POC: Dr. Robert Seidel, (703) 274-8838; DSN 274-8838

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: BATTLEVIEW: Visualization of the Battlefield (2121)

OBJECTIVE: Explore and demonstrate innovative training concepts and methodologies for improving the commander's ability to visualize the battlefield.

APPROACH: The research will use the data provided from highly realistic Combat Training Center (CTC) training exercises, and new, powerful computer graphical displays, along with the knowledge of experienced commanders, to develop new training technologies for commander and staff training and associated job aids. CTC data will be experimentally displayed (e.g., plan view, out-the-window, varying points-of-view) to commanders to determine how effectively these tools enable them to "visualize" the ground-truth of terrain features, friendly and enemy dispositions, and to anticipate future relationships among the forces. The "mental models" developed by expert commanders (e.g., the factors commanders take into account, their problem solving strategies and procedures, and their cognitive and perceptual skills) will be investigated to develop job aids and training strategies.

PROGRESS: New Start

FY93 MILESTONES:

Front-end analysis of battlefield preparation and operation requirements of tactical commanders and staffs

Research plan for design of commander and staff training methods and programs using CTC data and displays to support planning and operations

PROJECTED TECHNOLOGY:

FY95

Training methods using computer graphic techniques to enhance visualization of the battlefield

FY99

Battlefield visualization training methods, programs and job aids for commander and staff

START DATE: FY93

END DATE: FY99

FY93 FUNDING (\$000): \$184 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Presidio of Monterey Field Unit

POC: Dr. Howard McFann, (408) 647-5316; DSN 878-5316

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: MOSES: Military Operational Simulation and Evaluation Systems (2122)

OBJECTIVE: To design and demonstrate a decision support methodology that allows commanders to design improved Army training strategies for brigade and above by comparing mixes of training alternatives, based on data from computer-supported battle rehearsals and simulations.

APPROACH: Training management models using computer-supported methods will be developed which can help commanders decide on the most effective strategy to train and prepare units for combat. The first stage of this effort will be to develop (or adapt), apply, and demonstrate techniques for identifying and defining tasks for large unit training, assessment, and feedback. This includes: (a) deriving lists of unit collective tasks and candidate assessment/feedback techniques, and (b) having SME's screen matches of tasks and feedback techniques to test their meaningfulness, relevancy, and applicability to unit training practices. The next step will be to design, test and demonstrate methodologies for generating and evaluating tradeoffs among mixes of training alternatives (e.g., training aids, devices, simulations, and simulators (TADSS)), as a function of costs and performance benefits. Current and evolving technologies, such as Distributed Interactive Simulations (DIS), interactive models, and I-MILES, will be mapped to training events and tasks, by using statistical approaches, such as response surface analysis and linear programming.

PROGRESS:

FY92

Methodology to identify task clusters for brigade training strategies

FY93 MILESTONES:

Develop initial set of unit performance indicators from combat data

List of empirically-based tasks and task clusters using a brigade offensive and defensive mission, including air support

List of unit performance indicators and feedback procedures using a brigade example

PROJECTED TECHNOLOGY:

FY95

Computer program for matricing interrelated brigade tasks and task clusters to performance indicators, training events, and training resources (e.g., TADSS)

FY96

Methodology for commanders to use in developing large unit cost-effective training program plans and schedules

START DATE: FY92

END DATE: FY96

FY93 FUNDING (\$000): \$513 PROGRAM ELEMENT/PROJECT: 62785 A790

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Battlefield Training Assessment Technical Area

POC: Dr. Franklin Moses, (703) 274-8694; DSN 284-8694

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: STRATA-FI: Simulation Fidelity Requirements for Cost-Effective Aviation Training (2211)

OBJECTIVE: To experimentally determine essential simulation fidelity requirements for specified critical task training functions of aviation simulators.

APPROACH: The costs and training effectiveness of flight simulators are largely influenced by their levels of simulation fidelity. Thus, it is of vital importance to Army aviation to determine the value of different levels of fidelity for initial skill training and sustainment training of critical Army aviator tasks. Using ARI's state-of-the-art Simulator Training Advanced Testbed for Aviation (STRATA) as the primary research tool, all parameters of consequence to simulator design will be varied to determine their relative contribution to skill development and retention for rotary wing aviation tasks. This research will be accomplished on a task by task basis to determine the level of fidelity required to support practice on current skills or training for the acquisition of new skills in the simulator. Findings will allow training systems designers to define the lowest costs for elements of simulation systems required to effectively train the full spectrum of Army aviation tasks. In addition, experiments will be performed to assess the degree to which simulator design features affect transfer of training to actual aircraft task performance. Experiments will address the level of modularity and complexity required for networked and combined arms combat training.

PROGRESS:

The STRATA system was assembled, tested, and accepted at the contractor's facility, and delivered to Fort Rucker in May 1992

FY93 MILESTONES:

Initiate aerodynamic modeling fidelity research using STRATA
Conduct research on STRATA scene content requirements

PROJECTED TECHNOLOGY:

FY95

Empirically-based scene content requirements for training helicopter flight tasks in simulators

FY96

Display resolution requirements for task training in helicopter flight simulators

FY98

Aviation task training requirements for using helmet mounted displays

FY00

Visual and other sensory requirements for training aviation tasks using networked virtual reality training environments

START DATE: FY93

END DATE: FY00

FY93 FUNDING (\$000): \$2288 PROGRAM ELEMENT/PROJECT: 62785
A790/A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Rucker Field Unit

POC: Mr. Charles Gainer, (205) 255-4404; DSN 558-4404

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.5. Simulation Fidelity

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: TANTAMOUNT: Technologies for Advanced Mounted Warfare Training (2221)

OBJECTIVE: To design, develop and demonstrate simulation-based training and performance assessment technologies for commanders of advanced mounted combined arms teams, focusing on tasks which employ new battlefield sensors and new command, control and communication (C³) systems.

APPROACH: New training technologies will be designed, developed and demonstrated to prepare operators and commanders to take maximum tactical advantage of the advanced capabilities afforded by new C³ systems designed for use on fast-paced, dispersed battlefields. This research will: a) identify anticipated high-tech sensors and C³ components, b) specify the simulation capabilities required to immerse operators and commanders in this warfighting environment, c) determine tasks and training needs associated with these new systems, d) develop and demonstrate technologies for training the tasks required, and e) develop measures to assess performance and provide feedback using distributed soldier-in-the-loop simulation.

PROGRESS:

FY92

Combat Vehicle Command and Control Systems: Training implications based on company level simulations

Guidebook for research on Distributed Interactive Simulation (DIS) utilities developed to support conduct of training, performance evaluation, and training feedback

FY93 MILESTONES:

Identify the C³ and battlefield sensor components of the future that will have the greatest influence on command group performance

Specify the distributed soldier-in-the-loop training simulation required for mounted combined arms operations

PROJECTED TECHNOLOGY:

FY96

"Electronic Sandtable": A training technology for information integration on the future battlefield

FY97

"Electronic Sandbox": A training technology for information distribution on the future battlefield

START DATE: FY92

END DATE: FY97

FY93 FUNDING (\$000): \$462 PROGRAM ELEMENT/PROJECT: 62785 A790

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Knox Field Unit

POC: Dr. Barbara Black, (502) 624-3450; DSN 464-3450

SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: **ATTAIN: Air Defense Artillery Crew Training Technologies (2222)**

OBJECTIVE: To demonstrate theory-based training principles in the design of new training and job-aiding technologies for tactical air defense artillery (ADA) command, control, communication, and intelligence (C³I) of force and engagement operations.

APPROACH: Recent advances in ADA and C³I systems have the potential for inundating ADA crews with large amounts of time-sensitive information and the need to perform multiple, complex tasks under pressure. A front-end analysis (FEA) of task training requirements will be conducted to include: (1) defining the role of the platform commander as system manager, (2) defining the individual and interactive team tasks of the operators and equipment maintainers. Based on results of the FEA, an experimental training support system will be designed. An ADA training research facility and empirically-based, engagement decision support model (EDSUM) will be developed as a training support and job-aid. Data will then be collected to demonstrate proposed new techniques to be used in training and as job aids.

PROGRESS:

FY92

Developed and validated ADA command and control (C²) performance framework for classifying C³I information and ADA task requirements

FY93 MILESTONES:

Develop ADA C² engagement decision support model (EDSUM) for training

Establish ADA training research facility

PROJECTED TECHNOLOGY:

FY95

ADA Engagement Decision Support Model (EDSUM)

FY97

Experimental decision aids and engagement training technologies for ADA crew and team chiefs

START DATE: FY92

END DATE: FY97

FY93 FUNDING (\$000): \$525 PROGRAM ELEMENT/PROJECT: 62785 A790

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Bliss Field Unit

POC: Dr. Michael Strub, (915) 568-4491; DSN 978-4491

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: NIGHTFIGHTER: Training Technologies for Night Operations (2223)

OBJECTIVE: To develop and demonstrate training concepts and technologies that will improve the ability of Light Infantry units to fight at night.

APPROACH: The research will focus on the development of a new front-end analysis technology that is necessary for rigorously identifying the skills needed for proficient training and performance of critical missions, such as night attacks and patrols. A front-end analysis (FEA) methodology will be developed that will extend the observation of night operations to analysis of planning and preparation phases of battles. Night vision goggles and other visual aiding devices (e.g., thermal sights) will be explored for use in conducting the FEA based on observation of units and their leaders performing their tasks at night. Units will be observed during routine and experimentally arranged night training. Unit trainers and soldiers will be interviewed to identify problems and possible solutions. Deficiencies in unit and individual performance at night will be identified from field observation and prior research. Experimental training and job aiding techniques that enhance skill acquisition and performance of critical nightfighting tasks will be developed and demonstrated.

PROGRESS:

FY92

Night observations of field training in active units and Infantry School training were recorded and analyzed

Front-end analysis procedures for identifying the critical problem areas at night have been pilot tested and data were obtained from two Light Infantry units

FY93 MILESTONES:

Refine and complete front-end analysis methodology for night operations tasks

PROJECTED TECHNOLOGY:

FY94

Front-end analysis methodology for night operations tasks

FEA for sample light infantry nighttime missions

FY98

Experimental training techniques for enhancing performance at night

FY99

Demonstration of training technology systems which facilitate acquisition and sustainment of the commander, unit and individual skills needed to perform critical night operations tasks

START DATE: FY92

END DATE: FY99

FY93 FUNDING (\$000): \$332 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Benning Field Unit

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: MULTI-LINGUAL: Advanced Technologies for Mastering Foreign Languages (2231)

OBJECTIVE: To develop and demonstrate innovative instructional approaches and tutoring technologies which will improve acquisition and retention of foreign language skills, based on an improved understanding of the processes by which native English speakers acquire and retain second languages.

APPROACH: A set of experiments will be conducted to: (a) Develop theoretical frameworks and cognitive models of second language acquisition and retention; (b) Identify the major dimensions of second language acquisition and retention, and develop a computer-based research device (tutor) to be used to vary: tutoring rules (diagnosis, prescription, and remediation); student error feedback (e.g., frequency, type); immersion variables (e.g., dialogs, scenarios); modalities (visual, auditory); and cognitive task demands (e.g., exercise type); (c) Develop novel instructional approaches utilizing combinations of these dimensions in computer-based tutors for second language acquisition and retention.

PROGRESS:

FY91-92

Developed a grammatical error analysis method for selecting questions to be included in a language tutor

Developed method for using a parser to create a dynamic student model

Developed prototype, first generation, German language tutor as research environment for studying acquisition and retention

FY93 MILESTONES:

Survey state-of-the-art of second language acquisition and retention theories and technologies

Conduct experiments on acquisition and retention with the first generation German language research tutor

PROJECTED TECHNOLOGY:

FY94

Prototype, second generation, Spanish and Arabic tutors for research on acquisition and retention within and across languages

FY95

Tutoring technology incorporating experimentally-proven combinations of instructional variables

START DATE: FY89

END DATE: FY95

FY93 FUNDING (\$000): \$830 PROGRAM ELEMENT/PROJECT: 62785 A791

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Automated Instructional Systems Technical Area

POC: Dr. Robert Seidel, (703) 274-8838; DSN 274-8838

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.6. Foreign Language Skill Training

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

APPENDIX C

Advanced Development

The following data elements are used to describe the advanced development (6.3A) tasks included in ARI's FY 1993 research program:

TASK TITLE
OBJECTIVE
APPROACH
ARI TECHNOLOGY TRANSFER TO:
TRANSFER MECHANISM
IMPACT
RELATION TO PRESENT INDUSTRY INVESTMENT
FY93 MILESTONES
START DATE/END DATE
FY93 FUNDING
PROGRAM ELEMENT/PROJECT
DIVISION
TECHNICAL AREA/FIELD UNIT
ACTIVITY (POC/TELE #)
SPONSOR
ARI
SCIENCE & TECHNOLOGY OBJECTIVE (STO)
OSD KEY TECHNOLOGY AREA
OSD SCIENCE & TECHNOLOGY THRUST

FY93 Advanced Development (6.3A) Tasks

1. MANPOWER AND PERSONNEL R&D

1.1 HUMAN RESOURCE DEVELOPMENT

1.1.1 Leader Development

1112: CIVILIAN LEADERS: Army Civilian Supervisory Selection Methods

1113: STARS: Senior Leader Development

1.1.2 Organizational Performance

1122: COMMAND STAFF: Command Staff Performance Enhancement

1.2 SELECTION AND CLASSIFICATION

1.2.1 General Selection and Classification Techniques

1212: CAREER FORCE: Building the Career Force

1213: NEW MOS: Military Occupational Specialty (MOS) Restructuring

1.2.2 Specialized Selection & Classification Techniques

1222: TOMORROW'S WARRIOR: Army Selection and Classification: General Models and MOS Specific Needs

1223: SPECIAL FORCES: Improving Special Forces Personnel Development

1.3 MANPOWER AND PERSONNEL POLICY RESEARCH

1.3.1 Recruitment, Retention and Reenlistment

1312: ARMY FAMILIES: Family Factors in Maintaining Readiness During Downsizing

1.3.2 Manpower and Personnel Modeling

No Advanced Development (6.3A) Tasks

**TASK TITLE: CIVILIAN LEADERS: Army Civilian Supervisory
Selection Methods (1112)**

OBJECTIVE: Develop selection tools for first- and second-line civilian supervisors, and establish a longitudinal data base for tracking the impact of policies and programs within the civilian work force.

APPROACH: Following task analysis of first-level civilian supervisors' jobs, two types of selection instruments are being developed and assessed for adverse impact: an easily scorable in-basket exercise and biographical data/temperament assessment instruments. In addition, standardized selection interview procedures are being developed. These instruments will be field tested and subjected to concurrent validation with a nation-wide sample. The resulting data base will be used for subsequent predictive validation.

**ARI TECHNOLOGY TRANSFER TO: Director of Civilian Personnel
(DCP), ODCSPER**

TRANSFER MECHANISM: The current screening process uses information from the SF 171 and from the written SKAPs provided by the candidate. A structured interview guide was turned over to DCP in FY92 and is currently undergoing a supplementary field test. It will be used as a job aid for selection officials in constructing, conducting, and scoring job interviews. The other new tools (in-basket exercise and biodata/temperament instrument) will be validated in FY93 and can then be added to the screening process by local Civilian Personnel Offices (CPO). The CPO will administer the instruments and provide a profile for each applicant to the selecting official. The Civilian Survey Longitudinal Data Base, will be completed in FY93 and will be used by the DCP to monitor long term trends in Army civilian climate. In addition to its use on an annual basis to report to Congress, the Army, and operating CPOs throughout the world, this data base will be used as a means to assess the impact of civilian personnel policy decisions.

IMPACT: Based on preliminary validity findings and estimates of the effect of leader effectiveness on productivity from the research literature, it is estimated that the use of these tools will, over time, improve civilian work force productivity up to a level of 4%, for an ultimate annual savings estimated at \$800M (assuming a civilian work force of 400,000 at an annual average cost of \$50K each). In addition, improved supervisory leadership, together with systematic improvement of the Army's civilian personnel management system, will greatly enhance the ability of the Army to attract and retain quality civilian personnel.

RELATION TO PRESENT INDUSTRY INVESTMENT: In-basket technology is a standard assessment center tool in the private sector. The technology now being developed by ARI will permit scoring an in-basket using multiple choice items rather than through content analysis of the exercise by a testing expert, making it less expensive and time consuming to score and allowing for machine scoring. Biographical data instruments also have a history of use in the private sector. However, the instrument under development by ARI will use a new approach to rational keying, which is an emerging technology. If successful, it will make a major contribution to the value of these instruments as now used in the private sector. Leading-edge biodata work is being done by Dr. Michael Mumford at George Mason University; this work is partially DoD-funded and is feeding directly into ARI's program.

FY93 MILESTONES:

Report on concurrent validation of selection instruments
Report on second-level supervisor job analysis prototype
Report on civilian Biennial Survey Data Analysis
Data collection for predictive validation of selection instruments

START DATE: FY87

END DATE: FY93

FY93 FUNDING (\$000): \$218

PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Strategic Leadership Technical Area

ACTIVITY: ODCSPER (DCP)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

TASK TITLE: STARS: Senior Leader Development (1113)

OBJECTIVE: To identify critical performance requirements and competencies necessary for successful strategic leadership.

APPROACH: Interviews with one-, two-, three-, and four-star general officers were conducted. Content analysis of the interview data base laid out critical performance requirements, and competencies necessary for successful strategic leadership. These include technical and tactical competencies, long range planning, and envisioning (what the Army needs to "look like", and how it will operate, in 15-20 years). Analysis of the interviews across levels clearly indicated a progressively more profound development of critical thinking skills. These include both cognitive and metacognitive components. The findings on cognitive and metacognitive skills will be incorporated into specifications for simulation development at Senior Service College (SSC) level. In addition, training is being developed on group decision processes for use at SSC level to develop critical individual thinking skills.

ARI TECHNOLOGY TRANSFER TO: Army War College (AWC), ODCSOPS

TRANSFER MECHANISM: The initial product, delivered to the U.S. Army War College (AWC) in FY88, was a special text based on DA PAM 600-80, containing findings about the nature of three- and four-star job performance requirements. This was used to structure much of the first course in the core curriculum at the College. The completed General Officer Interview Data Base will be delivered to AWC in FY93 and will be used for instructional and reference purposes. The second FY93 product to be delivered will be specifications for simulation technology explicitly designed to develop the cognitive skills required at the topmost levels in the Army. These specifications will be implemented as part of the College's simulation center, as academic instruction shifts more toward experiential learning.

IMPACT: The War College instruction and simulation technology made possible by this research will speed the development of the leadership and decision skills of mid-career Army leaders and enhance their ability to operate in a distributed decision environment across the spectrum of conflict.

RELATION TO PRESENT INDUSTRY INVESTMENT: Other research on strategic leadership development is being done, for example, at the Center for Creative Leadership (CCL) at Greensboro, N.C. This research incorporates and expands findings from CCL and other academic institutions and applies them in the unique, strategic leader environment of the military. No one else in industry, academia, or DoD performs similar research. There is no known research concerned with developing simulation technology explicitly designed to build the cognitive skills on which high-level military performance depends.

FY93 MILESTONES:

Report on cross-level analysis of strategic thinking skills

Specification of simulation technology to enhance
warfighting thinking/decision skill development

Tryout of group decision process training at SSC

START DATE: FY86'

END DATE: FY93

FY93 FUNDING (\$000): \$156 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Strategic Leadership Technical Area

ACTIVITY:

ODCSOPS (AWC)

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

TASK TITLE: COMMAND STAFF: Command Staff Performance Enhancement (1122)

OBJECTIVE: To determine key factors in the development of command staff groups which affect success or failure in command and control exercises, and to validate recommended training strategies, organizational designs, and tools for achieving effective command and control performance.

APPROACH: This research will develop and implement a command and control (C2) performance database containing observations and lessons learned from Battle Command Training Program (BCTP) exercises as well as the data from ARI's Army Command and Control Evaluation System (ACCES) project. The database of scenario and performance data will be established in conjunction with the Center for Army Lessons Learned to provide a performance effectiveness baseline. Changes in simulation-based training strategies and organizational structure, and other changes suggested by data base analysis, supporting exploratory development research, and Army proponents, will be implemented in selected units for evaluation and validation.

ARI TECHNOLOGY TRANSFER TO: Combined Arms Command - Training (CAC-T), TRADOC

TRANSFER MECHANISM: Beginning in FY93, ARI research will provide the CAC DCG-Training with information required to develop an effective training strategy for division and corps command staff groups, for incorporation into the Combined Army Training Strategy (CATS). The Army Command and Control Evaluation System (ACCES) methodology was adopted by the Operational Test and Evaluation Command (OPTEC) in FY91 as their primary tool for evaluation of the Army Tactical Command and Control System; preliminary baseline data were collected at a corps exercise in the fall of 1991. ACCES will be available for adoption by the Battle Command Training Program (BCTP) in FY94 as a tool for guiding observations and data collection by BCTP observers. At the same time, ACCES will support After Action Reviews (AARs) for the training audience. And, the Center for Army Lessons Learned (CALL) will, beginning in FY93, issue bulletins on C2 Lessons Learned based on ACCES data. CALL is also planning to use the ARI C2 Performance Database (C2db) to identify significant issues and lessons learned emerging from BCTP and other exercises, beginning in FY94. This, in turn, could lead to changes in tactical staff doctrine, organization, and procedures by the Command and General Staff College.

IMPACT: The combination of objective methods for assessing C2 performance, the database of C2 performance indicators which provides a baseline for comparison, and validated methods and procedures for developing and maintaining effective C2 organizations, will allow the systematic adaptation of Army C2 to technological and doctrinal change. Research products will support changes in staff training, leader development, command

staff design, and command staff training strategies.

RELATION TO PRESENT INDUSTRY INVESTMENT: This research is unparalleled in industry or the other services. Performance effectiveness measures typically have not gone beyond the easily quantifiable "bottom line" outputs from a balance sheet or war game. ACCES and the related work under this task provide a unique opportunity to incorporate behavioral factors to command performance modeling and assessment systems.

FY93 MILESTONES:

Validate assessment measures, procedures, and techniques for unit leaders to build and sustain unit cohesion and motivation

Review and evaluation of techniques and procedures for organizational design

Review and evaluation of research addressing the concept of span of control

Needs analysis for C2 performance database

START DATE: FY93

END DATE: FY95

FY93 FUNDING (\$000): \$1868 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Leavenworth Field Unit
Fort Bliss Field Unit
Leadership and Organizational Change Technical Area

ACTIVITY:

TRADOC (CAC-T)

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.9. Leadership and Command Staff Training

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

TASK TITLE: CAREER FORCE: Building the Career Force (1212)

OBJECTIVE: Develop improved personnel procedures which will (1) select the right people, (2) put these people in the jobs they are most suited for, and (3) retain and promote the right people.

APPROACH: This research continues to track enlisted soldiers originally tested on general and specific aptitude measures, and then assessed on training and job performance during their first tour and into their second tour. This task will (1) refine and administer second tour measures of soldier performance; (2) conduct research linking entry test performance to performance at the end of training, during first tour, and in second tour, in order to identify the best combination of tests for effective selection and classification; and (3) determine the best measures to use for reenlistment and promotion decisions.

ARI TECHNOLOGY TRANSFER TO: Director of Military Personnel Management (DMPM), ODCSPER

TRANSFER MECHANISM: Results of a previous major effort, new aptitude area composites and the validation of the Army's selection and classification measures against first-tour performance were delivered in FY84 and FY86, respectively. For the current task, ARI will deliver, to DMPM ODCSPER, new selection and classification tests (incorporating psychomotor and spatial measures), with recommendations for their implementation, in FY94. ARI will also deliver to DMPM ODCSPER, in FY94, a recommended set of ratings and hands-on, knowledge, and administrative measures for predicting second tour performance, and a recommended set of procedures for implementing those measures during first tour.

IMPACT: This effort will substantially improve a selection and classification system which ARI in 1989 estimated produces annual benefits to the Army of \$250 million in terms of improved performance. Benefits will also accrue from improved promotion and reenlistment decisions. Those soldiers who are chosen as junior NCOs provide leadership and continuity critical to the Army's success on the battlefield. This effort will link those decisions to proven indicators of future success.

RELATION TO PRESENT INDUSTRY INVESTMENT: The Army's effort to predict future performance is the most comprehensive of its kind. Somewhat less ambitious efforts focussing on first tour performance have been conducted by the other Services. The Army has coordinated its effort with those of the other Services to obtain maximum benefit for all concerned. Implementation of new tests will be based on a joint assessment of which tests add the most to prediction of overall performance. The Army's examination of prediction of second tour performance to improve reenlistment and promotion procedures has made use of available industry techniques for predicting leadership to the extent appropriate, but the development of new, state of the art tools

has also been required.

FY93 MILESTONES:

Link selection and classification tests to measures of combat performance

Develop formal model of second tour performance

Link new selection and classification tests to second tour performance

Identify best predictors of in-service attrition

START DATE: FY89

END DATE: FY95

FY93 FUNDING (\$000): \$2084 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Selection and Classification Technical Area

ACTIVITY:

DCSPER (DMPM)

ARI

POC/TELEPHONE

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Division
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Dr. Michael Rumsey
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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.1. Soldier Assignment

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

**TASK TITLE: NEW MOS: Military Occupational Specialty (MOS)
Restructuring (1213)**

OBJECTIVE: To develop guidelines and procedures for identifying and evaluating job restructuring options for Army Military Occupational Specialties (MOSs) and Career Management Fields (CMFs).

APPROACH: a. Develop methods to assess comparability of jobs in terms of (1) knowledge required for task performance, (2) required abilities, and (3) task difficulty, importance, and frequency. b. Determine resource constraints which impact on restructuring decisions. c. Develop methods to combine information on job comparability and resource constraints to guide restructuring decisions.

ARI TECHNOLOGY TRANSFER TO: U.S. Total Army Personnel Command (PERSCOM), ODCSPER

TRANSFER MECHANISM: ARI will deliver, to PERSCOM in FY95, a prototype MOS restructuring decision support technology, consisting of tools to assess and integrate into MOS design: (1) required knowledge, (2) required abilities, (3) task difficulty, importance and frequency, and (4) relevant resource constraints. ARI will evaluate and make needed changes with PERSCOM to deliver an operational product in FY97.

IMPACT: The developed job restructuring methods and procedures will result in MOS and CMF design decisions that will help optimize the Army's ability to adequately man the current and proposed inventory of systems within the available supply of soldiers.

RELATION TO PRESENT INDUSTRY INVESTMENT: This research builds on previous government conducted or funded research on job-related abilities and job groupings, but no comparable research effort in industry has been identified.

FY93 MILESTONES:

Complete MOS Restructure Assessment for Field Artillery

Complete MOS Feasibility Analyses for Field Artillery

START DATE: FY89

END DATE: FY97

FY93 FUNDING (\$000): \$438 **PROGRAM ELEMENT/PROJECT:** 63007 A793

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Selection and Classification Technical Area (Brooks AFB)

ACTIVITY:

ODCSPER (PERSCOM)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.1. Soldier Assignment

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

TASK TITLE: TOMORROW'S WARRIOR: Army Selection and Classification: General Models and MOS-Specific Needs (1222)

OBJECTIVE: (1) Determine the best multi-stage model for Army selection and classification, including the activities which can most effectively be conducted at each stage. (2) Develop the best selection and classification procedures for classes of MOS with special needs, such as armor, infantry, and aviation.

APPROACH: a. Research to develop the best multi-stage model for Army selection and classification will: (1) describe existing procedures in terms of testing stages and testing activities, across all Services; (2) formulate alternative models, continuing to focus on testing stages and activities; and (3) evaluate the alternative models in terms of costs and benefits. b. Research on specific MOS groupings includes: (1) refinements of psychomotor, spatial and temperament measures; (2) trial use of psychomotor and spatial tests in infantry, armor, and field artillery specialties; and (3) development and evaluation of new measurement tools for aviator selection.

ARI TECHNOLOGY TRANSFER TO: Director of Military Personnel Management (DMPM), ODCSPER

TRANSFER MECHANISM: ARI will deliver to DMPM ODCSPER in FY94 recommendations for improved testing procedures, including cost-benefit information, which specify how particular testing procedures might best be used at each stage of the accession and training process; OASD will be briefed on these findings as well. ARI will also deliver to DMPM DCSPER in FY94 results from the field trial use of psychomotor and spatial tests in infantry, armor, and field artillery specialties with recommendations on how these tests might best be incorporated into the existing selection and classification system. For example, which tests are best suited for Army-wide implementation and which should be implemented by MOS grouping or Career Management Field? For the portion of the task dealing specifically with aviation selection, ARI will deliver to the US Army Aviation Center, by FY99, revised integrated aviation selection and classification systems.

IMPACT: Improved selection and classification procedures such that each individual's abilities will be optimally matched to MOS requirements. Improved matching will result in minimal attrition and optimal job performance.

RELATION TO PRESENT INDUSTRY INVESTMENT: The Army's effort to determine the best implementation model from its perspective is being conducted in coordination with a related effort by the Department of Defense. The portion of this task focussing on changes in particular MOS will make use of the technological development generated by the Army in a recent effort (Project A) as well as new developments in industry and academia in personality testing, adaptive testing, cognitive testing and artificial intelligence.

FY93 MILESTONES:

Compare Services' existing S&C systems and DOD's proposed modifications with the Army's system and plans

Develop new forms for Assembling Objects Test

Create new coaching-resistant Assembling Objects items

START DATE: FY89

END DATE: FY99

FY93 FUNDING (\$000): \$487 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Selection and Classification Technical Area

ACTIVITY:

QDCSPER (DMPM)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.1. Soldier Assignment

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

TASK TITLE: SPECIAL FORCES: Improving Special Forces Personnel Development (1223)

OBJECTIVE: Develop methods, models, and strategies to enhance the ability of Special Forces to recruit, select, train, and retain highly performing soldiers who have a high propensity for a Special Forces career.

APPROACH: Adapt related, Army-wide work from a broad spectrum of research areas to the unique Special Forces (SF) population, and develop research tools specifically geared to SF issues. ARI first conducted a needs analysis to identify important research issues for SF personnel development. Based on those findings and sponsor priorities, ARI is developing experimental recruiting strategies, methods, handbooks, and guides. New selection devices, MOS assignment models, assessor training programs, and retention strategies and programs are also being developed in this effort.

ARI TECHNOLOGY TRANSFER TO: U.S. Army Special Operations Command (USASOC)

TRANSFER MECHANISM: The Special Warfare Center and School (SWCS) will use ARI products in Special Forces recruiting, assessment, and job assignments. In FY92, a Physical Training Handbook was developed to help new recruits to prepare for SWCS selection and assessment, and is now part of the Special Forces recruiting packet. SWCS will use the assessor training program to be developed in FY93 to strengthen the skills of the assessors who rate candidates' performance in the Special Forces selection program. SWCS will also use the MOS allocation model to be developed in FY94 to match soldiers to Special Forces jobs.

IMPACT: This research will provide USASOC with better prepared recruits, improved assessment procedures, and improved soldier performance through better person-MOS matching and the retention of highly performing soldiers. Many of the findings and implementation strategies should also be transferable to the rest of the Army, yielding enhanced soldier performance overall.

RELATION TO PRESENT INDUSTRY INVESTMENT: The MOS allocation model for Special Forces benefits from earlier efforts to develop an Army-wide enlisted personnel classification and allocation system. Pertinent University work in classification and operations research is used; however, there is no industry equivalent to Special Forces research that is not sponsored by USASOC or other government agencies.

FY93 MILESTONES:

- Develop and document a longitudinal personnel database
- Evaluate the impact of a physical training handbook for recruiting
- Collect and analyze interview/survey data on information needs of Special Forces soldiers and spouses
- Collect and analyze interview/survey data on team assessment events
- Develop an assessor training program
- Complete first phase of analyses of Special Forces jobs
- Develop MOS allocation model
- Identify predictors of success in Special Forces training

START DATE: FY91

END DATE: FY94

FY93 FUNDING (\$000): \$723 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Leadership and Organizational Change Technical Area
Manpower and Personnel Policy Research Technical Area
Selection and Classification Technical Area

ACTIVITY:

USASOC

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.1. Soldier Assignment

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

**TASK TITLE: ARMY FAMILIES: Family Factors in Maintaining
Readiness During Downsizing (1312)**

OBJECTIVE: To increase family adaptation to military life and eliminate family-related barriers to individual and unit readiness.

APPROACH: This project has used literature searches, field visits, focus groups, analysis of existing data, and world-wide surveys to gather information on soldiers, their families, and Army programs, policies, and practices that affect them. The final phase of this research will explore how families are likely to change as the Army becomes smaller and CONUS-based.

ARI TECHNOLOGY TRANSFER TO: U.S. Army Community and Family Support Center (USACFSC), ODCSPER

TRANSFER MECHANISM: The U.S. Army Community and Family Support Center, the principal sponsor, used research analyses of (1) the Annual Survey of Army Families in FY88 and (2) the Survey of Soldiers and Families in FY90 to target populations for intervention, and to restructure CFSC programs and services with respect to the characteristics, problems, and coping abilities of the targeted groups. The analyses of family patterns and adaptation and analyses of the impact of families on retention and readiness were delivered in FY92. Downsizing and home basing analyses will be delivered in FY94.

IMPACT: To support the Army Family Action Plan and USACFSC through research on ways to (1) Improve methods for increasing family adaptation to Army life, (2) enhance retention planning capabilities for managing evolving force changes, and (3) design more cost-effective family programs for the CONUS-based, downsized, home-based Army.

RELATION TO PRESENT INDUSTRY INVESTMENT: Similar research on family support and adaptation/coping issues is ongoing in the other services and in civilian universities and has been coordinated with this project. Research at the University of Maryland, The University of North Carolina, and Iowa State University concerning families experiencing economic loss is particularly relevant to Army families and downsizing. Research under this task is unique in its consolidation of data into a model that enables examination of the reciprocal relationships between work (both military and civilian) and family adaptation/coping.

FY93 MILESTONES:

Summaries of Army Family Research Program findings

Analysis of the effects of downsizing on families and soldier careers

Identification of predictors of family adaptation to Army life

START DATE: FY86

END DATE: FY94

FY93 FUNDING (\$000): \$217 PROGRAM ELEMENT/PROJECT: 63007 A792

DIVISION: Manpower and Personnel Research Division

TECHNICAL AREA/FIELD UNIT:

Leadership and Organizational Change Technical Area

ACTIVITY:

TRADOC (USACFSC)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO): N/A

OSD SCIENCE AND TECHNOLOGY THRUST:

#8 - Sharpening the Warriors' Edge

FY93 Advanced Development (6.3A) Tasks

2.0 TRAINING SYSTEMS R&D

2.1 UNIT COLLECTIVE TRAINING STRATEGIES

2.1.1 Training Strategies for Synthetic Environments

2114: SYNTRAIN: Development of Advanced Training Technologies for Distributed Interactive Simulation (DIS) Systems

2.1.2 Unit Training Strategies

2123: BATTLESTAFF: Battle Staff Training and Integration

2124: STRONGARM: Strategies for Training and Assessing Armor Commanders' Performance with Devices and Simulations

2125: TRAIN-UP: Technology-based Reserve Component (RC) Training Strategies

2126: COMBAT: Combined Arms Training Strategies

2.2 LAND WARFARE AND ROTARY WING TRAINING

2.2.1 Task Training Fidelity Requirements

No Advanced Development (6.3A) Tasks

2.2.2 Combat Skills Training Methods and Strategies

2224: AVIATES: Aviation Training Strategies for Improving Combat Readiness

2225: IMPACT: Innovative Methods for Providing Army Classroom Training

2.2.3 Foreign Language Tutoring Technologies

No Advanced Development (6.3A) Tasks

2.2.4 Safety Training Technologies and Strategies

2241: SAFETRAN: Training Strategies and Systems for Aviation Safety

TASK TITLE: SYNTRAIN: Development of Advanced Training Technologies for Distributed Interactive Simulation (DIS) Systems (2114)

OBJECTIVE: To develop and demonstrate a training and performance measurement and feedback design technology that takes full advantage of current and emerging distributed interactive simulation (DIS) systems to improve the effectiveness and efficiency of Combined Arms Unit Training (i.e., design the DIS component of the Combined Arms Training Strategy, CATS).

APPROACH: Distributed Interactive Simulation, or DIS, provides the Army with an opportunity to increase training readiness while reducing costs for live ammunition, fuel, and weapons systems maintenance, and for avoiding real-world safety hazards. However, DIS cannot be designed to recreate the physical conditions found in field training or in combat operations. This effort will develop the training design principles to optimize the cost and training effectiveness of DIS. An ARI-developed Unit Performance Assessment System (UPAS), a methodology for measuring performance and providing training feedback in networked simulators, will serve as a basis for further research. Lessons Learned from its implementation will guide the development of data collection and After Action Review (AAR) aids for the Close Combat Tactical Trainer (CCTT). Investigations will determine how factors present or absent in DIS and in other training environments, such as the National Training Center (NTC), or the PRIME Range at the CMTC, affect performance capabilities for platoon level missions. Research will determine how air defense artillery (ADA) and signal communications should be incorporated into close combat simulations to increase the realism and effectiveness of DIS training. Incorporation of results of other exploratory development programs on effective DIS instructional features, feedback, sequencing and pacing, and use of massed vs. distributed practice (e.g., the DESYNE project) will form the basis of a methodology for developing prototype training programs and their scenarios.

ARI TECHNOLOGY TRANSFER TO: Simulation, Training and Instrumentation Command (STRICOM), AMC; TRADOC System Manager for Combined Arms Tactical Trainer (TSM CATT), TRADOC

TRANSFER MECHANISM: In FY92, the prototype UPAS was accepted in OSD as the design objective for the DOD DIS performance measurement standard, and recommended for implementation with SIMNET by TSM, CATT. In FY93, UPAS software and user's guide for collecting and analyzing data from SIMNET will be transferred to STRICOM and TRADOC for implementation. In FY96, guidance for generating realistic tactical scenario options for training in CCTT, to include ADA and signal communications variables will be transferred to STRICOM and TRADOC. Prototype DIS training modules will be transferred to demonstrate the methodology - for Special Operations Forces mission planning in FY97; and for dismounted infantry in FY98.

By FY99, guidelines for employing effective instructional features and strategies will be incorporated in a tested and validated DIS training support package, for use by DIS training and materiel developers.

IMPACT: Results of this research task will help STRICOM and TRADOC to ensure that the CCTT and other DIS training systems provide units with the simulated operational experiences that meet their training needs.

RELATION TO PRESENT INDUSTRY INVESTMENT: Industry is not supporting research on training design principles that will improve DIS training effectiveness.

FY93 MILESTONES:

Design advanced concepts for improving UPAS capability to support this AAR

Initial design concept for enhancing realism of DIS by including communication performance variables

START DATE: FY92

END DATE: FY99

FY93 FUNDING (\$000): \$817 PROGRAM ELEMENT/PROJECT: 63007
A793/A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

STRICOM/Orlando Field Unit
Fort Bliss Field Unit
Fort Gordon Field Unit

ACTIVITY: AMC (STRICOM)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

**TASK TITLE: BATTLESTAFF: Battle Staff Training and Integration
(2123)**

OBJECTIVE: To develop and demonstrate innovative staff training strategies and performance assessment methodologies to enhance maneuver battalion readiness for Airland Operations.

APPROACH: A systematic analysis of current and projected Joint Readiness Training Center/National Training Center (JRTC/NTC) observer data collection procedures, processing capabilities, and command requirements will support the design of an improved staff performance assessment methodology to be used in the field (e.g., at JRTC). A computer-based staff training program will be developed and evaluated. The relative performance of units using prototype training programs and products will be evaluated by employing JRTC observer/controllers' performance assessment of units training in the field to determine program effectiveness.

ARI TECHNOLOGY TRANSFER TO: Combined Arms Command-Training (CAC-T), TRADOC

TRANSFER MECHANISM: A field-tested Commander's Battle Staff Training Handbook draft and a performance assessment methodology and guide for observer/controllers at the JRTC, will be transferred in FY93 to TRADOC for implementation. A experimental computer-based (Asynchronous Computer Conferencing) battalion staff training module will be demonstrated in FY94 and recommended for use by TRADOC.

IMPACT: This research will assist the Army's capability of deploying combat ready battalions, able to meet dynamic conventional and contingency mission requirements. The research will improve battalion staff training, synchronization, and functional integration for Airland operations. Units and the CTCs will benefit from enhanced performance measurement standardization and assessment strategies.

RELATION TO PRESENT INDUSTRY INVESTMENT: There is no industry investment on this research topic.

FY93 MILESTONES:

Develop computer-based staff training strategy and prototype modules

START DATE: FY92

END DATE: FY94

FY93 FUNDING (\$000): \$487 **PROGRAM ELEMENT/PROJECT:** 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Benning Field Unit

<u>ACTIVITY:</u>	<u>TRADOC (CAC-T)</u>	<u>ARI</u>
POC/TELEPHONE	BG Nash DSN 552-5501	Dr. Seward Smith (706) 545-5589 DSN 835-5589

SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

**TASK TITLE: STRONGARM: Strategies for Training and Assessing
Armor Commanders' Performance with Devices and
Simulations (2124)**

OBJECTIVE: To provide the empirical basis for identifying mixes of armored unit training resources that best match current and future requirements and enhance readiness.

APPROACH: To provide an empirical foundation for armor training strategies, research will be conducted to assess the tasks and skills that can be trained with gunnery and maneuver training aids, devices, simulators, and simulations (TADSS). The research will include development of experimental methods for assessing and projecting the training capabilities of specific TADSS. This approach will support development and refinement of semi-automated unit performance measurement systems (such as the Unit Performance Assessment System (UPAS)), development and validation of required levels of proficiency ("gates"), and development and evaluation of alternative TADSS-based training methods. Future needs for TADSS will be identified through close monitoring of related technology-based research and results of training with fielded TADSS. Analytic methods will be applied to project appropriate mixes of resources in future training strategies. An example is the identification of combined arms training requirements that can be met through networking of gunnery and tactical simulations.

ARI TECHNOLOGY TRANSFER TO: U.S. Army Armor School (USAARMS), TRADOC; DOTD, SATD

TRANSFER MECHANISM: As part of the Combined Arms Training Strategy (CATS), the U.S. Army Armor School (USAARMS) is developing descriptive strategies for supporting gunnery and maneuver training events and providing a framework for the increasing use of (TADSS). In FY96, this effort will provide USAARMS with validated gunnery and maneuver training strategies. They will be based on an empirical database transferred to USAARMS in FY95, which provides a detailed assessment of the training effectiveness of gunnery and maneuver TADSS, individually and collectively. Also, a methodology for defining and validating future training strategies will be transferred to USAARMS in FY96 for use in designing armor training strategies as part of CATS.

IMPACT: This research will provide information necessary for building and validating armor training strategies. It will provide a foundation for training strategies based on more than listings of projected resources and events. The payoff should be more effective and efficient TADSS-based strategies not only for armor training, but also for combined arms training.

RELATION TO PRESENT INDUSTRY INVESTMENT: DoD and industry have invested enormous sums in the underlying computer, software and

electronics technologies that are the basis of TADSS. However, industry has not invested in empirical research on methods for determining the best mix of resources for skill acquisition and skill sustainment training.

FY93 MILESTONES:

Evaluate training effectiveness of prototype armor gunnery TADSS (e.g., Platoon Gunnery Trainer, Tank Weapons Gunnery Simulation System)

START DATE: FY92

END DATE: FY96

FY93 FUNDING (\$000): \$746 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Knox Field Unit

ACTIVITY:

TRADOC (USAARMS)

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

**TASK TITLE: TRAIN-UP: Technology-Based Reserve Component (RC)
Training Strategies (2125)**

OBJECTIVE: To devise and demonstrate technology-based training strategies which enhance the effectiveness and efficiency of training RC units with low Operating Tempo (OPTEMPO) at widely dispersed locations.

APPROACH: Prototype training strategies with the potential for meeting training requirements within RC constraints (e.g., limited training time, unit/soldier geographical dispersion) will be identified, developed, and evaluated. Appropriate usage (mixing and matching) of different training aids, devices, simulators, simulations (TADSS), e.g., M-COFT, GUARDFIST I, M-SIMNET, CCTT, and distributed training technologies (e.g., computer conferencing, video teletraining), will be empirically tested using Army National Guard and Army Reserve soldiers/units. Data to be collected will include: soldier, crew, and unit proficiency indicators; commander performance measures; scheduling efficiency information; training attitudes; and estimated training resource requirements. Results will be coordinated with the Combined Arms Training Strategies (CATS) proponents at TRADOC and proponent schools, the National Guard Bureau, OCAR, and FORSCOM.

ARI TECHNOLOGY TRANSFER TO: Training Analysis and Development Directorate (TDAD), TRADOC; Office, Chief of Army Reserves (OCAR), DA; National Guard Bureau (NGB), DA; Reserve Center (RC), FORSCOM

TRANSFER MECHANISM: By FY94, a recommended armor gunnery device/simulation training strategy for the RC will be presented to the CATS proponents at TRADOC, NGB, OCAR, and FORSCOM. Empirical research findings leading to a recommended maneuver training strategy for the RC will be presented in FY96 to these agencies.

IMPACT: Research results will have direct and immediate applicability to the Armor Training Device Strategy, the Combined Arms Training Strategy, and decisions concerning the acquisition and fielding of different TADSS and distributed training technologies.

RELATION TO PRESENT INDUSTRY INVESTMENT: The microprocessor-based electronic, graphics, and software industries have extremely large investments in technologies that form the basis of modern training devices and simulators. However, industry has not invested in empirical research on methods for determining the best mix of training resources.

FY93 MILESTONES:

Initiate data collection for development of prototype,
device/simulator-based, staff and maneuver training strategy

Obtain troop support for testing an armor gunnery device
strategy

START DATE: FY93

END DATE: FY96

FY93 FUNDING (\$000): \$424 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Boise Field Element (Fort Knox Field Unit)

ACTIVITY:

TRADOC (TDAD)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.8. Cognitive and Collective Skill Retention

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: COMBAT: Combined Arms Training Strategies (2126)

OBJECTIVE: To develop and demonstrate cost-effective training strategies for combined arms brigade and battalion training.

APPROACH: Recent research has provided a wealth of information on combined arms training. This includes information on: high-performing units at the Combat Training Centers; surveys on training in the Army conducted in support of the Combined Arms Training Strategy (CATS); as well as an extensive front-end analysis of combined arms tasks. This information will be supplemented by additional research to develop sets of field tested and proven "good ideas" and strategies for combined arms training. Innovative training methods and training management strategies -- as well as prototype aviation, armor and RC training strategy components resulting from other ARI research -- will be synthesized and then field-tested.

ARI TECHNOLOGY TRANSFER TO: Combined Arms Command-Training (CAC-T), TRADOC

TRANSFER MECHANISM: Field-tested, experimental combined arms training strategies will be presented to TRADOC (CAC-T) by the end of FY96, with recommendations for their implementation as part of future battalion and brigade CATS.

IMPACT: Empirically-based, field-proven training methods and strategies will provide the Army with information which will help commanders to design and schedule combined arms unit training programs to meet their mission requirements.

RELATION TO PRESENT INDUSTRY INVESTMENT: There is no industry investment in this research.

FY93 MILESTONES:

Conduct a front-end analysis of FORSCOM Divisions to identify highly successful training, maintenance, and resourcing strategies to include utilization and incorporation of TADSS in unit training programs

START DATE: FY93

END DATE: FY96

FY93 FUNDING (\$000): \$1114 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Presidio of Monterey Field Unit

ACTIVITY:

TRADOC (CAC-T)

ARI

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

**TASK TITLE: AVIATES: Aviation Training Strategies for Improving
Combat Readiness (2224)**

OBJECTIVE: To develop and demonstrate an aviation strategy for using training aids, devices, simulations and simulators (TADSS), as a major component of the Combined Arms Training Strategy (CATS) to ensure the combat readiness of aviators and aircrews, while reducing the load on expensive, high fidelity simulators and flying hours.

APPROACH: A detailed training requirements analysis will be performed to select candidate tasks as the focus of the research. These tasks will be paired with specific low-cost, part-task training devices to determine the transfer effectiveness of each device in training and sustaining specific aviation knowledges and skills. Using the results of this research, a prototype aviation training system and associated prototype training strategies will be configured. These training strategies will be compared experimentally using the variable fidelity features of the modular-based computer architecture in the Simulator Training Research Advanced Testbed for Aviation (STRATA).

ARI TECHNOLOGY TRANSFER TO: U.S. Army Aviation Center (USAAVNC), TRADOC

TRANSFER MECHANISM: In FY96, the USAAVNC will be provided with an experimentally validated prototype aviation training strategy, to include: requirements for low-cost, part-task, tactics and combined arms trainers; and assessments of the impact of low-cost devices on combat readiness as measured using field and networked simulators. The USAAVNC will then use the results for developing future TADSS requirements and designing aviation training strategies as part of the Combined Arms Training Strategy (CATS).

IMPACT: Maximizing the use of low-cost training devices will ensure the optimal usage of full scale simulators as a skill and knowledge integrator, leaving virtually all flight hours available for combat mission training.

RELATION TO PRESENT INDUSTRY INVESTMENT: DoD and industry have invested enormous sums in the underlying computer, software and electronic technologies that are the basis of aviation TADSS. However, there has not been, except for the highest fidelity simulators in the airline industry, investment in empirical research on methods for determining the best mix of training resources.

FY93 MILESTONES:

Conduct research on part-task and procedural training effectiveness of low-cost training devices

START DATE: FY92

END DATE: FY96

FY93 FUNDING (\$000): \$424 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Rucker Field Unit

ACTIVITY:

TRADOC (USAAVNC)

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.7. Unit Training Strategies

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: IMPACT: Innovative Methods for Providing Army Classroom Training (2225)

OBJECTIVE: To develop and demonstrate efficient state-of-the-art training technologies that will improve the effectiveness of Army classroom training within a constrained budget.

APPROACH: To enhance TRADOC's ability to perform its institutional training mission, the first step will be to match high priority TRADOC classroom training R&D requirements to emerging technologies in the cognitive and computer sciences. Since the Navy Personnel R&D Center (NPRDC) has a large, ongoing research program centered on classroom instruction, interaction with Navy researchers will help gain a clear understanding of work accomplished, problems, and results. Empirical evaluations of the resultant training research concepts, methods, and approaches will be conducted either at Fort Gordon for Signal/communication issues or at other appropriate Army sites. For example, computer assisted training technologies developed at NPRDC will be adapted to the need for a Mobile Subscriber Equipment training simulator, a prime requirement of the Signal School.

ARI TECHNOLOGY TRANSFER TO: Deputy Chief of Staff for Training (DCST), TRADOC; U.S. Army Signal Center and Fort Gordon (USASC&FG), TRADOC

TRANSFER MECHANISM: Throughout the project, as more effective classroom training methods and techniques are demonstrated and validated, they will be transferred to the Army for immediate consideration and use, either at Fort Gordon for Signal-specific training needs, or through TRADOC for general use throughout its schools and training centers. For example, in FY95, prototype network training simulations for Mobile Subscriber Equipment (MSE) operators will be developed and then deployed at Fort Gordon for their evaluation and implementation; and in FY96, MSE Network Manager training simulations will be validated in the same manner. By FY99, stand-alone or networked classroom training technologies will be demonstrated to TRADOC, potentially yielding an order of magnitude improvement in efficiency.

IMPACT: Although personnel and training resource cutbacks are foreseen, classroom training will remain a critical and costly component within the TRADOC Long Range Training Strategy. By adopting more efficient classroom training techniques resulting from this effort, TRADOC will be better able to meet its training requirements with reduced resources.

RELATION TO PRESENT INDUSTRY INVESTMENT: ARI's R&D will leverage industry, academic, and other DoD investments in underlying technologies in the cognitive and computer sciences, to provide TRADOC and its schools with a legacy of state-of-the-art training methods.

FY93 MILESTONES:

Determine the most appropriate training technology for particular training domains based on current cognitive science research and instructional theory

Develop assessment of available Navy technologies for improving classroom training

Develop research plans that will address identified high priority training needs that build on Navy programs

START DATE: FY93

END DATE: FY99

FY93 FUNDING (\$000): \$295 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Gordon Field Unit
(Research will be conducted at NPRDC and Fort Gordon)

ACTIVITY:

TRADOC (TDAD)

ARI

POC/TELEPHONE

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.8. Cognitive and Collective Skill Retention

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

TASK TITLE: SAFETRAIN: Training Strategies and Systems for Aviation Safety (2241)

OBJECTIVE: To design, demonstrate, and validate innovative training strategies and systems for improving aviation safety.

APPROACH: This research task focuses on the design, development, validation and demonstration, of training and evaluation methods and strategies for improving aviation safety. Training techniques and strategies will be designed which emphasize the time-bound demands of the tactical flight environment. Such demands include: (a) rapid transition from peacetime training to wartime employment, (b) increased use of advanced night vision system and helmet-mounted displays, (c) increased operational complexity and the requirement to integrate individual crew/team, and unit training, and (d) the need to maximize operational safety while meeting mission objectives. As part of this research, advanced helicopter simulation devices will be used to empirically observe crew/team errors within a variety of tactical task environments. Safety training strategies will be demonstrated and validated in simulated and actual field environments.

ARI TECHNOLOGY TRANSFER TO: U.S. Army Aviation Center (USAAVNC), TRADOC; U.S. Army Safety Center (USASC), TRADOC

TRANSFER MECHANISM: In FY90, the US Army Aviation Center (USAAVNC) was provided with research findings of aircrew coordination error patterns involved in rotary wing accidents. In FY91, the procedures for investigating aircrew coordination errors were transferred to the Army Safety Center. Also, in FY91, information to be used in rewriting the relevant aircrew training manuals (e.g., training standards), was provided to the USAAVNC. In FY92, a prototype, exportable, simulator-based training and evaluation package for cockpit resource management was validated and provided to the USAAVNC. In FY93, instructor pilot techniques and strategies for inflight aviation safety training and evaluation will be provided to the USAAVNC for implementation.

IMPACT: Valid aviation safety training techniques and strategies will assist the Army in achieving and maintaining a high level of human reliability in rotary wing aircraft cockpits. The resulting reduction in human error accidents will translate into direct and immediate savings of lives and aviation assets, and mission accomplishment.

RELATION TO PRESENT INDUSTRY INVESTMENT: DoD and industry have invested billions of dollars on rotary wing aircraft and pilot training. ARI is working in coordination with the other services and the civilian aircraft community through the FAA's Aircrew Qualification Program Working Group on Evaluation Standards, to exchange research findings on aviation safety training. That investment is being leveraged by ARI in its research to

demonstrate and validate training techniques and strategies that will improve aircrew safety.

FY93 MILESTONES:

Validate instructor pilot techniques and strategies for inflight training and evaluation of cockpit resource management

START DATE: FY90

END DATE: FY93

FY93 FUNDING (\$000): \$700 PROGRAM ELEMENT/PROJECT: 63007 A794

DIVISION: Training Systems Research Division

TECHNICAL AREA/FIELD UNIT:

Fort Rucker Field Unit

ACTIVITY:

TRADOC (USASC)

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SCIENCE AND TECHNOLOGY OBJECTIVE (STO):

V.B.5. Simulation Fidelity

OSD SCIENCE AND TECHNOLOGY THRUST: N/A

APPENDIX D

PLANNED TECHNOLOGY DEMONSTRATIONS (TECH DEMOS)

"A central tenet of the S&T strategy is that technology will be guided toward specific capabilities that can be proven with an Advanced Technology Demonstration.... Each Advanced Technology Demonstration will be designed to satisfy acquisition decision makers that the technology is feasible, affordable, and compatible with the operational concepts and force structure envisioned for the base force."

- Executive Summary, *Defense Science and Technology Strategy*, July 1992

Advanced Technology Demonstrations (ATD) are intended to support the fielding of major systems and system components. Involving the potential user in an active role, they will demonstrate technology more rigorously "up front", help fully mature technologies, and demonstrate technical feasibility, affordability and operational utility.

ARI's S&T program is not system-oriented; rather, it addresses systemic issues that address broad soldier-oriented problems that could arise on any potential battlefield. However, it is important that the products of this program be subjected to the same rigorous, real-world examination with extensive user involvement. Thus, starting in FY93, the ARI S&T program will plan for the conduct of technology demonstrations of limited scope, that will, however, meet the same objectives as the larger, more formal ATDs.

Four technology demonstrations will support the Manpower and Personnel R&D program:

- TD 1: Developing Warfighting Leaders Tech Demo
- TD 2: Selection and Classification for High Performing Soldiers Tech Demo
- TD 3: Selecting the Warrior Tech Demo
- TD 4: The Special Forces Warrior Tech Demo

Five technology demonstrations will support the Training Systems R&D program:

- TD 5: Individual Combatant Training In Virtual Environments Tech Demo
- TD 6: Unit Performance Assessment System (UPAS) Tech Demo
- TD 7: Battlefield Visualization Tech Demo
- TD 8: Simulator Training Research Testbed for Aviation (STRATA) Tech Demo
- TD 9: Advanced Language Learning Tech Demo

The conduct of certain of the demonstrations is being coordinated with other Army S&T organizations to leverage scarce resources and to ensure more comprehensive and complete demonstrations. Tech Demo 5 is being coordinated with the Human Research and Engineering Directorate (HRED), Army Research Laboratory (ARL). Tech Demos 5, 7 and 9 are being coordinated with the Corps of Engineer's Topographic Engineering Center (TEC).

ARI's nine planned tech demos are described on the following pages.

Manpower and Personnel R&D

Technology Demonstrations

Technology Demonstration:

TD 1: Developing Warfighting Leaders

Demonstration Date:

FY98

Objective:

To demonstrate new cognitive and non-cognitive predictors of leadership performance and the technology to improve leadership performance.

Criteria:

More accurate prediction of leadership effectiveness across levels of command.

Increased unit performance as a result of improved leadership performance.

ARI Task Title/Number:

LEADER TECH: Leader Skill Assessment and Development Technologies (1111)
(6.2)

Science and Technology Objective (STO):

V-B-9 (Leader and Command Staff Training)

DoD Thrust:

Thrust #8 (Sharpening the Warriors' Edge)

POC:

Trueman R. Tremble, Jr.
U.S. Military Academy Field Unit
Telephone #: Commercial (914) 938-2515 DSN 688-2515

Technology Demonstration:

TD 2: Selection and Classification for High Performing Soldiers

Demonstration Date:

FY97

Objective:

To demonstrate in an operational context the utility of new initial entry enlisted selection and classification procedures for improved performance of high quality soldiers who are placed in jobs using new techniques to predict the best fit with their capabilities.

Criteria:

Improved soldier and performance: 10% reduction in discipline problems;
10% improvement in tactical proficiency, and 10% improvement in junior NCO leadership

5% reduction in attrition of high quality soldiers

ARI Task Titles/Numbers:

QUALITY SOLDIERS: Alternative Selection and Classification Techniques (1211)

CAREER FORCE: Building the Career Force (1212)

Science and Technology Objective (STO):

V-B-1: Soldier Assignment

DoD Technology Thrust:

N/A

POC:

Michael G. Rumsey
Selection and Classification Technical Area
Telephone #: Commercial (703) 274-8275 DSN 284-8275

Technology Demonstration:

TD 3: Selecting the Warrior

Demonstration Date:

FY97

Objective:

To demonstrate in a simulated combat environment the utility of new personnel selection tests to select warriors based on their capability to perform in combat.

Criteria:

10% improvement in individual combat performance

10% improvement in unit combat performance

ARI Task Titles/Numbers:

TOMORROW'S WARRIOR: Army Selection and Classification: General Models and MOS-Specific Needs (1222)

CAREER FORCE: Building the Career Force (1212)

Science and Technology Objective:

V-B-1: Soldier Assignment

DoD Technology Thrust:

Thrust #8 (Sharpening the Warriors' Edge)

POC:

Michael G. Rumsey
Selection and Classification Technical Area
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Technology Demonstration:

TD 4: The Special Forces Warrior

Demonstration Date:

FY96

Objective:

To demonstrate new technologies for recruiting, selecting and retaining Special Forces warriors.

Criteria:

Increased selection rate for soldiers entering the Special Forces assessment and selection program

Reduced attrition/recycling in the Special Forces qualification course

ARI Task Title/Number:

SPECIAL FORCES: Improving Special Forces Personnel Development (1223)

Science and Technology Objective:

V-B-1: Soldier Assignment

DoD Technology Thrust:

Thrust #8 (Sharpening the Warriors' Edge)

POC:

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Training Systems R&D
Technology Demonstrations

Technology Demonstration:

TD 5: Individual Combatant Training in Virtual Environments

Demonstration Date:

A: FY95: Individual skill training programs

B: FY98: Team training programs

Objective:

To demonstrate individual training strategies and mission rehearsal techniques using "virtual reality" technology for key individuals (e.g., commanders) and members of high performance teams (e.g., Special Operations Forces (SOF)), which networks with distributed interactive simulations (DIS) such as SIMNET and the Close Combat Tactical Trainer (CCTT).

Criteria:

Achievement of specified proficiency levels by dismounted small unit commanders or members of SOF high performance teams.

Measurable increase in tactical performance due to use of "virtual reality"-based mission rehearsal techniques.

ARI Task Title/Number:

VIRTUE: Virtual Environments for Combat Training and Mission Rehearsal (2111)

Science and Technology Objectives (STO):

V-B-5 (Simulation Fidelity)

DoD Technology Thrust:

Thrust #8 (Sharpening the Warriors' Edge)

POC:

Stephen L. Goldberg
STRICOM/Orlando Field Unit
Telephone #: Commercial (407) 380-4690 DSN 960-4690

Technology Demonstration:

TD 6: Unit Performance Assessment System (UPAS)

Demonstration Date:

FY94

Objective:

To demonstrate a unit performance assessment technique -- UPAS -- that can be implemented in distributed interactive simulation (DIS) environments to enable quick and accurate training feedback (for the conduct of meaningful After Action Reviews (AAR)), and can be used to support research on the design and implementation of future DIS applications.

Criteria:

Improved AARs using UPAS based on detailed performance information provided in a timely and accurate fashion.

Provides data on the relative training effectiveness of proposed DIS training alternatives.

ARI Task Title:

SYNTRAIN: Development of Advanced Training Technologies for Distributed Interactive Simulation Systems (2114)

Science and Technology Objective (STO):

V-B-7 (Unit Training Strategies)

DoD Technology Thrust:

Thrust #6 (Synthetic Environments)

POC:

Stephen L. Goldberg
STRICOM/Orlando Field Unit
Telephone #: Commercial (407) 380-4690 DSN 960-4690

Technology Demonstration:

TD 7: Battlefield Visualization

Demonstration Date:

A: FY95: Preliminary computer-based "battlefield visualization" training program

B: FY99: Suite of "battlefield visualization" training methods, programs & job aids

Objective:

To demonstrate a training program and job aids to help commanders and their staffs "visualize the battlefield" (including terrain "ground truth" and the disposition of friendly and enemy forces).

Criteria:

"Battlefield visualization" training programs measurably increase situational awareness on the battlefield.

Embedded job-aids provide small unit commanders "battlefield visualization" information that leading to improved performance in simulated combat.

ARI Task Title/Number:

BATTLEVIEW: Visualization of the Battlefield (2121)

Science and Technology Objective (STO):

V-B-7: (Unit Training Strategies)

DoD Technology Thrust:

Thrust #8 (Sharpening the Warriors Edge)

POC:

Howard H. McFann

Presidio of Monterey Field Unit

Telephone #: Commercial (408) 647-5371 DSN 878-5371

Technology Demonstration:

TD 8: Simulator Training Research Testbed for Aviation (STRATA)

Demonstration Date:

FY95

Objective:

To demonstrate fidelity levels needed to support aircrew training for initial skill acquisition and to sustain tactical and flight skills for helicopter pilots for individual and collective training.

Criteria:

Acquisition and retention of required aviation skills using visual simulator fidelity levels selected to optimally cost-effective.

ARI Task Titles/Numbers:

STRATA-FI: Simulation Fidelity Requirements for Cost-Effective Aviation Training (2211)

Science and Technology Objective (STO):

V-B-5 (Simulator Fidelity)

Dod Technology Thrust:

Thrust #6 (Synthetic Environments)

POC:

Charles A. Gainer
Fort Rucker Field Unit
Telephone #: Commercial (205) 255-4404 DSN 556-4404

Technology Demonstration:

TD 9: Advanced Language Learning

Demonstration Date:

A: FY95: Portable computer tutor;

B: FY99: Immersion technology tutoring system

Objective:

To demonstrate virtual reality "immersion" training techniques for language proficiency that will enable combatants (from foot soldiers to interrogators to strategic commanders) to carry out worldwide contingency operations.

Criteria:

"Intelligent tutors" achieving user-specified levels of language proficiency. (FY95)

"Immersion" training techniques providing faster language learning and longer language skill retention intervals. (FY99)

ARI Tasks/Numbers:

MULTI-LINGUAL: Advanced Technologies for Mastering Foreign Languages (2231)

VITAL: Virtual Immersion Technology to Advance Language Learning (2232)

Science and Technology Objective (STO):

V-B-6 (Foreign Language Skill Training)

DoD Technology Thrust:

Thrust #8 (Sharpening the Warriors' Edge)

POC:

Robert J. Seidel

Automated Instructional Systems Technical Area

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APPENDIX E

DOD STRATEGIC SCIENCE AND TECHNOLOGY GUIDANCE

The Department of Defense has formulated a science and technology strategy that will:

- (1) provide for the early, intensive and continued involvement of warfighters,
- (2) fuel and exploit the information technology explosion, and
- (3) conduct extensive and realistic technology demonstrations."

(Defense Science and Technology Strategy, Director of Defense Research and Engineering, July 1992.)

DoD strategic guidance also focuses on 11 key technology areas to be stressed. The *DoD Key Technologies Plan* (Director of Defense Research and Engineering, July 1992) describes the 11 key technologies. The ARI exploratory development program addresses some of the technology issues found in the Human-System Interface Key Technology Area (Area #11).

DoD Key Technology #11: Human System Interface

"Human-system interfaces (HSI) are the key to operational effectiveness of most weapon systems.... The emphasis is on *systems* and the optimization of mission performance where the human is the critical element. A system broadly includes the weapon, operators, combat environment, and support structure. Recruitment, selection, assignment, training, protection and safety of the human must also be considered. HSI requires a multidisciplinary approach, involving the fields of human factors, psychology, physiology, operations research, electronics, computer sciences, and system engineering...."

Eight science and technology thrusts representing required future operational capabilities (seven existing and one proposed) have been articulated to better focus the activities of the military science and technology community. ARI's technology base program is playing a significant role in two of the eight: Thrust 6 (Synthetic Environments) and Thrust 8 (Sharpening the Warriors' Edge).

DoD Thrust #6: Synthetic Environments

"A broad range of information and human interaction technologies must be developed to synthesize present and future battlefields. We must therefore synthesize factory-to-battlefield environments with a mix of real and simulated objects and make them accessible from widely dispersed locations. Integrated teams of users, developers, and/or testers will be able to interact effectively. Synthetic environments will prepare our leaders and forces for war and will go with them to the real battlefield."

- Defense Science and Technology Strategy, July 1992

DoD Thrust #8: Sharpening the Warriors' Edge

"Warriors are the heart of the U. S. Armed Forces superior capabilities. Advanced technology in weapons and supporting systems must be applied to our warriors in a systematic manner to achieve the best possible synergy between human and equipment performance. The four major technology emphasis areas are: human performance, sensing, decision making, and lethality. Each warrior, having more capability for endurance, survivability, mobility, and lethality, will have an edge over potential enemies."

*- Army Science and Technology Master Plan,
Coordination Draft, Sep 92*