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INSTITUTE FOR SIMULATION AND TRAINING

Contract N61339-88-D-009-0001
PM TRADE

October 1989

# An Information Base for PM TRADE'S Technology Investment Strategy

Institute for Simulation and Training
12424 Research Parkway, Suite 300
Orlando FL 32826

**University of Central Florida**
**Division of Sponsored Research**

IST-CR-89-12

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# An Information Base For PM TRADE'S Technology Investment Strategy

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# ABSTRACT

The Army Project Manager for Training Devices (PM TRADE) identified a need in 1988 to categorize training relevant technology. The need was driven by PM TRADE's desire to provide investment guidance to industry and government, and to identify technology gaps in training technology. A strategy to manage this technology investment has been implemented for PM TRADE by the University of Central Florida's Institute for Simulation and Training. Key elements of the strategy include a technology integration plan, an automated data base of supporting facts and specific information, and a news bulletin published quarterly for PM TRADE. These elements will be used to communicate and coordinate technology initiatives with industry, academia and other government organizations. The framework for the technology integration plan and the data base is comprised of descriptions of fields of endeavor (technology areas, such as visual systems technology). The information in the relational data base fuels the continuing assessment of technology trends, and summarizes technology activities. Consideration is being given to making as much of the data base as possible open to wide spread access while including industry sensitive information for use within the government only. The total strategy is expected to be beneficial by: (1) leveraging available Army funding for training technology, (2) aiding PM TRADE incorporation of advanced technology into fielded training systems, and (3) publicizing key technology efforts supporting Army training systems.

# PREFACE

This is the final report for a component of a contract from the Army Project Manager for Training Devices (PM TRADE) to the Institute for Simulation and Training (IST) of the University of Central Florida (Contract N61339-88-D-0009, Delivery Order 0001). This report deals with PM TRADE's technology investment strategy and specifically several ways of gathering, evaluating and disseminating information relating to research and development for Army training systems. The authors wish to express their appreciation to the following PM TRADE personnel for their contributions to the research described in this report: Dr. Ronald Hofer, Mr. Stan Goodman, Ms. Connie Fischer, Mr. Dennis Kriha, and Mr. Ray Green. Mr. Ernie Smart of IST served as Program Manager. Other IST personnel contributing to the project included Mr. Kevin Uliano and Dr. Norm Lane (consultant).

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# An Information Base for PM TRADE'S Technology Investment Strategy

## INTRODUCTION

The state-of-the-art in simulation and training technology must be advanced in order to meet the increasing training requirements caused by increased weapon system complexity. In its technology investment strategy, PM TRADE has the mission to develop and advance the state-of-the-art in simulation and training device technology with the overall goal of producing more efficient Army training systems.

In creating an investment strategy, the agency making the investment must be considered. This report discusses the investment being made primarily by the government, and to a lesser extent by industry. The primary objective of the technology investment strategy is to identify and promote the transfer of technology into fielded capabilities. A fundamental element of the strategy is to capitalize on existing government, university and industrial programs and facilities. It is critically important that government communicate its research needs and thrusts to a broad community in order for technology advancements to occur across several fronts. It is the goal of PM TRADE to communicate these research needs in order to facilitate a dialogue with various laboratories. This dialogue will provide the seed for specific research efforts which can be funded in a variety of ways.

Three vehicles developed in this project for communicating technology needs and accomplishments are described in this report:

- Technology Research Integration Plan, organized around technology areas, called "fields of endeavor."
- data base residing on PM TRADE's LAN (local area network) which contains descriptions of projects and technoques important for the technology base supporting the Army's training systems.
- news bulletin, Training Systems and Devices, which highlights PM TRADE'S key research and development projects.

## Technology Investment

In order to describe technology investments properly, it is necessary to define who the investor is, what the investment consists of, and what can be expected as a return on the investment. In the case of technology, the investor is a government, industry, or academic entity. Although these investors make their investments for different reasons, the outcomes of the investment are not necessarily inconsistent.

The government (particularly PM TRADE) makes financial investments in the technology base in order to keep an active industrial base able to meet emerging training requirements in a cost and training-effective manner.

Firms in the industrial sector make investments in technology to meet customer requirements and enhance their competitive position in future procurements.

Groups in the the academic sector make technology investments to increase the knowledge base, to satisfy man's inquisitive nature, and to provide an environment conducive to learning.

Several disturbing trends in technology investment are noteworthy. Research funding from all government sources has been declining for several years. Industrial investment in Internal Research and Development (IRAD) is stagnating in order to keep overhead costs down. Research funding in the academic community is being fueled to an increasing extent through foreign investment. These trends have been related with a decline in technology investment, profits and competitiveness.

## Technology Assessment

The goal of technology assessment is to provide insight into the use of research efforts which impact training and simulation. In addition, the goals of technology assessment must be related in time to short term and long term efforts. The timing of research is critical. Short term technology efforts tend to be oriented to a specific training device or training deficiency, while long term efforts tend to be less specific with respect to product application. (For the purpose of this report, five years or less is considered a short term assessment.)

Technology has a profound impact on the simulation and training development process. Technological advances affect simulation and training from the definition of the requirements of a training system to the logisitics support of fielded devices. In addition, technological impacts on a particular weapon system often drive training device capabilities and requirements.

In order to limit the scope of PM TRADE's technology assessment and data base development, technology assessment and categorization was limited to technologies which manifest themselves in a piece of training equipment. This includes not only hardware and software systems, but also innovative ways which must be developed to assess the cost and training effectiveness of a particular implementation of technology.

Managing the sheer bulk of technological information relating to simulation and training has been a problem. Industry has not always had access to necessary information from the government to make informed decisions in managing their technology investment.

It is important to have a consistent set of rules in order to assess technology. The Technology Research and Integration Plan and associated data base developed by IST provide these ground rules. The construct of a field of endeavor provides the primary building block for developing the integration plan and data base. These fields of endeavor are technology thrusts considered vital for emerging training systems.

Both the data base and the technology integration plan are organized around the following fields of endeavor:

- Engagement Simulation and Instrumentation Technology
- Real-time, Man-in-the-loop Simulation Technology
- Low Cost, Complexity Training Simulation Technology
- Visual Simulation Technology.
- Training Acquisition Technology
- Artificial Intelligence and Interactive Information Technology

Each field of endeavor discussion establishes a domain of emerging or advancing technological opportunity. The goal of the integration plan and data base is to provide a means to capitalize on technology investment by assessing research efforts within the context of long term Army training requirements. These requirements include:

- increased substitution of simulation approaches (stand-alone devices and/or embedded capabilities) for conventional training and practice on operational equipment.

- the need to prepare for lower aptitude personnel operating and maintaining increasingly sophisticated equipment.

- systematic approaches for reducing recurring and nonrecurring training costs.

- training capabilities suited for National Guard and Reserve Component use.

- increased use of artificial intelligence (AI) technologies.

- increased application and system integration of new and emerging techniques for graphical representation of ideas, concepts, and simulated battle environments.

- use of microcomputers for delivering technical information and training.

- use of large-scale multi-player simulation networking.

These general requirements provide a framework for considering investment strategies which can be applied by the government and industry to meet specific emerging training requirements.

# SPECIFIC PRODUCTS

## Technology Research and Integration Plan

This document describes fields of endeavor (see Appenidx E) and provides a baseline assessment of relevant technology's impact on training and simulation. The methodology can also provide research entities a forum to inform the government of research, and a means to receive feedback on the Army's perception and assessment of current technology efforts. The major fields of endeavor currently contained in the integration plan include:

Engagement Simulation and Instrumentation

- *Pairing Systems*
- *Range Instrumentation*
- *Targets*
- *Robotics*

Real Time Man-in the-Loop Simulation Technology

- *Simulation Networks*
- *Battlefield Simulations*
- *Modular Design Standards*
- *Standard, Reusable, Rapidly Reconfigurable Data Bases*

Low Cost/Complexity Simulation

- *Novel Techniques for Low Fidelity Training Devices*
- *Test Bed for Cost/Training Effectiveness Evaluations*
- *Generic Reconfigurable Designs*

Visual Simulation Technology

- *Visual Presentation Technologies*
- *Visual Performance*

Training Acquisition Technology

- *Total Training System*
- *Representation and Simulation*
- *Optimization of Training Device Cost and Effectiveness*
- *Embedded Training*
- *Training Cost Effectiveness Relationships and Data Bases*

Artificial Intelligence and Interactive Informational Processes

- *Automated Instructional Process*
- *Job Aiding*
- *Natural Language Interfaces*
- *Voice Technology*

In developing the technology integration plan, IST was faced with the task of devising a way to accumulate and catalogue current technology thrusts. This may appear to be a straightforward task, but it proved and still proves to be a challenging effort. The first challenge was to devise a way to manage the sheer magnitude of available data related to training and simulation. The second challenge was to develop a methodology to organize the data in a manner suitable to the consumers of such data. The third challenge was to develop a means to safeguard sensitive data, and fourth was to provide an incentive for data providers to provide such data.

IST used classical systems engineering principles to meet these challenges in developing a system which can capture, catalogue, and assess technology. The systems engineering process recognizes the need for refinement and therefore offers a series of feedback loops to allow refinement of processes and procedures as development proceeds. This process began and continues to evolve to meet the needs of both consumers and providers of technology relevant to training and simulation.

The amount of information necessary to assess the impact of technology on a particular field of endeavor is quite large. Initially, members of IST thought visits to industrial, government and academic sites would provide the required information. This approach proved to be unsatisfactory for several reasons. The first reason relates to the efficient use of resources. Data gathering is a time consuming matter when the data is located in diverse geographic locations and in diverse forms. IST's staff simply was not prepared to embark on such a task.

Secondly, two other constraints would make such a task impractical even if resources were available. Researchers are often constrained by the nature of desired data. In the case of technology development, much of the data was proprietary in nature and there was a natural reluctance of many industrial organizations to part with their Internal Research and Development efforts to an intermediary, such as IST.

Also, research and development efforts tend to be dynamic. Therefore, gathering such data would prove to be impractical unless the entity was staffed to such a degree that data could be gathered on an almost continuous basis.

PM TRADE and IST have developed a method to alleviate the problems noted above with respect to data gathering. IST has reviewed pertinent training and simulation documentation with respect to research and development initiatives from all three services. Such documents as the Army's Aviation Simulation Master Plan and Navy 2000 documentation have been reviewed by IST.

In addition, specific laboratory programs, such as the Air Force's Helmet Mounted Display efforts, have been reviewed. These documents, available from many government sources (in the unclassified versions) formed a basis for an initial technology assessment. This assessment is reflected in the Technology Integration Plan for Training Systems and Devices.

## Data Base

The data base to cross-reference research programs is being developed using the Technogy Integration Plan. Data base development is at an early stage of development, but once fully developed, the data base will serve multiple purposes. It will be used as a source of information to analysts and engineers seeking information on the state-of-the-art in training and simulation. This data base will also be used to identify the technology thrusts necessary to meet the training requirements of the future. A sample data entry form is provided in Figure 1.

```
Query Next Previous Add Update Remove File Screen Current Master Detail
     Output Bye                                        ** 1: lsedata file**
                    Sponsored Research Entry Form  (page 1)
Entry Number: [    0]    Entry Date: [00/00/00]   Executive Summary:(Y/N) [ ]

Subject: [                                                              ]

Summary: [                                                              ]
         [                                                              ]
         [                                                              ]
         [                                                              ]
         [                                                              ]
         [                                                              ]
         [                                                              ]

Date of last change: (mm/dd/yy): [00/00/00]
                     Originator: [        ]                                 ]

Location: [                     ]   Document Type: [      ]
Reviewed (LSE/FOE):(Y/N)  [ ]       Initials:   [    ]
(IST): (Y/N)  [ ]                   Classification: [ ]
              *** Press S to go to the 2nd screen ***
```

**Figure 1 Sample Data Entry Screen for Data Base**

The form is suitable to report research efforts and references which have an impact on training and simulation.

IST has been making inputs into this data base for several months. As part of the data base entry process, IST has been evaluating the man-machine interface of the data base in an alpha test site mode.

Consideration is being given to upgrading the data base to accept industrial inputs with limited access applied to protect proprietary data. As much of the data base as possible would be accessible; industry-sensitive information would be for use within the government only. Using any combination of government, academic, or industrial entities, providers of information will be able to designate what type of users can view the data. This limited access capability should eliminate industry reluctance to share R&D efforts.

The information in the data base fuels the continuing assessment of technology trends and summarizes known technology activities. A relational structure will allow accessing information in the data base according to goals and objectives developed within the fields of endeavor.

The data base includes four secondary categories for organization: Lead Systems Engineering, Mission Area Management, Areas of Technology, and Training Device categories. Topics falling under these secondary categories are listed in Table 1.

### Lead System Engineering

Air Defense Artillery or Air Defense
Aviation
Battle Simulation
Command and Control
Close Combat Heavy
Close Combat Light
Communications
Combat Service Support
Combat Training Centers Communications
Engagement Simulation
Engineer, Mine Warfare
Fire Support
Intelligence, Electronic Warfare
Maueuver Simulation
Nuclear, Biological, Chemical
Ranges and Targets
Special Operations Forces
Technical Integration Liason Officer
Technical Planning and Integration

### Mission Areas Managers

Air Defense Artillery or Air Defense
Ammunition
Aviation
Base Support
Command and Control
Close Combat Heavy
Close Combat Light
Communications
Combat Service Support
Engineer, Mine Warfare
Fire Support
Intelligence Systems Management
Information Systems Management
Nuclear, Biological, and Chemical
Science and Tech Base
Special Operations Forces
Test and Evaluation
Training

### Areas of Technology

Artificial Intelligence
Computer Hardware
Computer Image Generation
Computer Software
English
Flight Dynamics Simulation
Field Training Devices
Human Factors
Neural Networks
Terrain Data Bases
Training Transfer

### Training Devices

Air Defense Artillery or Air Defense
Aviation
Command and Control
Close Combat Heavy
Close Combat Light
Communications
Combat Service Support
Engineer Mine Warfare
Fire Support
Intelligence, Electronic Warfare
Nuclear, Biological, and Chemical
Ordnance
Quartermaster
Special Operations Forces
Transportation

**Table 1 Additional Categories for Data Base Organization**

Figure 2 depicts how these key descriptors are linked.

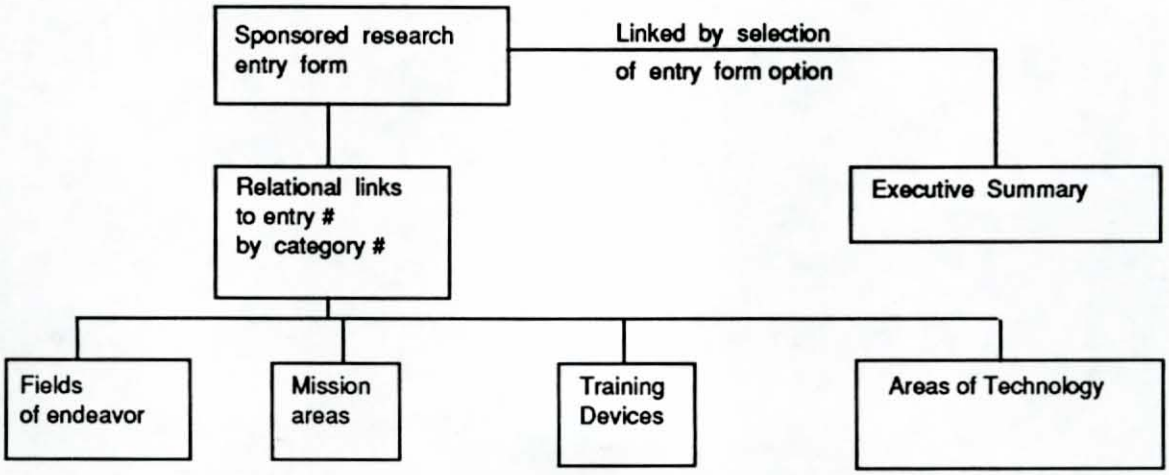


**Figure 2 Data Base Approach Showing Linking of Key Descriptors**

**Data Base Overview** The data base is written in Informix and resides on the TRADE LAN which runs under a Xenix operating system. The data base is designed to be used by engineers and scientist at PM TRADE. IST is responsible for filling the data base.

The data base production involves three major efforts: 1) designing and implementing the data base at PM TRADE, 2) designing in-house data base at IST, 3) filling the data base with appropriate material. Figure 3 depicts the process of data into the PM TRADE base. It also shows the process of creating data at IST and batch transmissions to PM TRADE using sending/receiving utilities.

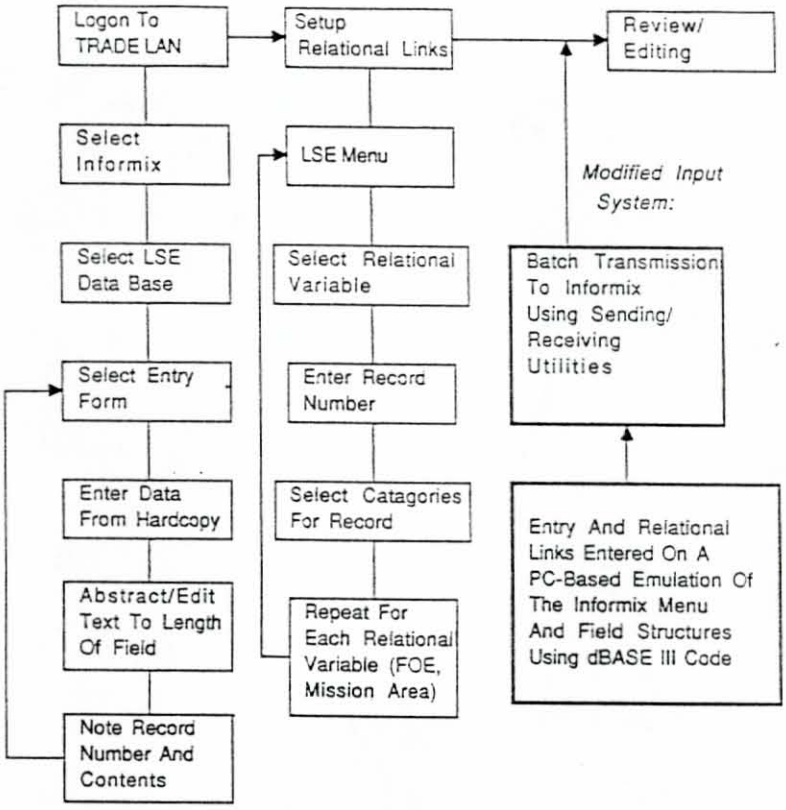


**Figure 3 Data Base Entry Procedure**

The in-house data base is designed to emulate the IST/PM TRADE data base. It is made to be used by IST personnel for data entry - the use of the in-house version reduces entry time by approximately 2/3. It is written in Clipper and can be used on any DOS based PC. The data is stored in three separate data bases. Once the data is entered and edited (usually between 20 and thirty records) it is batched and delivered to PM TRADE to be entered into the main data base. For more information on the batching procedure reference, see Appendix B. Appendix C contains the computer code to allow an interface between IST and PM TRADE interfaces.

**Data Dictionary Description** The full data dictionary is contained Appendix A. Information within the fields in the first screen of the database are as follows:

- *Field Number:* Each field is assigned a unique number. The fields are arranged within the dictionary in Field Number order. Field Numbers have no effect on searching.
- *Field Name:* This is the name of the field that must beused to formulate searches and displays.
- *Full Name:* Full Name is a more complete name of the field, and appears whenever that field is displayed.

- *Format:* Format defines the maximum length and the type of characters within the field. N indicates numeric and C indicates alphabetic character. For example, Field 1, Entry Number, has a format N5, which means the field may contain anywhere from 1 to 5 numeric characters.

- *Content:* Content is a narrative explanation of the purpose and nature of the field. Content can also provide special notes about the data. Sometimes an abbreviation is entered in a field in place of data.

- *Examples:* Unlike the other elements of the data dictionary, Examples does not always appear. It appears only when needed to better illustrate the nature of the data beyond what is provided in the Format and Content elements.

## News Bulletin

Training Systems and Devices is a newsletter produced quarterly by the Institute for Simulation and Training under contract to PM TRADE. The newsletter is designed to highlight new programs and technology thrusts important for emerging training systems and devices.

The TSD newsletter was first distributed at the 1988 Interservice/Industry Training Systems Conference and has been mailed out upon publication since. Circulation is over 1000 and includes agencies in government, industry, and academia. Additional copies are given out at various meetings and conferences, bringing total readership to 2000.

Although most of the articles have dealt with PM TRADE projects, plans are to solicit manuscripts from outside agencies. Currently, the articles are written based on interviews conducted by TSD editors. The articles then enter a review cycle, followed by layout and publication.

The Spring 1989 issue of TSD is contained in Appendix D. Topics covered in this issue include:

Shoot Through Obscuration Miles (STOM)
Upgrade of Opposing Force (OPFOR) Vehicles
Reduced Crew Vehicles
Computer Simulation.

## CONCLUSIONS

Anticipated benefits of the total strategy (the plan, the news bulletin and the data base) include:

- Communicating and coordinating trends, goals, and objectives of Army training and simulation technology.
- An investment strategy which uses available Army funding to leverage the advancement of technology without duplication.
- A source of current information for use by PM TRADE technical personnel for enhancing technology transfer into fielded applications.
- A source of information by industry, academia, and other government agencies of key PM TRADE R&D projects in support of training systems.

# Appendices

# Appendix A

# PM TRADE Data Dictionary

## APPENDIX A

**PM TRADE DATA DICTIONARY**

**FIELD NO:** 1
**FIELD NAME:** ENTRY_NUM
**FULL NAME:** ENTRY NUMBER
**FORMAT:** N5
**CONTENT:** The number is assigned automatically by the data base. The user can query certain records by using wildcards. For example, >3 instructs the system to search for all records greater than 3.

**FIELD NO:** 2
**FIELD NAME:** ENTRY_DATE
**FULL NAME:** ENTRY DATE
**FORMAT:** C8
**CONTENT:** The date the data were entered into the system.

**FIELD NO:** 3
**FIELD NAME:** SUBJ
**FULL NAME:** SUBJECT
**FORMAT:** C60
**CONTENT:** As much of the article title as can be fitted into the field.

**FIELD NO:** 4
**FIELD NAME:** EXEC_S
**FULL NAME:** EXECUTIVE SUMMARY
**FORMAT:** C1
**CONTENT:** The data base has the capability of including or linking an executive summary along with the regular abstract. This capability is quite helpful especially when dealing with complex articles that cannot be summarized within the boundaries of the regular abstract. When **X** is present, it tells the user there is a more elaborate summary included.

**FIELD NO:** 5-11
**FIELD NAME:** SUMMARY1-SUMMARY7
**FULL NAME:** SUMMARY
**FORMAT:** C60
**CONTENT:** Narrative description of the technical objective and/or research approach of an effort.

**FIELD NO:** 12
**FIELD NAME:** CHG_DATE
**FULL NAME:** DATE OF LAST CHANGE
**FORMAT:** C8; MM/DD/YY
**CONTENT:** Used to identify the date that minor corrections (spelling, etc.) were made to the record.

**FIELD NO:** 13
**FIELD NAME:** ORIG
**FULL NAME:** ORIGINATOR
**FORMAT:** C40
**CONTENT:** Name of first author, publishing company, or institution.

**FIELD NO:** 14
**FIELD NAME:** LOC
**FULL NAME:** LOCATION
**FORMAT:** C20
**CONTENT:** Location of the complete article, report, 1498, etc. in the library. To our purposes it will be IST followed by a letter and a number.
**EXAMPLES:** IST E-40, IST A-01

**FIELD NO:** 15
**FIELD NAME:** TYPE_DOC
**FULL NAME:** DOCUMENT TYPE
**FORMAT:** C5
**CONTENT:** Specifies which of the nine different types of document the record pertains to. Acceptable values:

TCHR - Technical Report
JART - Journal Article
SART - Symposium Article
BOOK - Book
UREP - Unpublished Report
TREP - Trip Report
GRF - Government Reporting Forms
CREP - Contract Report
BF - Briefings

**FIELD NO:** 16
**FIELD NAME:** REVIEWED
**FULL NAME:** REVIEWED (LSE/FOE): Y/N
**FORMAT:** C1; YES/NO
**CONTENT:** This entry will reveal if the information was reviewed by a Subject Matter Expert (SME).

**FIELD NO:** 17
**FIELD NAME:** INITIALS
**FULL NAME:** INITIALS
**FORMAT:** C3
**CONTENT:** Name initials of the SME.
**EXAMPLES:** JPK (J. Peter Kincaid)

**FIELD NO:** 18
**FIELD NAME:** IST
**FULL NAME:** IST: (Y/N)
**FORMAT:** C1; YES/NO
**CONTENT:** Verifies if the SME is from IST (Institute for Simulation & Training)

**FIELD NO:** 19
**FIELD NAME:** CLASSIF
**FULL NAME:** CLASSIFICATION
**FORMAT:** C1
**CONTENT:** Acceptable values:

U - Unclassified
C - Classified

**FIELD NO:** 20
**FIELD NAME:** GRAPHICS
**FULL NAME:** GRAPHICS FILE
**FORMAT:** C40
**CONTENT:** This field informs that there is an off-line graphic file included. For our purposes, we do not have the resources to add these kind of files.
**EXAMPLES:** CAT files

**FIELD NO:** 21
**FIELD NAME:** GRANT
**FULL NAME:** CONTRACT\GRANT
**FORMAT:** C40
**CONTENT:** The name and/or number of the contract or grant funding the project.

**FIELD NO:** 22
**FIELD NAME:** NUM
**FULL NAME:** NUMBER
**FORMAT:** C26
**CONTENT:** Numbers of the contract instrument used to fund the contract or grant associated with Field 21. Contract numbers are entered as found in the source data, except that semicolons are removed. Multiple contracts are separated by semicolons.
**EXAMPLES:** N66001-83-C-0358; MDA903-85-C-0169

**FIELD NO:** 23

**FIELD NAME:** S_DATE
**FULL NAME:** START DATE
**FORMAT:** C8; (MM/DD/YY)
**CONTENT:** Date the effort began or will begin. If date is unknown, the default value is 00/00/00. If day is unknown, 01 should be entered; for example, June 1984 is stored 06/01/84.

**FIELD NO:** 24
**FIELD NAME:** C_DATE
**FULL NAME:** EST COMP DATE
**FORMAT:** C8; (MM/DD/YY)
**CONTENT:** Date the work was completed or the estimated completion date. If date is unknown the default is 00/00/00.

**FIELD NO:** 25
**FIELD NAME:** ORG
**FULL NAME:** FUNDING ORGANIZATION
**FORMAT:** C40
**CONTENT:** Name of the funding organization providing the contract\grant in Field 21.

**FIELD NO:** 26
**FIELD NAME:** METHOD
**FULL NAME:** PERFORMANCE METHOD
**FORMAT:** C10
**CONTENT:** Describes the method used to perform the study.
**EXAMPLES:** Survey, literature review, operational testing

**FIELD NO:** 27
**FIELD NAME:** SOA
**FULL NAME:** ADVANCED S.O.A.
**FORMAT:** C3
**CONTENT:** An **X** in this field indicates that the research is intended to advance the state of the art.

**FIELD NO:** 28
**FIELD NAME:** ECD
**FULL NAME:** ENHANCING CURRENT DEVICES/SIMULATIONS; IDENTIFY DEVICES
**FORMAT:** C3
**CONTENT:** An **X** in this field indicates that the scope of the research is to enhance current devices in relation to the field of simulation and/or identify devices.

**FIELD NO:** 29
**FIELD NAME:** RA
**FULL NAME:** RISK AVOIDANCE
**FORMAT:** C3
**CONTENT:** An **X** in this field indicates that the research is intended to avoid risk in the development of simulation and training devices (by for example, making the equipment more reliable.)

**FIELD NO:** 30
**FIELD NAME:** FY_RES
**FULL NAME:** FY
**FORMAT:** C4
**CONTENT:** Last two digits of the fiscal year of which funding information is provided in Field 21, Contract/Grant.
**EXAMPLES:** 89

**FIELD NO:** 31
**FIELD NAME:** WORK_YRS
**FULL NAME:** PROF WORK YEARS
**FORMAT:** C4
**CONTENT:** Pertains to the standard man (work) years, which is equivalent to 2080 hrs, that will take to finish the project. When dealings with 1498's, it refers to the estimated resources for the fiscal year, Field 30.

**FIELD NO:** 32
**FIELD NAME:** FUNDS
**FULL NAME:** FUNDS
**FORMAT:** C8
**CONTENT:** Total amount of financial resources available for the project. When dealing with 1498's, it refers to the estimated funding for the fiscal year, Field 30.

**FIELD NO:** 33
**FIELD NAME:** DOD_NAME
**FULL NAME:** DOD ORGANIZATION NAME
**FORMAT:** C40
**CONTENT:** DoD organization responsible for the project.
**EXAMPLES:** Marine Corps Development and Education Office, Army Research Institute

**FIELD NO:** 34
**FIELD NAME:** DOD_ADDR1
**FULL NAME:** DOD ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** First line of postal address of the responsible DoD organization named in Field 33.
**EXAMPLES:** Building 5

**FIELD NO:** 35
**FIELD NAME:** DOD_ADDR2
**FULL NAME:** DOD ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** Second Line of postal address of the responsible DoD organization named in Field 33.
**EXAMPLES:** Cameron Station

**FIELD NO:** 36
**FIELD NAME:** DOD_ADDR3
**FULL NAME:** DOD ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** Third line of postal address of the responsible DoD organization named in Field 33.
**EXAMPLES:** Alexandria, VA 22314

**FIELD NO:** 37
**FIELD NAME:** DOD_CONT
**FULL NAME:** CONTACT
**FORMAT:** C40
**CONTENT:** Name of the individual, from the responsible DoD organization, from whom additional information may be obtained. Entered as last name, first initial (without a period), and military rank (if appropriate). Other titles (e.g., Dr.) are not used. Each portion is separated by a space.

**FIELD NO:** 38
**FIELD NAME:** DOD_PHONE
**FULL NAME:** PHONE
**FORMAT:** C12
**CONTENT:** Telephone number (commercial, Autovon, or both) for the responsible individual in Field 37. Entered in standard telephone number format.
**EXAMPLES:** 619-225-2056;933-2056

**FIELD NO:** 39
**FIELD NAME:** PERF_NAME
**FULL NAME:** PERFORMING ORGANIZATION NAME
**FORMAT:** C40
**CONTENT:** The organization actually performing the project. Abbreviations are used where necessary.
**EXAMPLES:** Essex Corp., Boeing Inc, Arizona State Univ.

**FIELD NO:** 40
**FIELD NAME:** PERF_ADDR1
**FULL NAME:** PERFORMING ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** First line of postal address of the performing organization named in Field 39.
**EXAMPLES:** Building 5

**FIELD NO:** 41
**FIELD NAME:** PERF_ADDR2
**FULL NAME:** PERFORMING ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** Second line of postal address of the performing organization named in Field 39.
**EXAMPLES:** Cameron Station

**FIELD NO:** 42
**FIELD NAME:** PERF_ADDR3
**FULL NAME:** PERFORMING ORGANIZATION ADDRESS
**FORMAT:** C53
**CONTENT:** Third line of postal address of the performing organization named in Field 39.
**EXAMPLES:** Alexandria, VA 22314

**FIELD NO:** 43
**FIELD NAME:** PERF_CONT
**FULL NAME:** PERFORMING ORGANIZATION CONTACT
**FORMAT:** C40
**CONTENT:** Name of the individual, from the performing organization, from whom additional information may be obtained. Entered as last name, first initial (without a period), and military rank (if appropriate). Other titles (e.g., Dr.) are not used. Each portion is separated by a space. Acceptable abbreviations of military ranks are the same as Field 37.

**FIELD NO:** 44
**FIELD NAME:** PERF_PHONE
**FULL NAME:** PERFORMING ORGANIZATION PHONE
**FORMAT:** C13
**CONTENT:** Telephone number (commercial, Autovon, or both) for the responsible individual in Field 43.
**EXAMPLES:** 619-225-2056;933-2056

**FIELD NO:** 45-49
**FIELD NAME:** PROGRESS1-PROGRESS5
**FULL NAME:** PROGRESS
**FORMAT:** C60
**CONTENT:** Narrative description of the project's progress.

**FIELD NO:** 50-55
**FIELD NAME:** KEY1-KEY6
**FULL NAME:** KEY WORDS
**FORMAT:** C30
**CONTENT:** Any words or phrases that identify the principal subjects covered in the report, and that conform to standard terminology and are exact enough to be used as subject index entries. Certain acronyms or buzz words may be used if they are recognized by specialists in the field and have the potential for becoming accepted terms.
**EXAMPLES:** Laser, Reversed osmosis

**FIELD NO:** 56-59
**FIELD NAME:** AUTHOR1-AUTHOR4
**FULL NAME:** AUTHORS
**FORMAT:** C24
**CONTENT:** Name of the investigators of the research. See Field 43, for the structured of the data.

**FIELD NO:** 60
**FIELD NAME:** TITLE1
**FULL NAME:** TITLE
**FORMAT:** C140
**CONTENT:** The title of the work as it appears in the source documentation.

**FIELD NO:** 62
**FIELD NAME:** PUBLISHER
**FULL NAME:** ORG/PUBLISHER (BOOK), JOURNAL (ARTICLE):
**FORMAT:** C60
**CONTENT:** Narrative descriptions and bibliographic citations of end products, such as technical documents, journal articles, etc., produced as a result of the research.

**FIELD NO:** 63
**FIELD NAME:** PUB_YR
**FULL NAME:** PUBLICATION YEAR
**FORMAT:** C4
**CONTENT:** Year the research in Field 60 was published.

**FIELD NO:** 64
**FIELD NAME:** PUB_VOL
**FULL NAME:** PUBLICATION VOLUME
**FORMAT:** C4
**CONTENT:** The appropriate volume number for Field 62.

**FIELD NO:** 65
**FIELD NAME:** PUB_PAGES
**FULL NAME:** PUBLICATION PAGES
**FORMAT:** C4
**CONTENT:** The appropriate pages for Field 62.

# Appendix B

# Batch Procedure Instructions

## APPENDIX B

## IST/PM TRADE IN-HOUSE DATA BASE

## Batch Procedure Instructions

### Introduction

The purpose of these instructions is to guide the user in archiving, converting, and batching to PM TRADE data created using the IST/ PM TRADE In-house data base. All of the facilities needed are located on the Zenith PC at IST. The following information is a step-by-step guide to insure successful transfer of data from IST to PM TRADE.

## Contact PM TRADE for Last Record Number

1. Call Dennis Kriha of PM TRADE at 380-4457
2. Ask Dennis for the entry number of the last record in the IST/ PM TRADE data base
3. Save the number for use later in the process
4. Repeat steps 1-3 until successfully completed

## Logging on to the Zenith PC

1. Turn on the PC using the switch on the power strip
2. At the **C:\>** prompt type **cd \dbase3**
   Press **<Enter>**
3. If the dBASE files are on a floppy disk insert the disk into the appropriate drive

## Converting dBASE Files to ASCII Files

1. If the dBASE files are on drive A, type **copya**
   Press **<Enter>**

   If the dBASE files are on drive B, type **copyb**
   Press **<Enter>**

   If the dBASE files are on drive C, type **copyc**
   Press **<Enter>**
2. Type **renum**
   Press **<Enter>**
3. When prompted for the entry number enter the number obtained from Dennis at PM TRADE
4. Type **trans**
   Press **<Enter>**
5. Respond to any prompts by typing **Y**

## Retrieve ASCII Files for Delivery

1. Insert a formatted disk into drive A:

2. Type **copy trans*.txt A:**
   Press **<Enter>**

3. The disk is now ready to be delivered to PM TRADE

## Clear dBASE Files

1. Type **zapall**
   Press **<Enter>**

2. Respond to prompt with correct disk drive

3. The dBASE files are now cleared and ready for more data

# Appendix C

# Instructions for Data Base Interface

## Appendix C

```
*****************************************************************
*                          LSEMENU
*                  IST/ PM TRADE In-House Data Base
*    University of Central Florida/ Institute for Simulation and
*                          Training
*                Written by John H. Bailey    7/5/89
*
*****************************************************************
*    lsemenu.prg   -    This is the menu program for the IST
*                       data base.
*
set status off
clear all
set color to bg+/n,n/w
set talk off
set bell off
set dele on
clear
Do While .T.
    clear
    ?? "                          IST/PM TRADE Data Base Menu "
    ?  "                          ============================ "
    set wrap on
    set message to 23 center
    @ 4, 23 prompt "Sponsored Research Entry Field"
    @ 5, 23 prompt "Fields of Endeavor"
    @ 6, 23 prompt "LSE/MAM/TD/AT"
    @ 7, 23 prompt "Executive summary"
    @ 8, 23 prompt "Quit" ;
        message "This will exit the program and return to DOS"
    Menu to choice
    do case
        case    choice = 1
                do lse
        case    choice = 2
                do foe
        case    choice = 3
                do foe2
        case    choice = 4
                do exec
```

```
        case    choice = 5
                clear
                set status on
                ?
                ?
                ?  '                You have exited the IST/PM TRADE
Data Base '
                ?
                ?
                return
    endcase
enddo

*
*
*    lse.prg  -  This is the main entry and update screen for the
*                 IST/PM TRADE Data Base.  It is invoked from the
*                lsemenu.prg program.
*
*
Do while .T.
clear
    set wrap on
    set message to 24 center
    @ 0, 5 prompt "Add" message "Add record to data base"
    @ 0, col() + 2 prompt "Update"  ;
        message "Update a current record"
    @ 0, col() + 2 prompt "Quit" message "Return to main menu"
    menu to choice2
use lsemain
  do case
    case choice2 = 1
       do add
    case choice2 = 2
       do update
    case choice2 = 3
       return
  endcase
enddo
*
*  this is the Add record procedure
*
Procedure add
    Do While lastkey() <> 17
      next = " "
      append blank
      go bottom
      replace entry_num with Recno()
      replace entry_date with '00/00/00'
      replace chg_date with '00/00/00'
      replace s_date with '00/00/00'
      replace c_date with '00/00/00'
```

```
      replace work_yrs with '0000'
      replace funds with '00000000'
      do lsefor
      clear
      @ 0, 20 say " <ctl> q to quit "
      wait " " to next
    enddo
return
*
*  this is the update procedure
*
Procedure update
    Do While .T.
      clear
      set wrap on
      set message to 24 center
      @ 0, 5 prompt "All" message "Update all records"
      @ 0, col() + 2 prompt "Entry Num" ;
           message "Update by #, > #"
      @ 0, col() +2 prompt "Subject" ;
           message "Update by Subject"
      @ 0, col() + 2 prompt "Quit" message "Quit Updating"
     menu to choice3
*
    Do case
      Case choice3 = 1
        go top
        do run
      Case choice3 = 2
        clear
        ?
        accept 'search> ' to entryn
        go top
        if val(substr(entryn,1,7)) = 0
          locate for entry_num = val(substr(entryn,2,7))
        else
          locate for entry_num = val(substr(entryn,1,7))
        endif
          if found()
            do lsefor
          endif
          if found() .and. substr(entryn,1,1) = '>'
            skip
            do run
          endif
       Case choice3 = 3
        clear
        ?
        accept 'search> ' to entryn
        go top
        do while .not. eof()
           if at(entryn, subj) # 0
```

```
            do lsefor
            skip
          else
            skip
          endif
        enddo
      Case choice3 = 4
        return
    endcase
enddo
```

```
*
*
* a generic update procedure to update all of file from
* a specified point
*
procedure run
Do While .not. eof()
    do lsefor
    skip
enddo
return
```

```
*
*
*    foe.prg -  This is the fields of endeavor add and update
*                program. It is invoked from the
*                lsemenu.prg program.
*
*
Do while .T.
clear
    set wrap on
    set message to 24 center
    @ 0, 5 prompt "Add" message "Add field of endeavor"
    @ 0, col() + 2 prompt "Update"  ;
        message "Update field of endeavor"
    @ 0, col() + 2 prompt "Quit" message "Return to main menu"
    menu to choice4
use foedbf
  do case
    case choice4 = 1
       do add2
    case choice4 = 2
       do update2
    case choice4 = 3
       return
  endcase
enddo
*
*  this is the Add record procedure
*
Procedure add2
    Do While lastkey() <> 17
      next = " "
      append blank
      go bottom
      do foefor
      clear
      @ 0, 20 say " <ctl> q to quit "
      wait " " to next
    enddo
return
*
*  this is the update procedure
*
Procedure update2
    Do While .T.
      clear
      set wrap on
      set message to 24 center
      @ 0, 5 prompt "All" message "Update all records"
      @ 0, col() + 2 prompt "Entry Num" ;
           message "Update by #, > #"
```

```
      @ 0, col() + 2 prompt "Quit" message "Quit Updating"
     menu to choice5
*
    Do case
      Case choice5 = 1
        go top
        do run2
      Case choice5 = 2
        clear
        ?
        accept 'search> ' to entryn
        go top
        if val(substr(entryn,1,7)) = 0
          locate for X1 = val(substr(entryn,2,7))
        else
          locate for X1 = val(substr(entryn,1,7))
        endif
          if found()
            do foefor
          endif
          if found() .and. substr(entryn,1,1) = '>'
            skip
            do run2
          endif
      Case choice5 = 3
        return
    endcase
enddo
*
*
* a generic update procedure to update all of file from
* a specified point
*
procedure run2
Do While .not. eof()
    do foefor
    skip
enddo
return
```

```
*
*
*    foe2.prg -  This is the Mission Areas entry and update
*                program. It is invoked from the
*                lsemenu.prg program.
*
*
Do while .T.
clear
    set wrap on
    set message to 24 center
    @ 0, 5 prompt "Add" message "Add Mission Area"
    @ 0, col() + 2 prompt "Update"  ;
        message "Update Mission Area"
    @ 0, col() + 2 prompt "Quit" message "Return to main menu"
    menu to choice6
use foedbf
  do case
    case choice6 = 1
       do add3
    case choice6 = 2
       do update3
    case choice6 = 3
       return
  endcase
enddo
*
*  this is the Add record procedure
*
Procedure add3
    clear
    accept 'Please enter the entry number: ' to EN
    go top
    do while .not. eof() .and. val(EN) # X1
      if val(EN) # X1
        skip
      endif
    enddo
    Do While .not. eof() .and. lastkey() # 17
      next = " "
      do foe2for
      clear
      @ 0, 20 say " <ctl> q to quit "
      wait " " to next
      skip
    enddo
return
*
*  this is the update procedure
*
Procedure update3
    Do While .T.
```

```
      clear
      set wrap on
      set message to 24 center
      @ 0, 5 prompt "All" message "Update all records"
      @ 0, col() + 2 prompt "Entry Num" ;
           message "Update by #, > #"
      @ 0, col() + 2 prompt "Quit" message "Quit Updating"
     menu to choice7
*
    Do case
      Case choice7 = 1
        go top
        do run3
      Case choice7 = 2
        clear
        ?
        accept 'search> ' to entryn
        go top
        if val(substr(entryn,1,7)) = 0
          locate for X1 = val(substr(entryn,2,7))
        else
          locate for X1 = val(substr(entryn,1,7))
        endif
          if found()
            do foe2for
          endif
          if found() .and. substr(entryn,1,1) = '>'
            skip
            do run3
          endif
      Case choice7 = 3
        return
    endcase
enddo
*
*
* a generic update procedure to update all of file from
* a specified point
*
procedure run3
Do While .not. eof()
    do foe2for
    skip
enddo
return
```

```
*
*
*    exec.prg -  This is the Executive Summary entry and update
*                program. It is invoked from the
*                lsemenu.prg program.
*
*
Do while .T.
clear
    set wrap on
    set message to 24 center
    @ 0, 5 prompt "Add" message "Add Executive Summary"
    @ 0, col() + 2 prompt "Update"  ;
        message "Update Executive Summary"
    @ 0, col() + 2 prompt "Quit" message "Return to main menu"
    menu to choice9
use execdbf
  do case
    case choice9 = 1
       do add4
    case choice9 = 2
       do update4
    case choice9 = 3
       return
  endcase
enddo
*
*  this is the Add record procedure
*
Procedure add4
    Do While lastkey() <> 17
      next = " "
      append blank
      go bottom
      do execfor
      clear
      @ 0, 20 say " <ctl> q to quit "
      wait " " to next
    enddo
return
*
*  this is the update procedure
*
Procedure update4
    Do While .T.
      clear
      set wrap on
      set message to 24 center
      @ 0, 5 prompt "All" message "Update all records"
      @ 0, col() + 2 prompt "Entry Num" ;
           message "Update by #, > #"
      @ 0, col() + 2 prompt "Quit" message "Quit Updating"
```

```
     menu to choice10
*
    Do case
      Case choice10 = 1
        go top
        do run4
      Case choice10 = 2
        clear
        ?
        accept 'search> ' to entryn
        go top
        if val(substr(entryn,1,7)) = 0
          locate for X3 = val(substr(entryn,2,7))
        else
          locate for X3 = val(substr(entryn,1,7))
        endif
          if found()
            do execfor
          endif
          if found() .and. substr(entryn,1,1) = '>'
            skip
            do run4
          endif
       Case choice10 = 3
          return
    endcase
enddo
*
*
* a generic update procedure to update all of file from
* a specified point
*
procedure run4
Do While .not. eof()
    do execfor
    skip
enddo
return
```

```
*************************************************************
*                                                           *
*   LSEFOR.FMT - format for lsemain called from lse.prg     *
*                                                           *
*************************************************************
*
clear
@ 2,19 say 'Sponsored Research Entry Form                 page 1'
@ 4,0 say 'Entry Number: ' get entry_num pict '99999'
@ 4,22 say 'Date: ' get entry_date pict '99/99/99'
@ 4,42 say 'Executive Summary: (Y/N) ' get exec_s pict 'Y'
@ 6,0 say 'Subject: ' get subj pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 8,0 say 'Summary: ' get summary1
@ 9,0 say '          ' get summary2
@ 10,0 say '          ' get summary3
@ 11,0 say '          ' get summary4
@ 12,0 say '          ' get summary5
@ 13,0 say '          ' get summary6
@ 14,0 say '          ' get summary7
@ 16,0 say 'Date of Last Change: (mm/dd/yy) ' get chg_date pict ;
'99/99/99'
@ 17,0 say '                    Originator: ' get orig pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 19,0 say 'Location: ' get loc pict '!!!!!!!!!!!!!!!!!!!!'
@ 19,35 say 'Document Type: ' get type_doc pict '!!!!!'
@ 20,0 say 'Reviewed (LSE/FOE): (Y/N) ' get reviewed pict 'Y'
@ 20,35 say 'Initials: ' get initials pict '!!!'
@ 21,0 say '(IST): (Y/N) ' get ist pict 'Y'
@ 21,35 say 'Classification: ' get classif pict '!'
read
clear
@ 2,19 say 'Sponsored Research Entry Form                 Page 2'
@ 4,0 say 'Graphics File: ' get graphics pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 6,0 say 'Contract/Grant: ' get grant pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 7,0 say '         Number: ' get num pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 8,0 say '    Start Date: (mm/dd/yy) ' get s_date pict ;
'99/99/99'
@ 8,38 say 'Est. Comp. Date: ' get c_date pict '99/99/99'
@ 9,0 say '  Funding Org.: ' get org pict ;
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 10,0 say '  Perf. Method: ' get method pict '!!!!!!!!!!'
@ 14,0 say 'Scope of Research '
@ 15,0 say '              ' get soa pict '!!!'
@ 15,21 say 'Advance SOA'
@ 16,0 say '              ' get ecd pict '!!!'
@ 16,21 say 'Enhancing Current Devices/ Simulations Ident. Dev.'
@ 17,0 say '              ' get ra pict '!!!'
@ 17,21 say 'Risk Avoidance'
```

```
@ 21,0 say 'Estimated Resources'
@ 22,7 say 'FY: ' get fy_res pict 'XXXX'
@ 22,20 say 'Prof. Work Years: ' get work_yrs pict '9999'
@ 22,47 say 'Funds: ' get funds pict '99999999'
read
clear
@ 2,19 say 'Sponsored Research Entry Form                Page 3'
@ 5,0 say 'Responsible DOD Organization'
@ 6,0 say '        Name: ' get dod_name
@ 7,0 say '        Address: ' get dod_addr1
@ 8,0 say '                 ' get dod_addr2
@ 9,0 say '                 ' get dod_addr3
@ 10,0 say '         Contact: ' get dod_cont
@ 11,0 say '         Phone: ' get dod_phone pict 'XXXXXXXXXXXX'
@ 14,0 say 'Performing Organization'
@ 15,0 say '         Name: ' get perf_name
@ 16,0 say '         Address: ' get perf_addr1
@ 17,0 say '                  ' get perf_addr2
@ 18,0 say '                  ' get perf_addr3
@ 19,0 say '         Contact: ' get perf_cont pict ;
'XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX'
@ 20,0 say '         Phone: ' get perf_phone pict 'XXXXXXXXXXXX'
read
clear
@ 2,19 say 'Sponsored Research Entry Form                Page 4'
@ 4,0 say 'Progress: ' get progress1
@ 5,11 get progress2
@ 6,11 get progress3
@ 7,11 get progress4
@ 8,11 get progress5
@   10,0   say   'Keywords:   '   get   key1   pict
'!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 10,44 get key2 pict '!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 11,11 get key3 pict '!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 11,44 get key4 pict '!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 12,11 get key5 pict '!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 12,44 get key6 pict '!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!'
@ 14,0 say 'Authors: ' get author1
@ 14,45 get author2
@ 15,10 get author3
@ 15,45 get author4
@ 17,0 say 'Title:  '
@ 18,0 get title1
@ 21,0 say 'Org/Pub (book),  Journal (article): '
@ 22,0 get publisher
@ 24,0 say 'Year: ' get pub_yr pict '!!!!'
@ 24,20 say 'Volume: ' get pub_vol pict '!!!!'
@ 24,45 say 'Pages: ' get pub_pages pict '!!!!!!!!!!'
read
```

```
*
*   Foefor.prg - Format program for the fields of endeavor
*
*
clear
@ 2, 19 say 'Fields of Endeavor (put X in appropriate catagory)'
@ 4, 0 say 'Entry Number: ' get x1 pict '99999'
@ 6, 0 get A1 pict '!!'
@ 6, 3 say '1100.0   ENGAGEMENT SIMULATION AND INSTRUMENTATION'
@ 7,0 get A2 pict '!!'
@ 7, 3 say '1110.0   Pairing Systems'
@ 8, 5 get A3 pict '!!'
@ 8, 8 say '1111.0   Indirect Fire Simulation'
@ 9, 5 get A4 pict '!!'
@ 9, 8 say '1112.0   Shoot Through Obscuration Miles (STOW)'
@ 10, 5 get A5 pict '!!'
@ 10, 8 say '1112.1   Obscurant Technology'
@ 11, 5 get A6 pict '!!'
@ 11, 8 say '1112.2   Miles Enhancement/Through Obscurants'
@ 12, 0 get A7 pict '!!'
@ 12, 3 say '1120.0   Range Instrumentation'
@ 13, 5 get A8 pict '!!'
@ 13, 8 say 'Next Generation Training Instrumentation'
@ 14, 5 get A9 pict '!!'
@ 14, 8 say 'Automated Scoring System'
@ 15, 5 get A0 pict '!!'
@ 15, 8 say 'Manned Vehicle Technology'
@ 16, 5 get AA pict '!!'
@ 16, 8 say 'System Concepts for APFOR Augmentation'
@ 17, 0 get AB pict '!!'
@ 17, 3 say '1130.0   Targets'
@ 18, 0 get AC pict '!!'
@ 18, 3 say '1140.0   Robotics'
@ 19, 5 get AD pict '!!'
@ 19, 8 say '1141.0   AI/Robotics'
@ 20, 5 get AE pict '!!'
@ 20, 8 say '1141.1   Unmanned Vehicle Technology'
@ 21, 5 get AF pict '!!'
@ 21, 8 say '1141.2   Manned Vehicle Technology'
@ 22, 5 get AG pict '!!'
@ 22, 8 say '1141.3   System Concept for OPFOR Augmentation'
read
clear
@ 2, 0 get AH pict '!!'
@ 2, 3 say '1150.0   Other'
@ 3, 5 get AI pict '!!'
@ 3, 8 say '1142.0   Computer Simulation'
@ 4, 5 get AJ pict '!!'
@ 4, 8 say '1142.1   Automated OPFOR'
@ 5, 5 get AK pict '!!'
@ 5, 8 say '1142.2   Role Player Assistant'
@ 6, 0 get AL pict '!!'
```

```
@ 16, 60  GET  FOEDBF->E0 PICT '!!'
@ 16, 65  SAY "IEW"
@ 17,  2  GET  FOEDBF->EA PICT '!!'
@ 17,  7  SAY "NBC"
@ 17, 16  GET  FOEDBF->EB PICT '!!'
@ 17, 21  SAY "ORD"
@ 17, 31  GET  FOEDBF->EC PICT '!!'
@ 17, 36  SAY "QM"
@ 17, 46  GET  FOEDBF->ED PICT '!!'
@ 17, 51  SAY "SOF"
@ 17, 60  GET  FOEDBF->EE PICT '!!'
@ 17, 65  SAY "TRANS"
@ 19,  1  SAY "Areas of Technology"
@ 20,  2  GET  FOEDBF->F1 PICT '!!'
@ 20,  7  SAY "AI"
@ 20, 16  GET  FOEDBF->F2 PICT '!!'
@ 20, 21  SAY "CHW"
@ 20, 31  GET  FOEDBF->F3 PICT '!!'
@ 20, 36  SAY "CIG"
@ 20, 46  GET  FOEDBF->F4 PICT '!!'
@ 20, 51  SAY "CSW"
@ 20, 60  GET  FOEDBF->F5 PICT '!!'
@ 20, 65  SAY "E"
@ 21, 2 GET FOEDBF->F6 PICT '!!'
@ 21, 7 SAY "FDY"
@ 21, 16 GET FOEDBF->F7 PICT '!!'
@ 21, 21 SAY "FTD"
@ 21, 31 GET FOEDBF->F8 PICT '!!'
@ 21, 36 SAY "HF"
@ 21, 46 GET FOEDBF->F9 PICT '!!'
@ 21, 51 SAY "NN"
@ 21, 60 GET FOEDBF->FA PICT '!!'
@ 21, 65 SAY "TDB"
@ 22, 2 GET FOEDBF->FB PICT '!!'
@ 22,7 SAY "TT"
READ
```

```
*
*    execfor.prg  -  This is the format program for the executive
*                    summary screens to be used for data input
*                    and update.
*
*
clear
@ 2, 19 say 'Executive Summary Screen      (page 1) '
@ 3, 25 say 'Entry #: ' get x3 pict '99999'
@ 5, 0 say 'Executive    ' get exec1
@ 6, 0 say ' Summary:    ' get exec2
@ 7, 13 get exec3
@ 8, 13 get exec4
@ 9, 13 get exec5
@ 10, 13 get exec6
@ 11, 13 get exec7
@ 12, 13 get exec8
@ 13, 13 get exec9
@ 14, 13 get exec10
@ 15, 13 get exec11
@ 16, 13 get exec12
@ 17, 13 get exec13
@ 18, 13 get exec14
@ 19, 13 get exec15
@ 20, 13 get exec16
@ 21, 13 get exec17
@ 22, 13 get exec18
read
clear
@ 2, 19 say 'Executive Summary Screen        (page 2) '
@ 4, 0 say 'Executive    ' get exec19
@ 5, 0 say ' Summary:    ' get exec20
@ 6, 13 get exec21
@ 7, 13 get exec22
@ 8, 13 get exec23
@ 9, 13 get exec24
@ 10, 13 get exec25
@ 11, 13 get exec26
@ 12, 13 get exec27
@ 13, 13 get exec28
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Structure for database: C:foedbf.dbf
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ESTIMATED FORMAT

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YEAR
SCOPE OF RESEARCH
KEY WORDS
AUTHORS

FORMAT #2

ENTRY NUMBER
TITLE
SUMMARY
AUTHORS
YEAR
ORG/PUBLISHER
VOLUME & PAGES

FORMAT #3

ENTRY NUMBER
TITLE
SUMMARY
AUTHORS
YEAR
ORG/PUBLISHER
VOLUME & PAGES
PERFORMING ORGANIZATION

FORMAT #4

WHOLE REPORT

# Appendix D

# TSD Newsletter

# TRAINING SYSTEMS AND DEVICES

*A News Bulletin Promoting Technology Transfer*

Summer 89 | PM TRADE | Vol. 1 No. 3

# Training capabilities upgraded at NTC

This issue has several articles devoted to technology developments for upgrading the training capabilites at the National Training Center (NTC) at Fort Irwin, California.

These projects are being conducted in response to an initiative of the Army Chief of Staff in 1987 following a decision brief presented by the Army staff.

A center piece of the plan called for a phased increase in the Blue Force from the current Heavy Battalion to a Brigade. In order to maintain doctrinally correct force ratios between the Blue Force and the OPFOR, the OPFOR needed to be increased from the Motorized Rifle Regiment to a Motorized Rifle Division.

Upgrade projects include:

- Shoot Through Obscuration Miles (STOM)
- Upgrade of Opposing Force (OPFOR) Vehicles
- Reduced Crewed Vehicles
- Computer Simulation (Role player's assistant and automated OPFOR)

In January 1987, PM TRADE was designated as the technical agent for materiel acquisition at the NTC in support of the planned expansion. As part of PM TRADE's overall strategy for addressing NTC materiel requirements, an Industry Day was held in May, 1987, at the NTC. Industry was asked to submit white papers to present new concepts and extend ideas that surfaced during these discussions.

In February 1988, PM TRADE released the NTC BAA. Forty-six proposals were submitted by industry which included the technology areas described above. These projects represent a substantial commitment by PM TRADE to develop advanced technology that will increase training realism and effectiveness, and reduce required resources.

## NTC upgrade reduces personnel requirements

The goal of a PM TRADE research project is to save personnel resources by providing a role player's assistant and Automated OPFOR (Opposing Forces) for the computer simulation of the rear and adjacent forces.

The project is funded through the NTC BAA to investigate the use of Artificial Intelligence techniques for supplementing the battle simulation which will be fielded at the National Training Center (NTC).

According to Lead Systems Engineer Robert Paulson, "Running man-in-the-loop battle simulations is resource intensive and the size of the support team increases as the size of the exercises grows." A goal of the NTC upgrade is to reduce personnel costs through application of technology while expanding the operation from battalion to brigade size. The approach for the computer simulation is unique in that it will combine live players and simulated forces in the same training exercise.

The role player's assistant and the automated OPFOR are expert systems. The role player's assistant provides information to the role player through interrogation of the expert system, and by recognizing events and prompting the role player.

The assistant supports the role player on the BLUE side. In its initial configuration, the assistant will be a computer console housed

*see Reduces, page 2*

# IST and FHTIC host network symposium

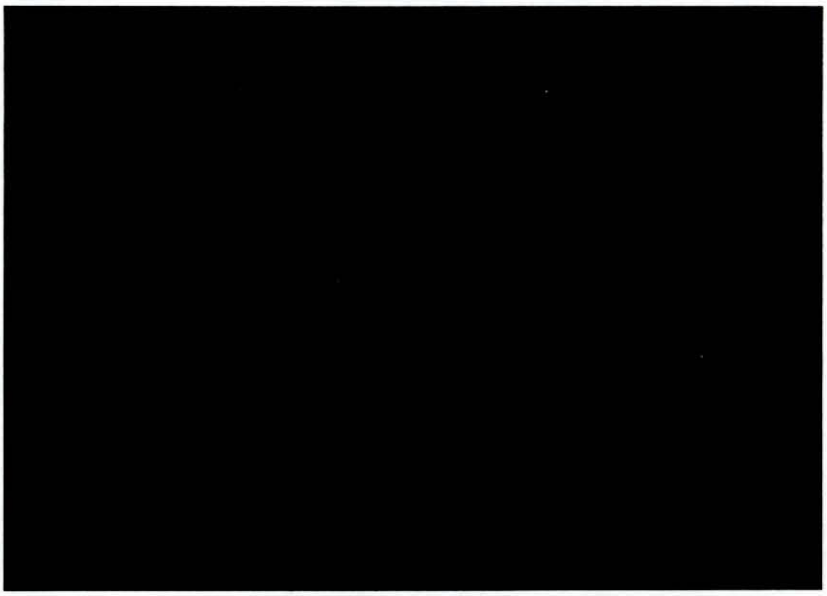
Interactive Networked Simulation for Training was the theme of the first in a series of annual symposia sponsored by Institute for Simulation and Training. This first symposium was co-sponsored by the Florida High Technology and Industry Council.

Over 200 researchers from the U.S. and Europe attended the symposium on April 26-27, held at the Holiday Inn, University in Orlando, Florida.

"We had a very good response," Dr. Peter Kincaid, Symposium Co-Chair, said.

The purpose of the symposium was to provide a forum for the identification of user networking requirements and the related research areas that must be investigated to resolve behavioral, engineering, and training questions.

April's symposium featured keynote speakers Dr. Earl Alluisi, Office of the Under Secretary of Defense, and Col. Jack Thorpe, DARPA.



*Dr. Earl Alluisi speaks to more than 200 researchers at the symposium.*

"We have a vision," Alluisi said in his keynote address. "The vision is of an interactive network that can be used for training individual troops, sailors, marines, and airmen as parts of the crews to which they belong. The network is the key."

Alluisi said the goal of using interactive networks is to attain a new level of peacetime readiness, with troops trained to the levels of combat skills and effectiveness as seasoned combat veterans.

A panel discussion and 20 presentations covering a variety of topics were included in the symposium. As a result of questions raised during discussions, a committee was formed to address the problems of networking standards.

In addition to providing information, the symposium offered the opportunity to interact with people involved in diverse aspects of network simulation.

Tentative dates for next year's symposium are February 27-28.

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*Reduces continued*

in the Computer Instrumentation System building at the NTC (designated the Star Wars Center). The assistant will contain much of the knowledge of an experienced and senior tactical officer.

Two benefits may be produced through use of the assistant: reducing the skill level required of the role player, or reducing the number of required role players. For example, a less experienced role player could replace a battalion commander by relying on the advice given by the role player's assistant. Similarly, a single battalion commander could take on the roles of many battalion commanders.

The Automated OPFOR will perform a similar function for the RED side. Paulson emphasized that the current OPFOR at NTC (played by U.S. soldiers dressed in aggressor uniforms) will be augmented, but not replaced by the simulated OPFOR. The soldier-to-soldier play at the Forward Line of Troops (FLOT) is essential for realism.

Paulson said plans call for a technology demonstration in one year of a subset of the system recognizable as useful by military tacticians. Long term plans are to have something on the ground in the '92-'93 timeframe at NTC.

## New STOM technology looks promising

PM TRADE is sponsoring the development of Shoot Through Obscuration MILES (STOM), which has the potential to considerably enhance the training utility of training systems based on MILES. According to Mr. Jim Surhigh, Lead Systems Engineer at PM TRADE, STOM has the potential to provide MILES-based training in fog, smoke and dust, conditions which are routinely encountered in such training sites as the National Training Center and in Germany.

The technical breakthrough that could make STOM practical is the use of carbon dioxide lasers and pyroelectric detectors which operate at room temperature. Previous detectors for carbon dioxide lasers had to be cooled below the temperature of liquid nitrogen, making them impractical for field use.

Lasers currently used in MILES systems are based on the use of gallium arsenide and the associated dectectors, which work well at room temperature but the laser beams will not cut through obscurants. Soldiers also report that even though they can see targets through their thermal sights in foggy, smoky or dusty conditions, they are unable to shoot the targets with MILES weapon simulators. The new STOM technology has the potential to solve this training problem. Surhigh emphasized that the goal of the STOM project is to establish proof of principle. He added that the technology looks

*see STOM, page 8*

## PM TRADE studying options for Opposing Force (OPFOR ) vehicles

The OPFOR program will provide a family of replacement OPFOR vehicles at the NTC (Ft. Irwin, California), the Joint Readiness Training Center (JRTC, Ft. Chaffee, Arkansas), and the Combat Maneuver Training Center (CMTC, Hohenfels, Germany). The fleet of Sheridan tanks (M551s) currently used as OPFOR vehicles at the NTC are aging and becoming expensive to maintain. The OPFOR Vehicle program will replace and expand the aging fleet at the NTC. The program will also provide a fleet of OPFOR vehicles at the JRTC and CMTC, where there is no objective OPFOR contingent.

PM TRADE, with active industry input, is working with several Army agencies to determine materiel alternatives for a new generation of Opposing Force (OPFOR) vehicles. The ultimate goal of this program is to increase the cost/training effectiveness of Army Combat Training Centers. Other programs (described in this issue) will provide the technology to be inserted into the OPFOR vehicle program.

Five different threat systems are required to be represented:

- tank
- infantry fighting vehicle
- air defense weapon
- self propelled howitzer
- antitank guided missile

"We've involved industry in the planning of this project from the onset," Dennis Heath, PM TRADE's Lead Systems Engineer for the project, said. "We started with the identification of the need during Industry Day which was held in May 1987. We've also had excellent industry input, first in the form of white papers, following Industry Day, and more recently, written responses to a CBD announcement, which helps define formal requirements for the program." He added that a second draft of these requirements was sent out to industry in February 1989 and comments and insights have been instrumental in shaping the program.

Heath stressed that five separate chassis may not be needed to represent the five threat variants; several of these threat vehicles may be combined on a single chassis. "To the extent that we can represent more than one threat variant on a single chassis and make the vehicle 'fleet common'," said Heath, "we can save the Army money, and still meet the training need." Heath added that much time has been spent in looking at cost and effectiveness tradeoffs for this program.

PM TRADE is acting as executive agent for the program,

*see OPFOR, page 5*

# IST conducting advanced networking research

The Institute for Simulation and Training has been awarded three related contracts by PM TRADE to conduct advanced research on networking of simulation for training. The contracts are sponsored by the Defense Advanced Research Projects Agency and will be administered by PM TRADE.

According to Brian Goldiez, program manager, the work to be conducted over the next two years will support various aspects of combined arms training, including:

- networking/communication technology
- intelligent simulated forces
- low cost aviation training

These technologies are vital to developing the capability to provide real-time intervactive simulated representation of battlefield environments at an affordable price. General Thurman, TRADOC Commander, has said that one objective is to be capable of training the Army without having to go to the field by the year 2004. Development over the next 10 to 20 years is expected to increasingly depend on networking technology for large scale combined arms training and force development test and evaluation.

Ernie Smart, the general program manager, said work on these projects will include personnel from the State University System and other universities throughout Florida and the nation. According to Smart, approximately 30 faculty members and students will be involved in the project at some point.

## Networking/Communication Technology

Advanced concepts of networking applied to team training has been the object of a large scale R&D project by the Defense Advanced Research Projects Agency (DARPA). The focus of this research has been Simulated Networking (SIMNET). For most researchers, networking is new enough that problems are still being explored for efficiency, interface technologies, and communication protocols.

A laboratory will be developed which will have the capability to evaluate the impact of new technolgies related to networking.

Test beds will be developed to support research in networking, aviation technology, and intelligent semi-automated forces. These test beds will provide flexible and open interfaces for new technologies.

Another important task in this research is the development of networking standards. As a result of the recent Networking Symposium (see IST and FHTIC host networking smposium, page 2), more than 40 companies have offered to comment on networking standards and protocols. The goal of this networking standards group is to prepare a draft specification and convene a working meeting August 22-23 to finalize the specification. This workshop will address the establishment of technical standards for network protocols and architectures for interfacing defense simulation systems. Industry standards will be heavily considered. (Contact Brian Goldiez at 407-658-5015 if you would like to review the draft or attend the meeting.)

***We want to train the Army without going to the field by the year 2004.***

General Thurman, TRADOC Cmdr.

This research will provide two main benefits for the simulation and training community. The first benefit will be the establishment of a standard technique to evaluate network performance and interoperability.

The second benefit will be the provision of a laboratory environment available to the simulation and training community that develops and evaluates advancements in networking technology. These benefits will allow simulation and networking technology to proceed in an orderly manner.

### Intelligent Simulated Forces

This research addresses issues related to the development of intelligent opposing forces. Researchers will examine current approaches to simulation of opposing forces, develop a flexible evaluation environment for opposing force simulations, and establish benchmarks for evaluating alternative opposing force simulation concepts and prototypes.

IST will work with industry to evaluate and enhance new opposing force models, and explore new technological approaches to implement these forces.

The problem addressed by this research is that present approaches to semi-automating forces are computational intensive and not totally realistic in all respects. "The OPFOR at a distance looks fine," Goldiez said, "but individual targets in view (which are semi-automated) frequently don't behave like real targets. They just aren't 'smart' enough yet. We intend to improve the situation."

One of the first steps in conducting this research is the development of a taxonomy organized according to three factors: fidelity of the simulation, size of the force being simulated, and computational or modeling constraints. Approaches to developing semiautomated opposing forces will be analyzed according to these three factors.

Another technical problem to be addressed is that many computer programming languages, such as FORTRAN and Ada, are mixed in the same simulator. Goldiez added "exchanging information in this environment in real time is no trivial task."

### Low Cost Aviation Trainer

There are two objectives in this area of research. The primary objective is to increase the model fidelity of aviation tactical training using microprocessor technology. According to Goldiez, this requires better understanding of the assumptions used to model the aircraft which are ultimately contained in the software.

"We need to understand what simplifying assumptions do collectively and individually to the simulated vehicle fidelity in all flight regimes," Goldiez said. "Once these assumptions are understood, we can selectively implement them based on the fidelity required by the user."

The secondary objective of this research is to nework aviation units with ground units. "This has been done before," Goldiez said, "but only by putting the aviation units on the same network with the SIMNETs. We're going to use bridging technologies to network the units."

IST will create a testbed using commercially available systems to conduct this research.

## *Simulation networks show promise and problems*

The networking of simulation training systems departs from traditional use of a computer network which allows the sharing of computer resources among multiple computers. In the application of the networking of simulators, the network is used almost exclusively for communication of process states between vehicles engaged in the training exercise.

Simulation networks make it possible for crews to train force-on-force in real-time battles. In this free-play world, there is no instructor to set rules or generate scenarios.

Although these networks provide enhanced training, there are many inherent limitations to using networks in this application. The disadvantage arises when attempts are made to apply traditional techniques of performance evaluation. The complexities and dynamics of team performance present dproblems in constructing appropriate instructional scenarios. These problems need systematic, validated and concerted design approaches.

Another problem is that as the number of simulators on the network and workload per simulator increases, there will be a deterioration in the throughput of the network and degradation of other performance measures. If these delays become significant, the effectiveness of real-time training simulation may be compromised due to response requirements which are time-critical.

Depending on communication protocols, there may be an increase in the frequency of retransmissions and lost or distorted messages. The magnitude of this problem is related to how well data is distributed throughout the networked system, and the soundness of the network access and internal network protocols.

# PM TRADE explores reduced crewed vehicles concept at NTC

*Editor's note: The last issue of Training Systems and Devices carried a story on the Robot Vehicle Working Group Meeting, hosted by PM TRADE. We promised a more complete description of PM TRADE's efforts in AI/robotics augmentation at the National Training Center (NTC). This article addresses the effort to reduce crew size of the first echelon vehicles at the NTC. Another article to appear in a future issue will describe a proposed project to apply robotics technology to second echelon vehicles at the NTC.*

The Hughes Advanced System Facility, teamed with Honeywell's Systems and Research Center, has started a research project to explore ways to reduce crew sizes for operating OPFOR (opposing force) vehicles.

According to Mr. Admiral Piper, who heads the project for PM TRADE, "One of the best ways to do this in a cost-effective way is to take a careful look at what tasks can be automated and what crew positions can be combined."

The demand for personnel resources is already substantial and continues to grow at a time when personnel is in increasingly shorter supply. The goal is to reduce the crew size from the current three or four crew members to two members. Previous work which Hughes and Honeywell have done for NATO and DARPA examined ways to reduce crew sizes for future main battle tanks. The gunner has been identified as the key crew position to examine for potential elimination. According to Piper, the research starts with the assumption that the gunner's function can be automated to a large extent, and those functions and tasks which can not be automated can be distributed between the driver and the tank commander. The unique contraint placed on the reduced crew concept for training is that the vehicle crewed by two men must function and appear in all aspects to be a fully crewed vehicle.

This research was initiated because of the NTC's plans to increase the opposing force substantially—from a motorized Soviet rifle regiment to a Soviet motorized rifle division which has many more vehicles. The goal of the Army is to achieve this increase without a corresponding increase of personnel resources.

According to the Hughes' Principal Investigator, Dr. David Baum, "The combat vehicle experts on the Hughes team will work with the human engineering and training staff to identify and examine the feasibility of various automation and soldier-machine interface concepts."

Several considerations constrain the conceptual analysis:

- The reduction in crew size by function automation must not change the fighting capability of the OPFOR vehicle and crew, or jeopardize soldier safety.
- The system should be operable by current armor and mechanized infantry personnel.
- An on-board, self-contained solution is preferred.
- The solution should be applicable across vehicle types to the maximum extent possible.

A concept being explored is based on automatic target recognition technology. The concept includes equipping each OPFOR vehicle with an imaging sensor package and sensor processing module. No change is required of the Blue Force equipment.

The sensor processor, called the automated target recognizer (ATR), controls the sensors and processes the range data to perform the functions of target search, detection, and classification. Having detected and classified a Blue Force tank (using, for example, a low light level TV camera, or a FLIR), the ATR would cue the tank commander for target verification and prioritization, and perform other "human" functions automatically.

Long term goals of the project call for a study phase and a possible technology demonstration within the next 36 months. At that time, applicability of the results of the project to retrofitting vehicles at NTC will be examined.

For further information, contact Mr. Piper at 407/380-4287 or (Autovon) 960-4287.

*OPFOR continued*

integrating the inputs of several other Army agencies, including:

• the Tank and Automotive Command (TACOM) , which is providing technical expertise relating to chassis.

• the Armament Research, Development, and Engineering Center, (ARDEC), which is providing technical expertise relating to turre t and particularly fire control systems.

• the Army Training Support Center (ATSC), which is providing information about visual modification (VISMOD) for the vehicles.

• the Missile and Space Intelligence Center (MSIC), which is providing threat characteristics

• the Combined Armed Training Center (CATA) of TRADOC, which is performing the Tradeoff Analysis (TOA).

PM TRADE is also providing technical expertise for the tactical engagement systems,, weapons engagement simulation subsystems, and instrumentation.

Three major options are being considered in the ongoing Tradeoff Determination (TOD) study:

• full scale development, designing vehicles from scratch

• modification of vehicles in the current Army inventory

• non-developmental items (having contractors integrate vehicles from existing components and subsystems, both commercial and mil-spec, or buy threat vehicles).

The results of the TOD and TOA will be briefed to the CSA in summer. The resulting decision will determine the direction of the OPFOR Vehicle Program.

LTC Steve Overstreet, Product Manager for Combat Training Centers, and Dave Manning have been active in this program. Manning is on a six month assignment to PM TRADE specifically to serve as Program Manager.

For more information, contact Mr. Heath at (Autovon) 960-4370 or (407) 380-4370.

# Training symposium videos available

The Training Technology Symposium held in March by TRADOC's Futures Training Division was videotaped and edited to eight hours. High level speakers from industry addressed more than a dozen general officers at the symposium, held at Fort Leavenworth, Kansas.

The video set includes the opening and closing remarks by General Thurman, Commander, TRADOC, and excerpts from 13 presentations. For information on the availability of the video set, contact LTC Bill Samuelson at (804) 727-4265, or write :

LTC Samuelson, TRADOC
Futures Training Division
Department of the Army
Ft. Monroe, Virginia 23651
ATTN: ATTG-C

**Listed in order of appearance, the presentations are:**

Dr. Linda Fenty, Electronic Data Systems *Training: Challenge for Readiness and Warfighting*

Mr. Nick Handres, Electronic Data Systems *AI Mechanical Maintenance*

Dr. Don Stamper, Electronic Data Systems *Technology Migration*

Dr. Richard Farson, Western Science Behavioral Institute *Computer Conferencing*

Dr.Alan Chute, AT&T *Teletraining*

Dr. Paul Caro, Flight Safety Corp. *Simulators*

Mr. John Zidek, GE *AEGIS Training Systems*

Mr. Robert Holkan, NASA,Johnson Space Center *Crew Training*

Mr. Scott Fischer, NASA Ames Research Center *Virtual Environment Technology*

General Paul Gorman (retired), Cardinal Point *Vision for the 90's*

Mr. John Larson, EER Systems Inc., and Mr. Bruce Ballentine, Scott Instruments *Speech Recognition & Voice Input/Output Technology*

Mr. Marc Petrin, Sanders Associates/Lockheed *Maintenance Training*

Dr. Alan Chute, AT&T *Integrated Learning Center for the Future*

*Stom continued*

promising and the resulting detector devices may be relatively inexpensive.

Simulaser Corporation is working under a contract through PM TRADE's Broad Agency Announcement to conduct this project. Their design goal is to demonstrate sucesssful pairing through a 30 meter fog oil cloud and a 10 meter dust cloud at ranges up to 4 km. The prototype system is scheduled for testing during FY90 at the National Training Center, Ft. Irwin, California.

If the STOM equipment proves reliable and effective, it will be considered for incorporation in next generation MILES training devices and Tank Weapon Gunnery Simulation System/Precision Gunnery System (TWGS/PGS) training devices.

Mr. Surhigh may be reached at (Autovon) 960-4351 or 407/380-4351 for further information.

## IST hosts workshop

A workshop to address the establishment of technical standards for the interopearability of defense simulations will be held August 22-23 by the Institue for Simulation and Training for the Department of Defense.

If interested, contact Brian Goldiez at (407) 658-5015, or write: IST, 12424 Research Parkway, Suite 300, Orlando, FL 32826.

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# Appendix E

# Fields of Endeavor

# Fields of Endeavor

## 1100 Engagement Simulation and Instrumentation

1. MANPRINT
2. Performance Assesment
3. Embedded training
4. Simulation
5. CBI/IVD/CAI
6. Training & Cost Effective Models
7. Networking Simulators
8. Fiber Optics
9. Image Processing
10. Image Display
11. Low Cost Visual
12. Expert Systems
13. Perceptual Learning
14. Experimental Classroom
15. Instructor/Trainee
16. Authoring System
17. Laser disk
18. Simulation Complexity Studies
19. Performance Measurement and Evaluation
20. Interactive Tasks/Skills
21. Comprehensive Skills
22. Group Dynamics
23. High Work Loads
24. Supervisory Controls
25. Knowledge Acquisition
26. Trainee Station Design
27. Instuctor Console Design
28. Adaptive Learning
29. Competency Based Training
30. Sustainment Training

1200 Real Time Man-in-the Loop Simulation Technology

1. Embedded Training
2. Instructor/Trainee Console Design
3. Modular Design
4. Rapid Scene Generation
4. Networking Simulators
5. Parallel Processing
6. Longhaul
7. Distributed Processing
8. Architectures
9. VHSIC
10. Fiber Optics
11. Expert Systems
12. AI
13. Trainee Station Design
14. Instructor Console design

2100 Low Cost/Complexity Simulation

1. Training and Cost Effective Models
2. Low Cost Visual
3. CBI/CAI/IVD
4. Simulation Complexity Studies
5. Modular Design

2200 Visual Simulation Technology

1. Simulation
2. Rapid Database Generation
3. CBI/IVD/CAI
4. Rapid Scene Genaration
5. AI
6. Networking Simulators
7. Low Cost Visual
8. Graphics
9. Image Processing
10. Image Display
11. Visual
12. Helmet Mounted
13. Laser Disk
14. Simulation Complexity Studies

3100 Training Acquisition Technology

1. Performance Assesment
2. Embedded Training
3. Instructor/Trainee Console Design
4. Personnel Selection and Retention
5. Training & Cost Effective Models
6. Experimental Classroom
7. Instructor/Trainee
8. Performance Measurement & Evaluation
9. Interactive Task/Skills
10. Comprehensive Skills
11. Group Dynamics
12. Competency Based Training
13. Sustainment Training

4200 AI and Interactive Informational Processes

1. CBI/IVD/CAI
2. Embedded Training
3. Database Development
4. High Level Simulation Language
5. Robotics
6. AI
7. CGI
8. Voice Synthesis
9. Authoring System
10. Laser Disk
11. Human Information Processing/Perception & Monitoring
12. Experimental Classroom
13. Knowledge Acquisition
14. Interactive Task/Skills
15. Competency Based Training
16. Comprehensive Skills