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Embedded Training Technology Research And Integration Laboratory To Support Total Weapon System Acquisition: Volume I Technical Proposal

University of Central Florida Institute for Simulation and Training

INSTITUTE FOR SIMULATION AND TRAINING

Proposal submitted to
PM TRADE

in response to
PM TRADE Broad Agency Announcement
BAA NTSC 91-02

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Volume I
Technical Proposal

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

University of Central Florida
Division of Sponsored Research

IST-PR-91-5

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ABSTRACT

The Institute for Simulation and Training (IST) at the University of Central Florida (UCF) proposes to create an Embedded Training Research and Integration Laboratory which will promote acceptance and evolution of new simulation and training system technologies in the total weapon system acquisition process. The mission of the Laboratory will be to:

a. Develop an architecture for the integration of embedded technology concepts in the initial stages of new weapon system developments.

b. Conduct research, concept development and evaluation of embedded and alternate training technology concepts.

c. Promote the concepts for integration of IST/UCF existing and proposed laboratories where facilities such as NASA/AMES CSRDF, GTRI, U of Iowa, U of AL, and similar research facilities are capable of interactive operations in a Distributed Laboratory system. Military facilities such as TACOM RDEC, ARDEC, HEL, HRL, ETL, Ft Knox, and Ft Rucker could also be linked at the interface by application of Distributed Interactive Simulation (DIS).

The Laboratory will be established as a not-for-profit research and development organization made up of representation from government and academia. The initial, near term efforts will be aimed at definition of objectives, and planning of a facility which will constitute a solid foundation for training and simulation technology research and integration well into the next century. In the intermediate to longer term, this project will result in the development of a major local laboratory serving the PM TRADE mission in particular, and that of the Army in general. Successful research results will be scheduled for Proof of Principle evaluation at BDS-D sites and/or appropriate AMC laboratories. Also in the long term, financial support from products and services will be sought from the industrial community.

TABLE OF CONTENTS

EMBEDDED TRAINING
TECHNOLOGY RESEARCH AND INTEGRATION LABORATORY
TO SUPPORT THE TOTAL WEAPON SYSTEM ACQUISITION PROCESS

1.0 BACKGROUND:

OPERATION DESERT STORM has validated modern high technology weapon system concepts. Smart weapons and precision fire control on the move have set the parameters for the next move up for Next Generation/Future Systems (NG/FS). The Army community has been, and continues in the forefront of technology advancements with the Armored System Modernization (ASM), M1A2 cognitive cockpit proposals, and the Light Helicopter.

In the Army training systems community, Distributed Interactive Simulation (DIS) standards, Battlefield Distributed Simulation - Developmental (BDS-D), Wide-Area Networks, and many other on-going projects are, likewise, setting the parameters for the next move up in training systems within the Army.

As we move into the 90's, the results of DESERT STORM and the reduced threat environment will, in all likelihood, cause Congress, OSD and the U.S. Army to re-think the total weapon system arsenal and associated R & D strategies. With reduction in threat will come further reduction in procurement funds and a strong message from Congress to keep weapon systems in R & D to push the leading edge of technology.

An Army Policy Letter, dated March 1987, defined embedded training as... "Training that is provided by capabilities designed to be built into or added into operational systems to enhance and maintain the skill proficiency necessary to operate and maintain that equipment end item." ...and, has mandated that "...among viable alternatives, embedded training shall be the preferred method of training."

1.1 Total System Concept.

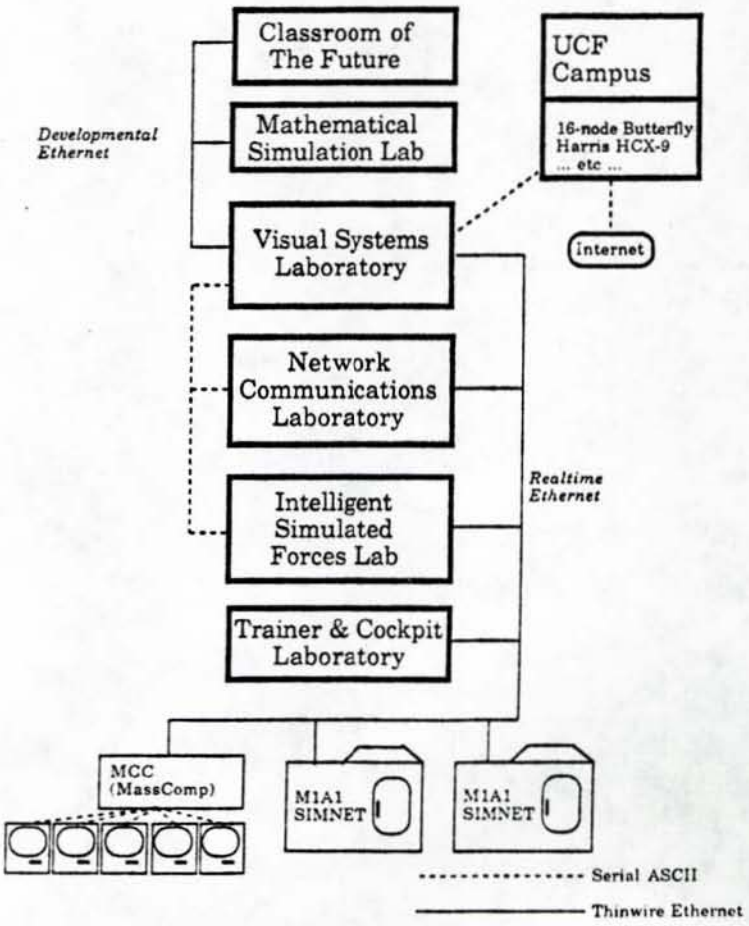
Congress and OSD have pressed for a "total system development" approach for 15 years. The TACOM RDEC and Picatinny ARDEC are both actively engaged in development of Component Advanced Technology Test Beds (CATTB) and Advanced Technology Transition Demonstrators (ATTD) in support of "total system", including embedded training design. Expo 90 (Oct 90) displayed a series of ATTD's as well as new gun technology, reconfigurable crew stations, command and control, battlefield communications, and Vehicle Integrated Defense System (VIDS) concepts. However, the training portions of the "total system" concept are, once again, taking a back seat to the pressures of funding shortfalls. Training in general, and embedded training in particular, will continue to be dealt with as an after thought if assertive actions are not taken to implement embedded

training (ET) concept formulation concurrently with weapon system development prior to MILESTONE I. ET concepts must be researched to determine basic requirements and to document them, probably in the form of general specifications, or MIL SPECS. This will allow the weapon system engineers to lay the basis for incorporation of embedded training in the initial weapon system design.

1.2 Networked Simulation Laboratories At IST.

In 1988, PM TRADE initiated a program to develop a Low Cost Simulation Test Bed (LCSTB) facility at IST/UCF. Since then, it has been enhanced with further work under DARPA and ARI contracts, and state grants. Figure 1 shows the current IST lab hardware and software simulation tools which are suited to rapid prototyping, evaluation of man-machine interactions and data base development.

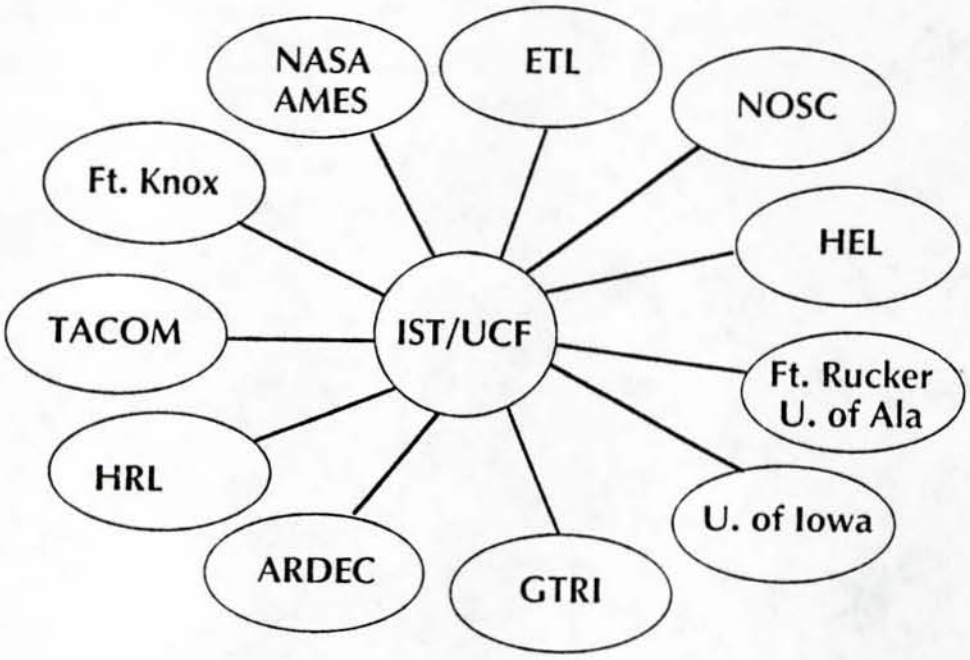
Figure 1 - NETWORKED LABORATORIES AT IST



ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

Simulation capabilities proposed in this document will eventually support interactive combined arms training through networking with remote laboratories. The LCSTB development has fostered cooperative research work with sister SIMNET facilities, academia, government, and industry laboratories located throughout the country in a "distributed laboratory" environment (Figure 2) where research work and results can be shared. Continuation of that work is the root of this proposal.

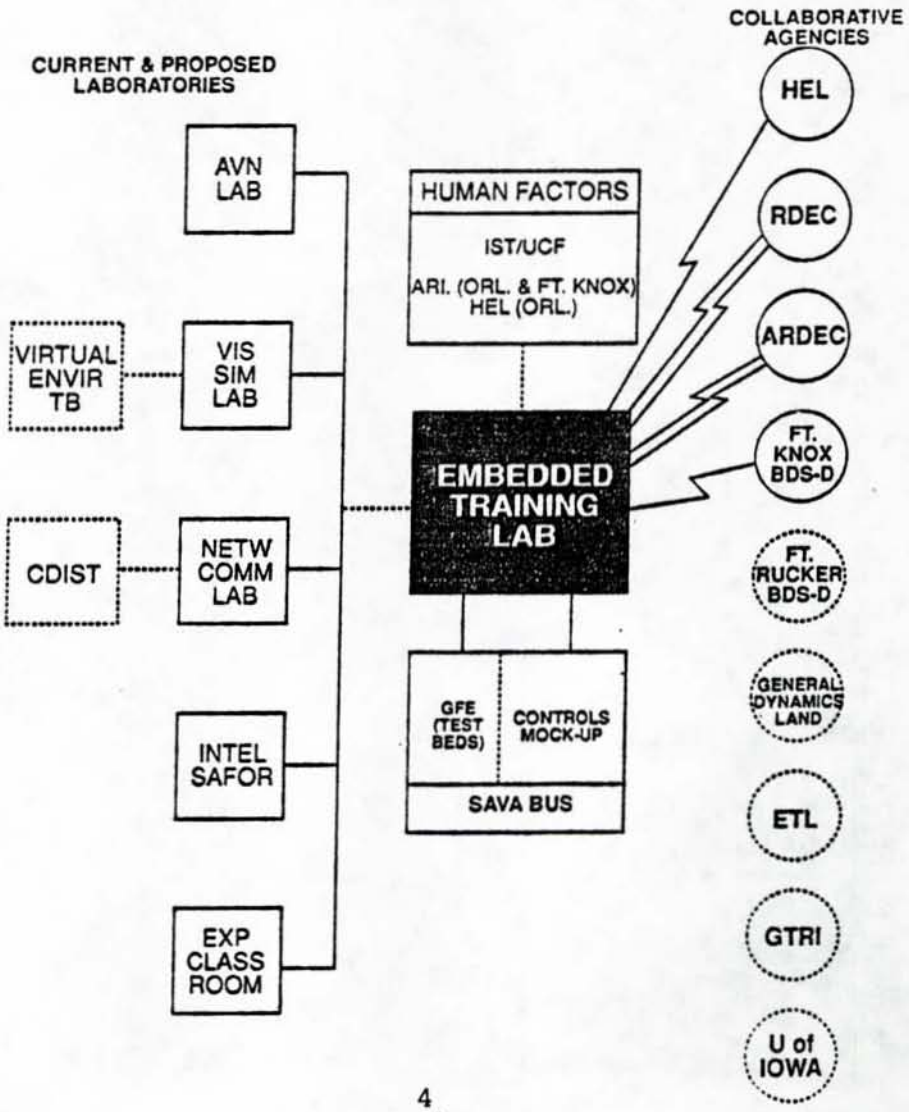
Figure 2 - DISTRIBUTED LABORATORY CONCEPT



2.0 EMBEDDED TRAINING RESEARCH AND INTEGRATION LABORATORY (ET-TRAIL).

Integration of the proposed ET laboratory with the LCSTB and selected laboratories and agencies will pull together a powerful tool for PM TRADE and the US Army to provide answers to embedded training issues in the total weapon system acquisition process. In addition, proposed new test beds for Virtual Environment and Distributed Interactive Simulator Testing will become a major source of new technology and data input to ET-TRAIL. Figure 3 provides a pictorial view of this concept.

Figure 3 - EMBEDDED TRAINING LABORATORY CONCEPT



ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

2.1 Laboratory Objectives.

The Embedded Training Technology Research and Integration Laboratory will be focused on developing basic requirements to be used by weapon system and training system design engineers to efficiently implement embedded training in the total weapon system design. The specific objectives are to:

a. Develop an architecture for the integration of embedded technology concepts in the initial stages of new weapon system developments.

b. Conduct research, concept development and evaluation of embedded and alternate training technology concepts.

c. Promote the concept of integration of IST/UCF existing and proposed laboratories where facilities such as NASA/AMES CSRDF, GTRI, U of Iowa, U of AL, and similar research facilities are capable of interactive operations in a Distributed Laboratory system. Military facilities such as TACOM RDEC, ARDEC, HEL, HRL, ETL, Ft Knox, and Ft Rucker could also be linked at the interface by application of Distributed Interactive Simulation (DIS).

2.2 Strategy.

The Embedded Training Technology Research and Integration Laboratory (ET-TRAIL) will begin by integrating and enhancing current IST/UCF laboratory and test bed facilities and adding available, existing GFE training devices as experimentation test beds. Over the three year contract period, ET-TRAIL will develop to the point of giving PM TRADE, ARI, TRADOC, and weapon system developers an enhanced capability to evaluate emerging simulation and training system technologies for Army weapon system initiatives.

While it is not the intent of this proposal to focus on armored vehicle systems at the expense of aviation, infantry, or any other branch of the Army, several existing armor and training system developments have capabilities that, as GFE, can be used or emulated as test beds to conduct ET experiments which have broader general applications. Among these are SAVA, GUARDFIST I, COFT, and the Extended Range Gunnery Fire Control Demonstration System (ERGFCDS). With modifications, one or more of these systems will be useful as a cornerstone of ET-TRAIL and will support "generic" embedded training studies. Such modifications and implementation of other test design work will require ET-TRAIL to incorporate a small electronic laboratory and workshop facility for the purposes of:

a. Installing additional computer capacity in simulators for embedded training.

b. Intervening in hard-wired controls systems.

c. Installing interfaces which will allow the tutoring computer(s) to seize control of the training system for various purposes.

d. Installing keypad or other devices to perform interactions with the tutoring system.

ET-TRAIL will be designed to include provisions for medium speed (MIL-STD-1553B) and high speed digital data transfer, and a video (cablevision). These buses will emulate their weapon system functions, and will be needed to handle the data gathering requirements for feedback and research purposes. Standard Army Vetronics Architecture (SAVA) will become an integral component of ET-TRAIL. SAVA will give PM TRADE the capability to support all types of weapon training system developments. It will have immediate application to support current systems such as LH, ASM, Armored Gun System (AGS), and CLASS.

The ET-TRAIL concept is to include provisions for electronic linkage (networking) using the DIS Standards and methodology to accommodate the full range of vehicle and tactical training strategies in support of combined arms training. In addition, intra-laboratory interfaces will be designed for data exchange and operational linking.

2.3 Project Management

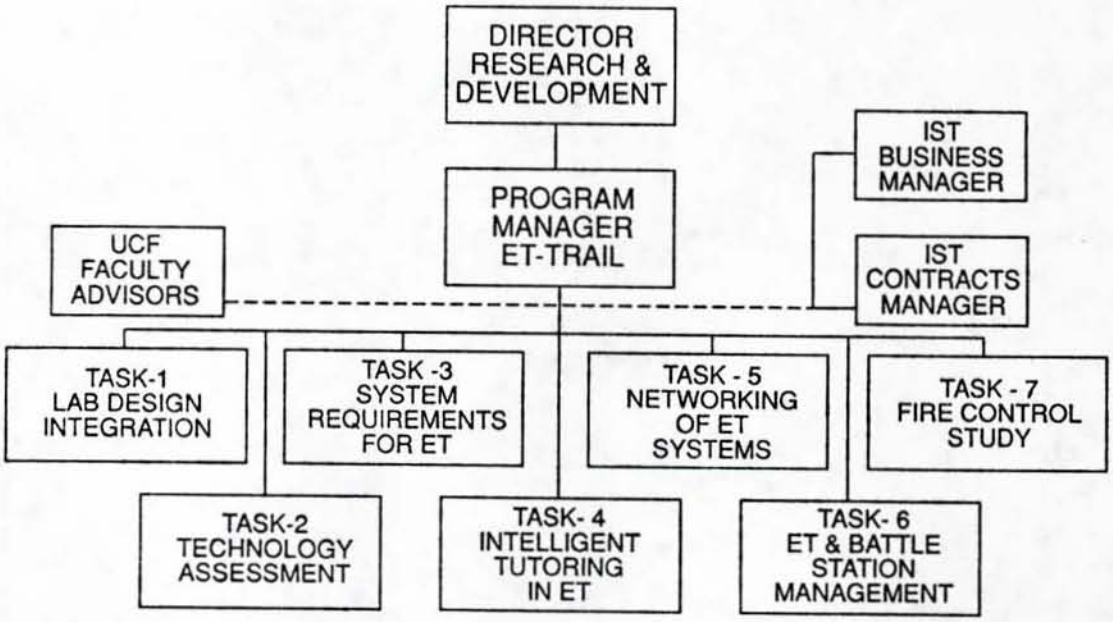
Development of the ET-TRAIL will be managed by standard project management principles. As shown in Figure 4, the Project Manager will report to the Technical Director, and will be responsible for maintaining appropriate staffing levels and keeping the project within time and budgetary constraints. The senior engineer, or principal investigator, will report to the Project Manager and will be responsible for administration of the technical aspects of their project. The Project Manager will maintain communication with the customer, project technical staff and IST management, and seek an expeditious resolution to any areas of concern which may arise. The Project Manager will utilize IST's existing infrastructure of administrative support to assist him in the execution of his duties.

IST will use its technical and administrative staff, UCF faculty and graduate students to carry out the majority of the

labor effort. Where appropriate, IST will seek the services of various expert groups, and collaborative research with other government laboratories, industry, and academia. ARI/Orlando and HEL/Orlando are expected to play a key role in providing Human Factors guidance.

IST will implement a configuration management program for the ET-TRAIL. As the development of ET-TRAIL progresses, the software developed for operation, interface files, data management and data interpretation will be continually updated and enhanced to provide for efficient research activity. IST will provide configuration management for the different software programs developed and their various versions through the use of commercially available configuration management tools.

Figure 4 - Organization For Project Management



3.0 TECHNICAL APPROACH:

3.1 Task 1: Laboratory Design And Installation.

3.1.1 ET-TRAIL Design. A detailed design with realistic goals and milestones will be prepared for government review and approval. Implementation of the plan will begin with acquiring approximately 2500 square feet of space, including electronic and mechanical workshop areas. Currently, IST is evaluating two alternatives for new spaces oriented to a laboratory with raised floors, bay doors and other features. If a contract for the ET lab capability is awarded to IST, such additional space will be acquired. Anticipated floor space needs are:

a. Laboratory, 400-600 square feet

b. Electronics Shop, 400-600 square feet

c. Mechanical Work Shop, 400-600 square feet with a large garage type door to accommodate bulky material and "dirty" work away from the Electronics shop.

d. Test Bay, 1000 square feet with a large door to accommodate simulator hulls or vehicles when required.

3.1.1.1 Workshop Equipment. A preliminary list of anticipated laboratory equipment needs are presented in Appendix A. Refinement of the list will be coordinated with the government for acquisition through the UCF procurement processes.

3.1.1.2 Government Furnished Equipment (GFE). Acquisition and modification of a GFE GUARDFIST I and a set of Standard Army Vetronics Architecture (SAVA) modules is required to jump-start ET-TRAIL into evaluation of embedded training capabilities in the DIS and network environments. The proposed approach will provide experience in the interfacing of weapon system components (SAVA) and trainer electronics in the embedded training mode. Other GFE requirements are addressed in later paragraphs dealing with particular task execution requirements.

3.1.1.3 Communications. Communications hardware and software will be developed to be compatible with existing networked systems (e.g., SIMNET), but will be self-contained to test networking of embedded training.

3.1.1.4 Modular and Reconfigurable. ET-TRAIL will be designed to be reconfigurable, stand-alone components in modular designs.

Hardware and software modules will be used to create crew stations which will provide adequate functional and physical fidelity for studies of various embedded training system concepts. Training system hardware and software capabilities will be developed as needed by future research tasks. Instruments and controls will not necessarily replicate actual equipment in either appearance or function. Likewise, perceptual sensations (eg, visual, auditory, and other cues) provided by simulated scenarios will not necessarily replicate those experienced in combat, but they will represent features of the combat environment which are essential to the research task design. ET-TRAIL systems will be operable with current simulation networking capabilities. Future technologies, such as artificial intelligence techniques, CD-ROM, and virtual reality, will be used to study the effects of enhanced simulation realism.

3.1.2 ET-TRAIL/SAVA Module Integration. ET-TRAIL structure will be designed and developed to be reconfigurable based on integration of Standard Army Vetronics Architecture (SAVA) modules. SAVA is designed to be used for integrating electrical and electronic subsystems in future military vehicles. The major characteristic of the architecture is standard hardware and software modules and interfaces. SAVA will apply to a broad range of combat vehicles with very different performance, availability and cost requirements. SAVA will support intra- vehicle communications and enable vehicle subsystem communications with each other and the crew. SAVA provides four shared functions common to all vehicle subsystems:

a. Data distribution and control
b. Power distribution and control
c. Computer resources
d. Crew interfaces, controls and displays

SAVA attributes include technology update mechanisms, redundancy and fault tolerance, enhanced maintainability, flexibility, expendability, and reduced weight and volume.

SAVA will support training by providing on-line, embedded training capabilities for vehicle and Vetronics operations. It will provide on-line, embedded training capabilities for battlefield maintenance of the vehicle and Vetronics. Additionally, SAVA will support on-line help functions to assist crew members in system operation.

The high speed data bus and Very High Speed Integrated Circuit (VHSIC) technology features enhance the integration feasibility of SAVA. The VHSIC development has been actively supported on a tri-service basis through the VHSIC Manufacturing Technology Program

and VHSIC Insertion Program on a highest priority basis.

3.1.2.1 ET-TRAIL Bus Design. The first sets of SAVA common modules are scheduled for delivery on limited vehicular applications in FY91. SAVA modules components are defined in MIL-STD-344. From this document, a list of hardware and software modules needed for embedded training capabilities will be developed for procurement. It will be necessary to first learn how to interface the modules and software in order to extract system data needed for the training system and insert training related digital data. This bus structure, integrated with MIL-STD-1553B buses and a video bus, will become the heart of ET-TRAIL and its future capability. The results of this design process will be published and integrated as input to Task 3.

3.1.3 GUARDFIST/SAVA Integration. Upon completion of the initial design, installation, and SAVA integration into ET-TRAIL, GUARDFIST will be interfaced with the ET-TRAIL bus structure. This will provide a "hot-bench" on which the challenges of total system integration of ET can be investigated. SAVA modules include analog to digital interface units which will be used in this task as an interface with GUARDFIST control overlay devices. This process will be analogous to, and instructive in, the actual integration of ET in a new weapon system bus structure. The results of this task will be reported in workshops and will be documented as input(s) to Task 3.

3.1.3.1 GUARDFIST I Description. GUARDFIST I is designed to interface directly with M1 Tank vehicle controls and provides combat training scenarios via 16-inch hi-resolution color monitors mounted directly in line with tank sights. GUARDFIST I interfaces with a static tank to provide stationary and moving platform gunnery training for the driver, gunner and tank commander. Fully operational and degraded mode gunnery training are provided. This "full crew" training is normally conducted and managed from an I/O Station but is also controllable from the vehicle tank commander (TC) position. The trainer (I/O or TC) has access to a total of 36 training exercises and 18 evaluation exercises. GUARDFIST provides power to the intercom boxes to allow intra tank communications through the actual CVC helmets. The intercom system also allows the I/O to communicate with the crew. GUARDFIST provides monitoring of crew errors and a detailed crew performance printout of simulated day and thermal engagements. Silicon Graphics provides computer generated visuals and a sound generator that produces realistic tank and gunnery sounds.

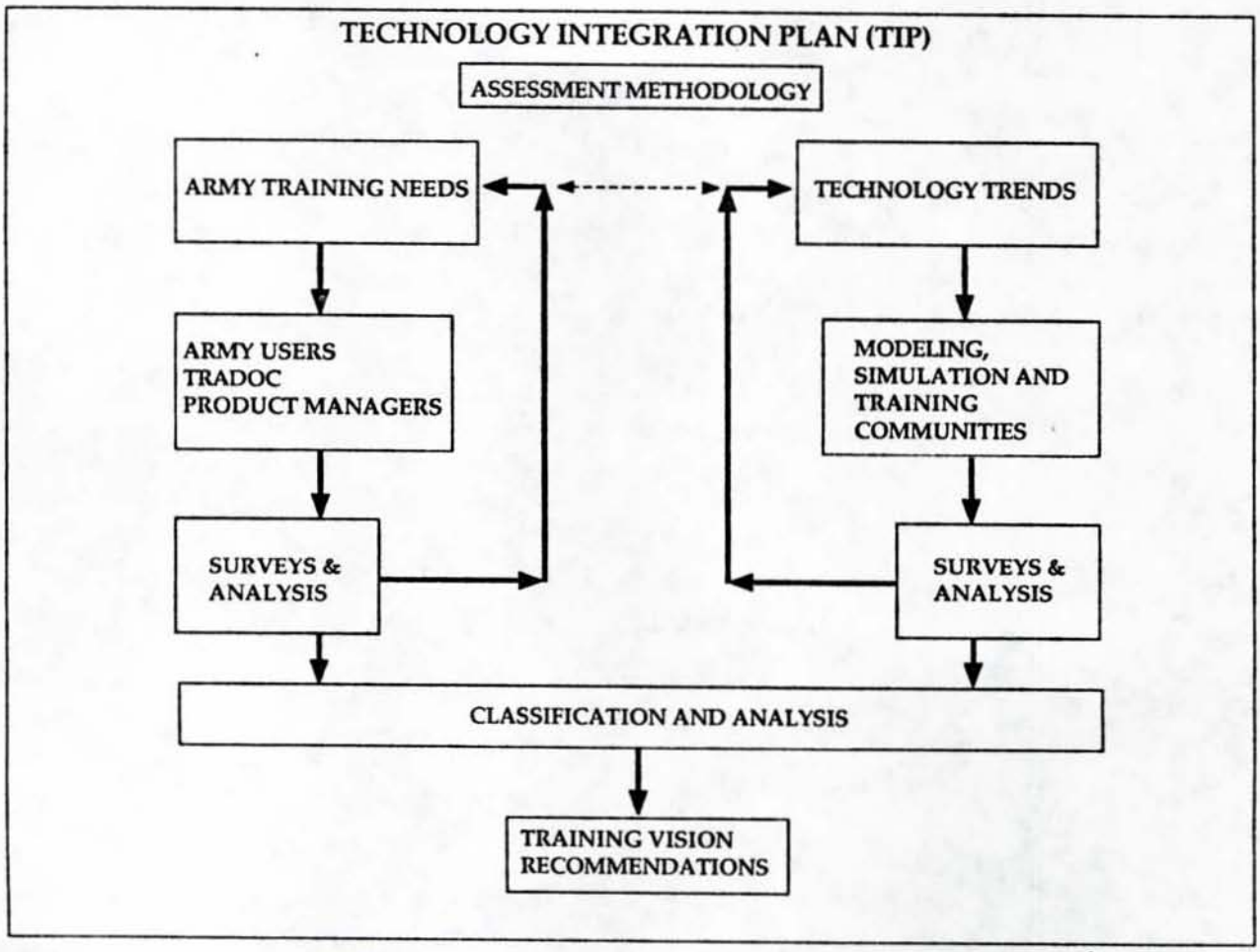
3.1.3.2 Tank Mock-Up. GUARDFIST I will be installed on a plywood framework with dummy controls. Investigation will be conducted to determine availability of GFE items to make the mock-up as

realistic as budgetary constraints will allow. Recommendations for future GFE acquisitions will be submitted for review and approval.

3.2 Task 2: Training Technology Assessment.

3.2.1 Technology Trends. During the first year of the contract, it will be necessary to collect, assess, and prioritize technology trends. New task design, development and execution will be required to remain current with emerging technology related or applicable to embedded training. The process shown in Figure 5, and defined in PM TRADE's Technology Integration Plan (TIP) will be followed. Results will be documented for new task designs and for dissemination in the training system community.

Figure 5 ASSESSMENT METHODOLOGY



3.3 Task 3: System Requirements for ET.

3.3.1 ET Documentation. An architecture for the integration of embedded technology concepts in development of new weapon systems will be defined. Laboratory research results will establish a foundation of basic physical and functional requirements upon which a draft ET Design Handbook will be written. The output of the task will be a draft standards document formatted for PM TRADE use in specification of system requirements for ET. The document will integrate the results from other tasks and/or special tasks designed to investigate specific ET requirements. The document will identify cuing and input/output system requirements, computer resource considerations, bus requirements, and student interfaces for embedded training in the total weapon system design. In accomplishing the objective, the document will provide guidance in the following ET design considerations.

3.3.1.1 Effectiveness and Capability of ET Concepts to:

a. Train combat-related skills
b. Sustain skills
c. Integrate skills within and across players
d. Identify training - soldier interface problems

3.3.1.2 Improve/Enhance Training Effectiveness of ET Concepts to:

a. Determine efficient sequencing of training events
b. Evaluate instructional features (e.g., cuing, demonstrations, adaptive instruction, intelligent tutoring system)
c. Determine frequency and kinds of feedback required
d. Evaluate how changes in fidelity affect training effectiveness or efficiency

3.3.1.3 Testing of the Engineering, Operational, and Environmental Feasibility of ET Concepts to:

a. Assess technological feasibility
b. Assess implementation feasibility
c. Assess reliability and maintain-ability
d. Determine system processing and memory requirements
e. Determine space claims, electronic interface and other physical requirements
f. Evaluate safety considerations
g. Determine time and procedures needed to switch between training and operational modes
h. Evaluate networking impact for multi-crew collective training

i. Determine the "programming hooks" required in prime system software to allow access to the weapon system's executive software, application programs, and databases. (i.e., Prime system operations software must be written and organized in a manner that allows integration of training system software.)

3.3.1.4 Evaluation of ET Concepts versus Alternate Training Approaches To Compare:

a. Training time requirements to meet task standards
b. Capability to sustain perishable tasks
c. Requirements for instructional staff
d. Need for additional documentation to supplement system instructional features
e. Ability to interface with non-ET system training
f. Requirements for modifying course-ware

3.3.1.5 Evaluation of Mission Oriented ET Concepts for:

a. Individual and crew training
b. Target acquisition
c. Tactical movement
d. Tactical weapon operation
e. Crew/platoon communications

3.4 Task 4: Intelligent Tutoring Systems (ITS) in ET.

3.4.1 ITS Application. ITS provides the ability to focus training on the specific strengths and weaknesses of the trainee and will enhance effectiveness of embedded training in weapon systems. The use of ITS technologies to adapt the course of instruction, feedback and practice to ongoing measures of performance will be investigated in the GUARDFIST 1. This task will first investigate the characteristic and capabilities of GUARDFIST 1 as a potential test bed to demonstrate ITS capabilities and establish requirements for integration in Next Generation/ Future Systems (NG/FS).

3.4.1.1 GUARDFIST I vs COFT GFE. In the unlikely event that GUARDFIST I is found to be not suitable for ITS application, a Conduct of Fire Trainer (COFT) will be investigated as an alternative. COFT fidelity levels and training matrix would make an ideal test bed for ITS, but may not be available for this task. The COFT, originally developed to train crew tasks for the M1A1 Tank, is currently being modified by the Army to an M1A2 configuration. The modification will have a crew station for commander and gunner replicating the turret interior, an instructor

operator station, and a debriefing area. Additional computer power and an improved image generator will permit training of the M1A2 capabilities. An updated training matrix similar to the M1A1 version will be utilized to employ scenarios to train crew coordination and use of the commander's independent thermal viewer (CITV). The system will have improved graphics and the inherent capability to link (Ethernet) units for platoon and section training. A COFT in this (M1A2) configuration would also be ideal for the research proposed later in Task 6.

3.4.2 ITS Experience. The investigation will be leveraging on six years of research conducted by IST/UCF personnel for the Naval Tactical Data System embedded operator training (L-TRAN). In addition, IST/UCF conducted research using expert systems in developing intelligent tutoring programs will be evaluated for possible incorporation into the ET test bed.

3.4.3 Objective. The objective of this task is to examine the appropriate levels of training to embed, (ie., entry to sustainment and individual through crew/collective). Weight, power and RAM impact on effectiveness and feasibility will be considered. The first step will be to analyze the existing GUARDFIST 1 and its training capabilities so the researchers can identify particular training areas which may be enhanced by ITS technology integration. Knowledge engineering, instructional strategies, software implementation, student modeling, and performance measurement will be planned, and evaluated. Iterations for different training objectives will be submitted to PM TRADE for review and approval as the research task continues through the following years of the contract.

3.4.4 Performance Measurement. Based on the above assumptions that a tank gunnery type of trainer (GUARDFIST 1 or COFT) can be obtained for this task, factors such as those in the following paragraphs will be used in performance measurement.

3.4.4.1 Measures of Gunner Performance.

a. Speed (opening time, time to hit)
b. Accuracy (hits, misses, lay error)
c. Exposure time for defensive engagements
d. Number of rounds used in engaging targets
e. Frequency of correct target prioritization

3.4.4.2 Measures of Driver Performance

a. Ability to monitor instruments for malfunctions
b. Correct responses to simulated emergencies
c. Ability to follow a prescribed route/course

3.5 Task 5: Networking of ET Systems.

3.5.1 Network Application. The TRADOC Comprehensive Training System Architecture (CTSA) envisions a Combined Arms Training Strategy (CATS) in a mix of field training and simulators for both individual and collective training, and includes simulations for command and staff for unit training through the battalion level. The future objective of embedded training capability in tanks like the M1A2 and/or Block III is to allow the soldier to train like he fights. This will require the linking of two or more actual tanks, fighting vehicles, and other combined arms weapon systems, which have been modified for embedded training.

3.5.2 Objective. The objective is to investigate the application of network standards, protocol translators, network issues, and virtual environment to embedded training in the battlefield environment. This task will make use of then current Draft Military Standard for Distributed Interactive Simulation (DIS) Protocol Data Units (PDUs). Simulation models for Ethernet, Token-Ring and Fiber Distributed Data Interface (FDDI) local area networks (LAN) will be used to predict the performance of candidate networks which might be used to interconnect embedded training systems. The IST Networking and Communications Technology Laboratory, which contains a variety of computational and communications equipment, will be used in carrying out this task. Findings on usage of the DIS PDU protocol will be provided as input papers to Workshops for further development of DIS Standards. In addition, task results will:

a. Identify implementation strategies for ET networks
b. Develop networked ET prototype hardware and software
c. Demonstrate prototypes
d. Provide input to DIS Standards Workshops

3.5.3 Task Execution. The method of transmitting simulation data from module to module (combat vehicle to combat vehicle) is the primary subject of this research. The task will investigate use of SINCGARS Radio as the primary local network, versus current LAN's. The means for data logging, plan view display, management command and control console (MCC), and after action review (AAR) will be examined in terms of hardware and software requirements, and alternative cost implications. The results will be documented in the Task 3 document as guidance for future ET designs. Demonstration of networking of ET systems will include mission planning, formations, use of terrain, consideration of threats, visibility, enemy strength, alternate courses of action, flexibility in response to NBC/artillery attack, issuance of FRAGO's, changes to plans, and Command and Control.

3.6 Task 6: ET & Battle Station Management

3.6.1 Future Vehicle Technology. New combat vehicles such as the M1A2 and Block III Tank will incorporate more advanced technology, such as inertial navigation systems, multifunction displays and automation much like modern aircraft cockpits. With the advent of more automation, job aiding, navigational and tactical information, the tank crew will also become battle station managers. These changes will significantly change operational procedures within the vehicle and redefine crew roles. Critical issues will include:

a. Information management/information presentations.
b. Precision navigation/use of map displays
c. Tactical display use/functionality
d. Workload/task distribution
e. Communications (inter and intra crew)
f. Crew coordination

Experience in advanced aircraft cockpits reveals that these improvements do not necessarily reduce task loading because while many tasks are simplified, new tasks are usually introduced. Often these new tasks require very different types of skills and these new skills are frequently the type which are subject to the fastest degradation.

3.6.2 Impact on Embedded Training. The changes in the weapon system operator interface will have significant implications to embedded training design and must therefore be thoroughly investigated and analyzed. The specific impacts on embedded training design can only be determined through research on the changes in overall training needs, task definition, and task allocation associated with these advanced systems. Specific research goals will be defined based on an analysis of new crew tasks and system functionality within the context of embedded training applications. Three initial potential embedded training functions have been identified that warrant investigation, with others to be determined as understanding of new system(s) functions increases. The initial embedded training functions that would be examined through ET-TRAIL are:

a. Automated performance monitoring, assessment and feedback.

b. Introduction of simulated targets into the tactical display, ie., subset of simulated forces capability.

(These could be totally simulated or represent MILES targets.)

c. Simulated system failures.

3.6.3 Task Execution. Researchers will define a test bed configuration to incorporate display systems comprised of actual (GFE) equipment, or a simulated tank cockpit using commercial off-the-shelf hardware. Modification of a SIMNET system does not appear to be feasible in the context of the BAA budgetary constraints. However, that would be the preferred approach and will be considered in the initial investigations of the task design. In general, the test bed will reflect the M1A2 multifunction display configuration with integration of command and control, navigation, tactics, system status and other functions derived through the IVIS (Inter-Vehicular Information System) and BMS (Battlefield Management System) programs. Software will be developed for a display and control system interfacing with ET-TRAIL bus system. Investigation will be conducted to determine if software from other government or commercial sources may be utilized to implement these functions.

The resulting module of ET-TRAIL will be utilized as the research vehicle for examining embedded training concepts and investigation of behavioral training issues related to advanced vehicle configurations. Once the basic research task is defined, it may become obvious that further work is required in the SIMNET-D (ADST) system. Recommendations will be made and task planning developed upon approval by the government.

3.7 Task 7: Fire Control Study.

3.7.1 Background. Extended Range Gunnery Fire Control Demonstration System (ERGFCDS) is the fire control portion of the Component Advanced Technology Test Bed (CATTB) for the Block III Tank. It is projected to simulate up to 10 targets, and include multi-spectral sensors, automatic target detection and cuing, and auto tracking capabilities. An embedded training system for teaching fire control functions is planned. ERGFCDS ET system will include combat scenarios representing various battlefield and fire control system conditions (e.g., degraded laser range finder, limited visibility). A mission analysis will be performed for the Block III fire control system by the ERGFCDS contractor (TI) to determine the missions to be simulated. ERGFCDS ET will include the capability to select particular conditions or modify the scenarios for specific training, and will have the capability to

measure and correct trainee performance. The software for ERGFCDS will be developed by Texas Instruments (TI).

3.7.2 Software Program Evaluation. Task 7 proposes to obtain a copy of the ERGFCDS demonstration software (GFE) for evaluation of the embedded training functional characteristics. It will be necessary to obtain a processor capable of running this software package, probably a standard military 1750 processor (GFE). Once the software and processor are obtained and made operational, IST will conduct the functional evaluation, followed by a training effectiveness evaluation. Recommendations will be prepared on possible integration of the software and processor into ET-TRAIL, and to assist PM TRADE in this part of the ERGFCDS project technical management.

3.8 DELIVERABLES

For each task, IST will deliver:

- Detailed Work Plans
- Quarterly Status and Management Reports
- Minutes of all Project Review Meetings
- Draft Embedded Training Design Handbook
- Reports on analysis, research, and demonstrations as stated in each task.

3.9 MEETINGS AND REVIEWS

Work Plan Reviews will be held as indicated in the proposed schedules. Progress Review meetings will be held quarterly. Research and Integration Working Group Meetings will be held as deemed appropriate in coordination with the government representatives. Minutes from these activities will be provided as deliverables on this project.

3.10 SCHEDULE AND LEVEL OF EFFORT

Establishment of the modular, reconfigurable embedded training testbed (ET-TRAIL) and integration of the SAVA and MIL-STD-1553B bus structure requires an estimated total of 11-manyears over the 36 month contract. The level of effort required to accomplish the six research tasks proposed is approximately 16-manyears over the 36 month period. The overall 27-manyear effort breaks-out to be 8.3-manyears the first year, 9.7-manyears in the second year, and 8.9-manyears in the third year. Each task schedule and manpower requirement is shown on the following pages.

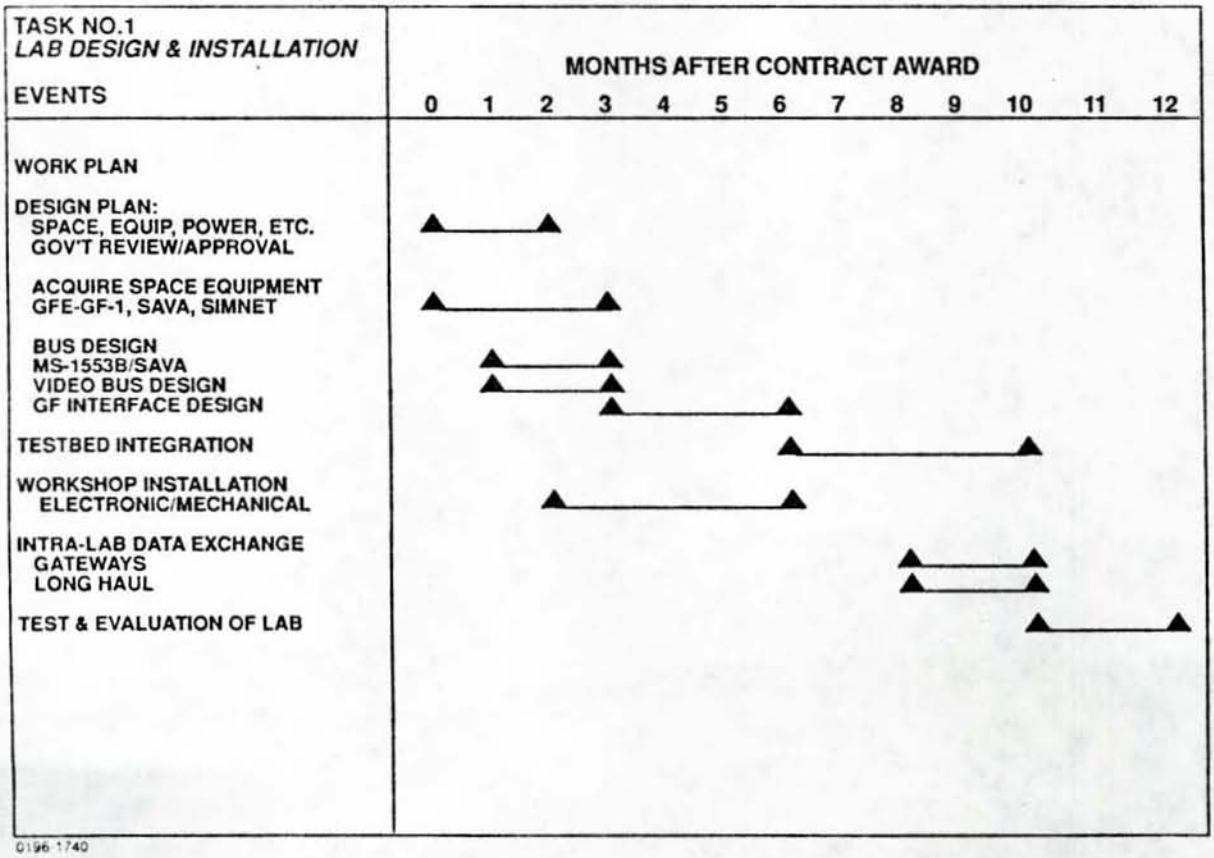
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 1. Laboratory Design & Installation

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	822	1040	560	2422
Senior Engineer	1456	800	840	3096
Engineer (EE)	1040	1040	1080	3160
Engr Technician	1664	1712	1920	5296
Computer Sc	640	832	720	2192
Visual Sc	320	624	240	884
Research Psych	0	0	0	0
GRA (Comp Sc)	390	320	200	910
GRA (Psych)	0	0	0	0
GRA (Eng)	560	560	460	1580
TOTAL	**6892**	**6928**	**6020**	**19540**

Major Milestones



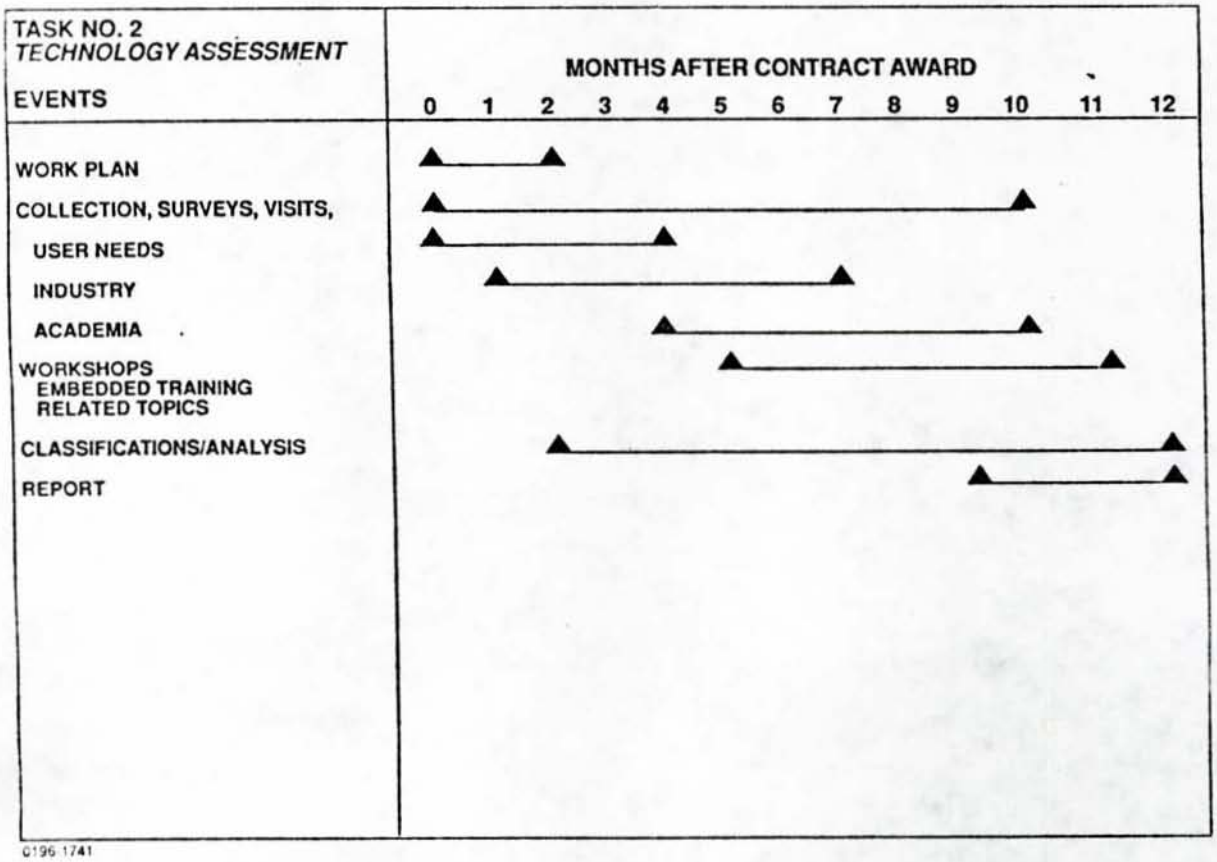
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 2. Training Technology Assessment

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	200	0	0	200
Senior Engineer	0	0	0	0
Engineer (EE)	180	0	0	180
Engr Technician	0	0	0	0
Computer Sc	180	0	0	180
Visual Sc	160	0	0	160
Research Psych	170	0	0	170
GRA (Comp Sc)	170	0	0	170
GRA (Psych)	0	0	0	0
GRA (Eng)	160	0	0	160
TOTAL	**1220**	**0**	**0**	**1220**

Major Milestones



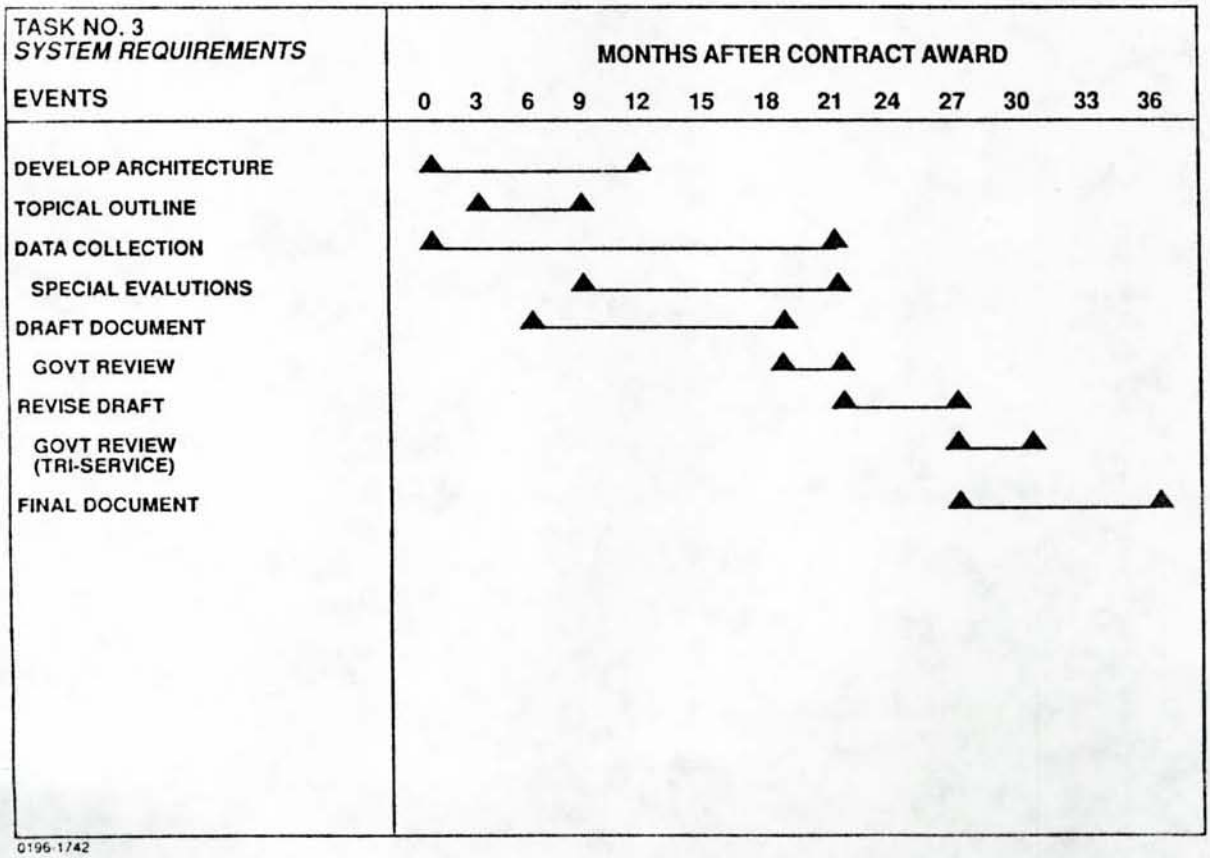
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 3. System Requirements for ET

Level of Efforts

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	170	416	480	1066
Senior Engineer	0	360	400	760
Engineer (EE)	340	240	240	820
Engr Technician	0	0	0	0
Computer Sc	0	160	160	320
Visual Sc	0	160	80	240
Research Psych	0	0	208	208
GRA (Comp Sc)	0	0	0	0
GRA (Psych)	0	240	80	320
GRA (Eng)	208	160	0	368
TOTAL	**718**	**1736**	**1648**	**4102**

Major Milestones



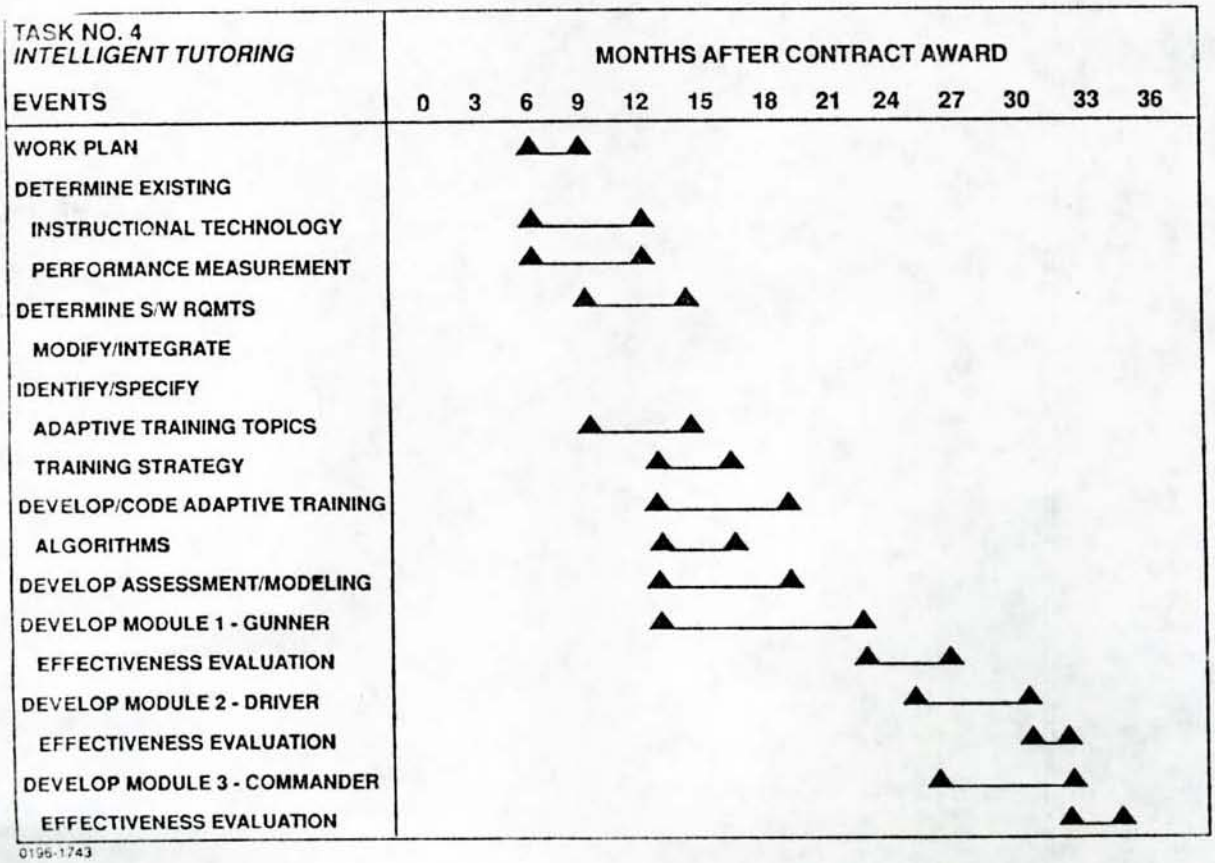
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 4. Intelligent Tutoring in ET

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	340	104	320	764
Senior Engineer	208	160	240	608
Engineer (EE)	180	160	240	580
Engr Technician	80	160	160	400
Computer Sc	480	428	360	1268
Visual Sc	160	160	80	400
Research Psych	390	832	752	1974
GRA (Comp Sc)	320	240	200	760
GRA (Psych)	400	610	480	1490
GRA (Eng)	0	0	0	0
TOTAL	**2558**	**2854**	**2832**	**8244**

Major Milestones



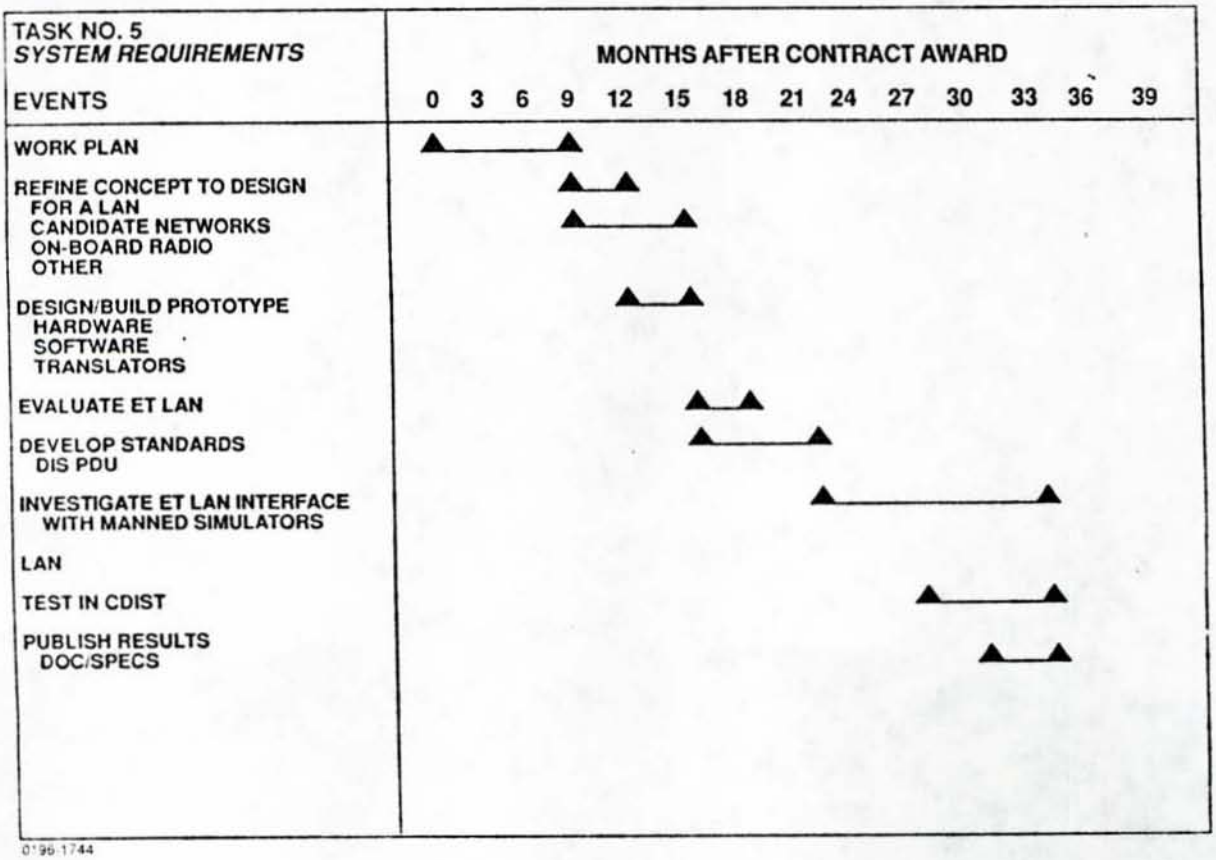
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 5. Networking of ET Systems

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	208	208	240	656
Senior Engineer	208	440	200	848
Engineer (EE)	170	160	160	490
Engr Technician	80	0	0	80
Computer Sc	340	160	160	660
Visual Sc	80	208	80	368
Research Psych	0	0	0	0
GRA (Comp Sc)	160	160	160	480
GRA (Psych)	0	0	0	0
GRA (Eng)	160	160	160	480
TOTAL	**1406**	**1496**	**1160**	**4062**

Major Milestones



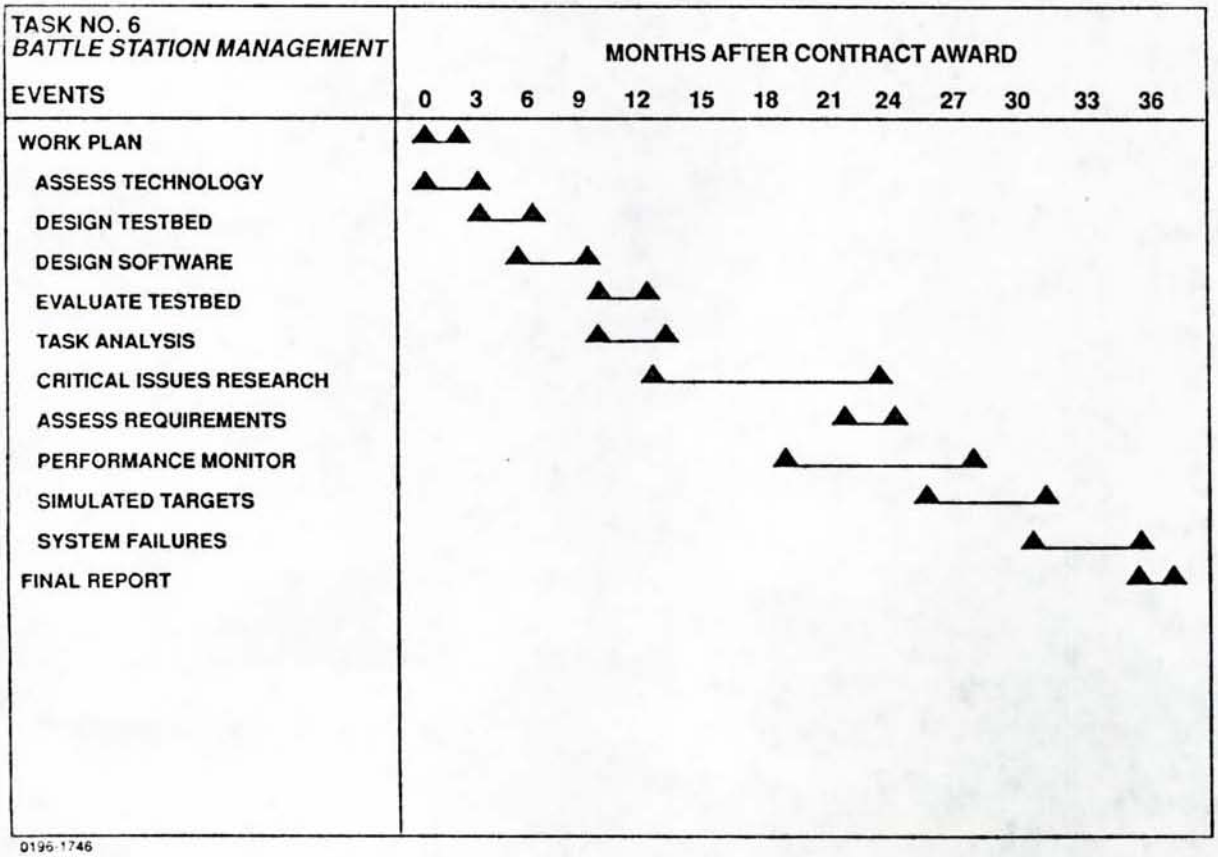
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 6. ET & Battle Station Management

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	340	104	240	684
Senior Engineer	208	160	200	568
Engineer (EE)	170	240	160	570
Engr Technician	0	208	0	208
Computer Sc	170	340	160	670
Visual Sc	0	0	160	160
Research Psych	480	1040	960	2480
GRA (Comp Sc)	0	160	320	480
GRA (Psych)	170	400	480	1050
GRA (Eng)	160	0	0	160
TOTAL	**1698**	**2652**	**2680**	**703025**

Major Milestones



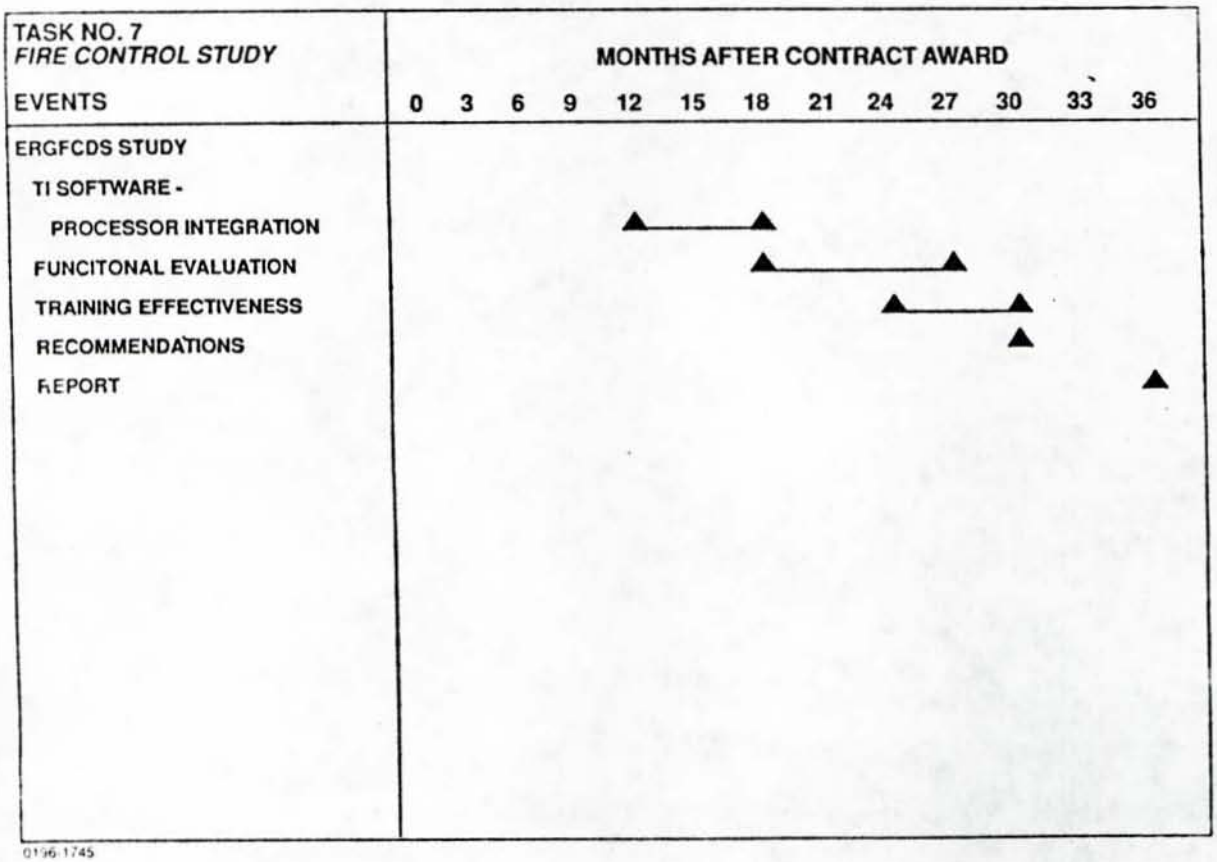
ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

TASK 7. Fire Control Study

Level of Effort

Labor Category	YEAR 1	YEAR 2	YEAR 3	TOTAL
Program Manager	0	208	240	448
Senior Engineer	0	160	200	360
Engineer (EE)	0	240	160	400
Engr Technician	0	0	0	0
Computer Sc	0	160	160	320
Visual Sc	0	208	0	208
Research Psych	0	208	160	368
GRA (Comp Sc)	0	160	160	320
GRA (Psych)	0	0	0	0
GRA (Eng)	0	160	160	320
TOTAL	**0**	**1504**	**1240**	**2744**

Major Milestones



SECTION 4.0 PERSONNEL

IST will draw upon the broad base administrative and technical expertise during the life of this project. Technical personnel from IST/UCF and other sources, as appropriate, will be utilized in performing the tasks defined in this proposal except for the program manager (PM) and electrical engineer who will be hired on contract award. IST and UCF will provide the administrative support. The resumes of key IST and UCF technical personnel who will participate in this project are included in Appendix B. Several of the personnel listed below have been included in other proposals. However, should those proposals all become contracts requiring 100-percent of their time, new personnel will be hired. Upon award of this contract, Brian Goldiez, Director of R&D will assume the Program Manager role until the new PM is hired. Mr. Ernie Smart will assist as necessary. Following is a list of labor categories and personnel:

Labor Categories	Personnel
Program Manager	(To be hired)
Senior Engineer	Dr. Roger Johnson
Electrical Engineer	(To be hired)
Engineering Technician	D. Shen
Computer Scientist	C. Bouwens
Visual Scientist	C. Lisle
Research Psychologist	Dr. P. Moskal
Graduate Assistant - Computer Science	
Graduate Assistant - Psychology	
Graduate Assistant - Engineering	

SECTION 5.0 GOVERNMENT SUPPORT FOR PROJECT

Government furnished equipment from the Low Cost/ Complexity Simulation Test Bed contract will be used in this project. In addition, equipment and software from other Army BAA's, DARPA BAA's, Grants and donations will be utilized in the make-up of the proposed Laboratory. Other government equipment which will procured for ET-TRAIL are GUARDFIST 1, SAVA, ERGFCDS software and a standard military 1750 processor.

SECTION 6.0 OTHER PROPOSAL SUBMITTALS

This proposal is not being submitted to any other federal, state, or local agency or any other party.

SECTION 7.0 ENVIRONMENTAL IMPACT

Work accomplished under this proposal will not result in any effect on the environment.

SECTION 8.0 IST CONTRACTING EXPERIENCE

IST has established Government contracting experience. It currently has a number of active contracts with the Naval Training Systems Center and other Government agencies including contracts N61339-85-D-0024, N61339-86-D-0008, N61339-88-D-0008, N61339-88-D-0009, N61339-88-G-0002, N61339-89-C-0029, N61339-89-C-43, N61339-89-C-0044, and N61339-89-C-45. IST has previously provided the Naval Training Systems Center with extensive organizational and capabilities descriptions in response to sources sought announcements and in various proposals. Reference for this material is made to the IST capabilities description provided in conjunction with IST's NAVTRASYSCEN IQC N61339-88-D-0009.

SECTION 9.0 FACILITIES

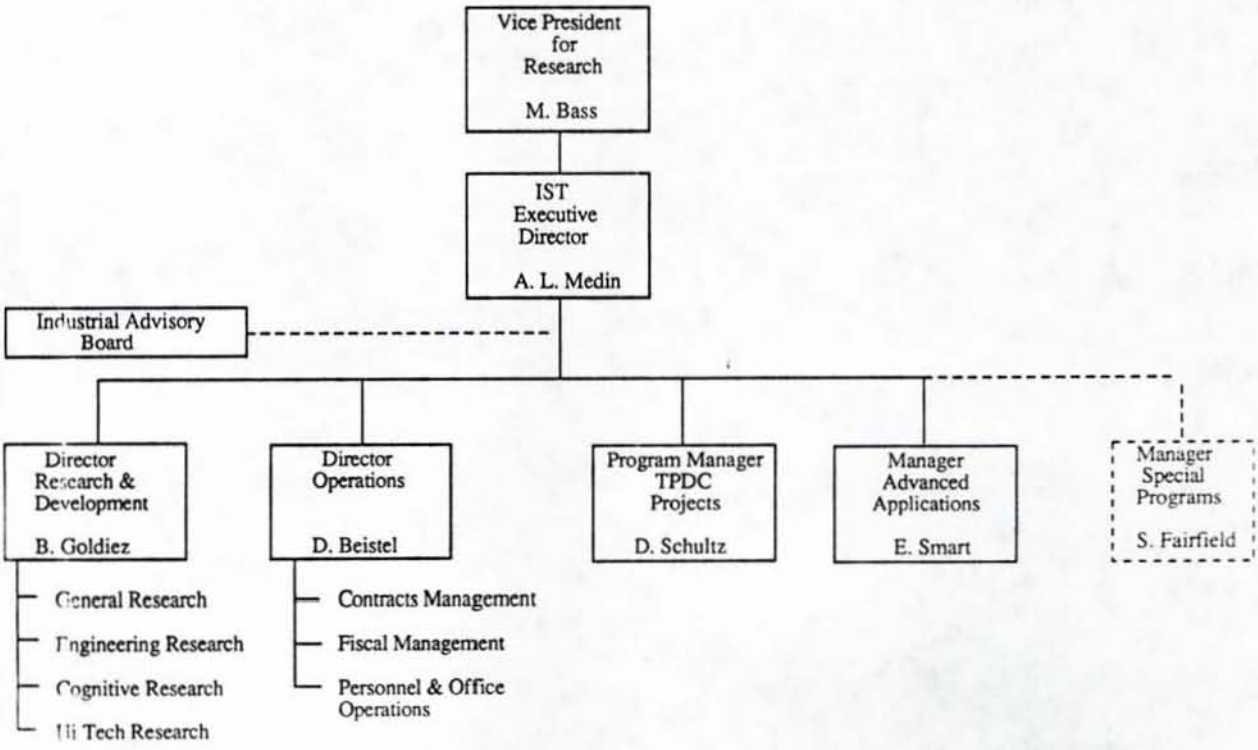
The Institute for Simulation and Training at the University of Central Florida is situated in the Central Florida Research Park in Orlando, Florida. The research park is located adjacent to the University of Central Florida campus. IST is located in the Research Pavilion at 12424 Research Parkway, adjacent to the Naval Training Systems Center. IST's facilities include over 20,000 square feet of office space and approximately 7,000 square feet of research laboratory space.

An important feature of IST's laboratories is the ability to conduct research separately, link hardware and software to investigate system level issues, and to link other laboratories so that data and results can be shared. This approach maximizes the utilization of expertise and systems to meet the various levels of granularity of training and simulation related research. The research facilities of IST currently consist of six separate laboratories; Networking and Communications Technology Laboratory, Visual Systems Laboratory, Low Cost Flight Trainer Laboratory, Team Training Laboratory, Low Cost Part-Task Trainer Laboratory, and the Classroom Educational Laboratory. Expanded laboratory facilities will be required to meet the needs of this project.

SECTION 10.0 IST ORGANIZATIONAL BACKGROUND

The purpose of the Institute for Simulation and Training (IST) is to conduct research and to develop technology that advances the state of the art in affordable and effective training systems. IST has built laboratories with unique capabilities for conducting interdisciplinary simulation and training research programs requiring the disciplines of engineering, computer science, human factors and instructional systems. The Institute has a full-time research staff with skills in thesis disciplines, and draws from the University of central Florida faculty as well as other colleges and universities in Florida and elsewhere to augment capabilities required for particular research programs. The purpose of IST's research efforts are to advance the state of the art in simulation and training, make simulation and training more affordable and effective, transfer technology to the simulation and training community both within and without the Department of Defense, and to provide an environment for simulation and training education.

Figure 6. IST Organization



APPENDIX A

WORK SHOP EQUIPMENT

ET TECHNOLOGY RESEARCH & INTEGRATION LABORATORY

APPENDIX A

Workshop Equipment Requirements.

Electronic Equipment	**Qty**
Oscilloscope, 100mhz	2
Digital Analyzer	1
Video Signal Analyzer	1
Signal Generators	2
Universal Power Supply	2
Microprocessor Development Work Station	1
Miscellaneous Hand Tools	misc
Work Benches, 3 x 8 ft	4
Parts Stock	misc.

Mechanical Equipment	**Qty**
Drill Press	1
Table Saw	1
Hand & Power tools*	misc
Work Benches	4
Parts/Tool Cabinets	4
Gas Welding Set	1
Materials Stock	misc

*Hand & Power Tools include: Router, Skill Saw, Drills, Jig Saw, Circular Sander, Belt Sander, Power Plane.

APPENDIX B

RESUMES OF KEY PERSONNEL

CHRISTINA L. BOUWENS

EDUCATION: M.S. Mathematical Science, UCF, 1990
B.S. Mathematics, Geneva College, 1984

Additional course work: VMS Systems Management I
Network Protocols & Standards

EXPERIENCE SUMMARY: Ms. Bouwens has more than one and a half years of experience as a research associate working in the areas of networking technology and analysis of numerical integration methods at the Institute for Simulation and Training. She has been the project engineer for development of the draft Military Standard for Distributed Interactive Simulation and has been involved in IST's research with alternative communication architectures for real-time distributed simulation. In addition to her experience as a research associate, Ms. Bouwens has 5 years of teaching experience at the high school and college levels. Ms. Bouwens has 5 years of teaching experience at the high school and college levels. She is a member of Pi Mu Epsilon, the national honorary mathematics society.

APPLICABLE EXPERIENCE:

Sept 1989 - Present | Research Associate | Institute for Simulation & Training

Current duties include providing technical direction in IST's interoperability standards development. This standards work includes co-authoring the draft standard and rationale document for protocol data units for Distributive Interactive Simulation, research of various problems related to networked real-time simulation, providing guidance for Open Systems Interconnection (OSI) related work, and participating in research associated with alternative communication architectures. Other research activities include investigation and analysis of integration algorithms for use in real-time simulation systems.

Aug 1990 - Dec 1990 | Adjunct Faculty | University of Central Florida, Orlando, FL

Course instructor for a College Algebra class.

Aug 1988 - May 1989 | Graduate Teaching Assistant | University of Central Florida, Orlando, FL

Course instructor for Introductory and Intermediate Algebra at the University of Central Florida/Valencia Community College's Academic Skills Center.

Aug 1988 - May 1989 | Graduate Teaching Assistant | University of Central Florida, Orlando, FL

Course instructor for several Business Calculus classes.

Aug 1984 - May 1988	Teacher	Orangewood Christian School Maitland, FL

Developed and taught mathematics curriculum for grades 7-12 and computer curriculum for grades 1-12. Mathematics courses include: Pre-Algebra, Algebra I & II, Geometry, Trigonometry and Analytic Geometry, AP Calculus.

CURRENT STATUS: Full-time employee of the University of Central Florida

ROGER W. JOHNSON

EDUCATION: B.S., Electrical Engineering, U.S. Naval Academy, 1952
M.S., Instrumentation and Control Systems Engr, MIT, 1958
Ph.D., Control Systems Engineering, UCLA, 1966

• A total of more than fourteen years of college engineering effort, consisting of five years of college graduate engineering work, and eleven years of teaching college engineering courses (seven at the graduate level); this made possible extensive "engineering design" and "development" projects covering a myriad of engineering disciplines, namely electrical, electronic, mechanical, structural, aeronautical, astronautical and thermodynamic. More than thirty professional books and papers published (see attachment #1).

EXPERIENCE SUMMARY:

• Approximately six years of directing engineering development programs. Directed exploratory development of new technical engineering concepts to include prototype "brass board" hardware development projects on advanced space detection sensors (charged-coupled-devices, [CCDs], infra-red, x-ray), on a space computer (fault tolerant architecture), on a laser-communication transceiver, are examples that were consolidated into customer satellites and launched for orbital test providing data used to engineer the final satellite sensor/device for operational use as Deputy Chief of Staff of Technology (Chief Scientist) of SAMSO. Directed space related engineering analyses and hardware design for space implementation as Director of Civil Space Programs of Grumman Aerospace Corp. Directed Ballistic Missile guidance paramenter evaluation using precision radar and navigation satellite measurements as Test Director of the VAFB Technical Director's Office. Directed formulations for satellite attitude control commands for the successful recovery of the Defense Meteorological Satellite Program Vehicle as Engineering Consultant to RCA.

• More than five years of directing space and missile test range instrumentation analysis and computer operation/software development as the Director of Computer Services Division of Range Operations VAFB; management of software development, automating the computer information management systems at KSC as the Deputy Director and then the Director of Information Services for the Shuttle Processing Contract (SPC); the establishment of the Software Support Facility (Naval Training Equipment Center, Orlando) to include facility construction, hardware installation, software development, and installation, computer training and operation as the Director of Field Operations for Software Sys. Dept., Grumman Aerospace Corporation; and the management of the software development, defining the computer support and software architecture requirements for the Space Station Freedom Program](SSFP) as the Manager of Information Systems Software Support for the Space Station Program Support Contract (SSPSC).

• One year of directing the operations and maintenance of launch processing (LPS) and instrumentation systems for the Shuttle Processing Contract (SPC) as the Director of Integrated Ground Operations after two years of SPC assessment and serving as Grumman's Proposal Manager for SPC.

• Retired from USAF as Colonel, with a distinguished career.

APPLICABLE EXPERIENCE:

Aug 1989 - Present	Assistant Director & Assoc.Professor of Engineering	University of Central of South Campus Florida

Teaching undergraduate and graduate courses in "Control Systems" and "Signals and Systems Analysis" totalling 12 semester hours a year. Coordinating cooperative engineering/education programs with Industry (Martin Marietta) as Chairman of the UCF (COE)/Martin Marietta Steering Committee. Participating in research activities with IST (Navy contract on Tactical Electronic Simulation Test System [TESTS]) and with Space and Education Research Center (SERC) on "Automation and Intelligent Launch System Research Center" activities.

May 1988 - Aug 1989	Manager, Info. Systems Software Division	Grumman Space Station Program Support Division

Dr. Johnson directed approximately 18 engineers and software analysts in information systems resource and multi-element analysis, product acceptance, quality assessment, documentation control, strategic planning and the Software Support Environment (SSE) development for the flight and ground software of the Space Station Freedom Program.

Apr 1986 - Mar 1988	Specialist Business	Grumman Technical Development Services, Div. of Grumman Corporation

Direct proposal activity for new business in the space system support areas at KSC and JSC.

Jul 1985 - Jul 1986	Director (Acting) Info. Srvs for Services Division the Shuttle Process. Contract (SPC)	Grumman Technical

Directed approximately 136 Managers, Engineers, Computer Analysts and Programmers. The tasks involved the identification and installation of the computer hardware with its attendant data-communication network, the software development of automated management and factory collection systems, computer operations and software application programs for business operations for the support of the SPC at KSC.

Oct 1984 - Jul 1985	Deputy Director, Info. Srvs, for the SPC	Grumman Technical Services Division

Directed approximately 75 Managers, Engineers, Computer Analysts and Programmers. The tasks are the same as above except for the omission of the business computer support tasks.

Oct 1983 - Oct 1984	Director, Integrated Ground Operations for the Shuttle Processing Contract (SPC)	Grumman Technical Services

Directed approximately 670 Managers, Engineers, Technicians and Computer Operators. The tasks consolidated under Integrated Ground Operations were the Operations and Maintenance of the Launch Processing System (LPS), i.e. network of distributed computers used in the launch testing of the Space Shuttle. Also, directed the Instrumentation, Measurements and Calibration activities supporting all SPC tasks coupled with the attendant Configuration Control, Scheduling and Logistic Support.

Nov 1981 - Oct 1981	Director, Space System Operations for Space Programs	Grumman Aerospace Corp.

Directed the Management and Launch Processing System Assessment Teams (12 engineers) during the STS-3 and later vehicles. Directed the Vandenberg AFB, Shuttle Processing Contract (SPC) Assessment Team (10 engineers). Beginning in December 1982, directed the Grumman Aerospace Corp. proposal team, for a major role in the SPC.

Jul 1979 - Nov 1981	Director, Field Operations for the Software Systems Department	Grumman Aerospace Corp.

Responsible for day-to-day activities, resource allocation and program management of the Software Support Facility now under contract with the Naval Training Equipment Center, Orlando, Florida. Duties included the establishment of Software Support Facility (Naval Training Equipment Center, Orlando) by managing the facility construction, hardware installation, software development and its installation on the host computer, teaching software configuration management, and software modification techniques pursuant to the A6E Weapon System Trainer Software. Supervised 8 managers, and engineers, directed contract and new proposal efforts with a budget of approximately 1.8 million dollars. Also, responsible for manpower resource allocations to field sites outside of Orlando.

Aug 1977 - Jul 1979	Director, NASA/ Civil Space Programs	Grumman Aerospace Corp.

Responsible for day-to-day activities, resource allocations and program management of space programs relating to advanced studies and mission hardware to include large space structure fabrication and deployment articles coupled with their integration into the Space Shuttle. Projects typical to this development were the prototype Automated Beam Builder (produced one meter triangular aluminum beams for space construction) and the Astronaut Foot-restraint and Cherry Picker end-effector (used with the shuttle RMS). Supervised 50 managers and engineers; directed contracts and new proposal efforts with a budget of approximately 3 million dollars.

Jan 1977 - Aug 1977	Assistant to Director of Space Programs	Grumman Aerospace Corporation

Responsible for resource allocation and program management to the manned NASA business area. This included large space structure programs in fabrication and deployment of low density structure from the Space Shuttle for beneficial use of the U.S. Supervised 40 managers and engineers; directed contracts and new proposal efforts with a budget of approximately 2 million dollars.

Sept 1976 - Jan 1977	Engineer Consultant Division, Princeton, N.J.	RCA/Astro-Electronics

Developed organizational plan and rationale for an "Independent Boost Vehicle/Spacecraft Integration Team". Participated in successful recovery of the Defense Meteorological Satellite Program (DMSP) Vehicle after an attitude control failure occurred on the launch of the first Block 5 satellite in September 1976. Involvement included, first that determination of the orbital parameters and the vehicle attitude motion, second, the formulation of the attitude command

sequences for the magnetic torquing coils for despin, and final lock-on to the normal three-axis stabilized attitude, and third to execute command sequences through four telemetry ground stations around the world that ultimately recovered the satellite. Following this incident, the satellite's useful life was four years.

Feb 1976 - Sep 1976	Deputy Chief-of Staff for Advanced Space Organization Programs	Space & Missile Systems (SAMSO)

Responsibilities included the direction of exploratory development of new technical concepts and techniques, the space qualification of advanced military hardware (including attitude control, guidance, navigation, power, space computer and sensor systems) by space demonstration and acting as the corporate planning director and chief scientist of SAMSO. Supervised approximately 250 military and Aerospace Corporation engineers and directed 42 contracts, including the development of three prototype satellites, totalling 72 million dollars. In this capacity, was responsible for channeling technologies originating at USAF Laboratories and elsewhere into military space systems.

1974 - Feb 1976	Deputy Chief-of-Staff SAMSO for Technology	

Responsibilities essentially the same as listed above except for the exclusion of the development planning function.

1972 - 1974	Director, Computer Srvs Div. of Range Operations	Space & Missile Test Evaluation Center

Responsibilities included all data processing (real-time and batch), software modifications and computer systems resources at SAMTEC. Supervised 38 government and 150 contract engineers on a budget of approximately 6 million dollars.

1972	Guidance & Control Analyst, Technical Dir. Office	SAMTEC, Vandenberg AFB, CA

Responsibilities included the supervision of test plan formulations for evaluations of guidance and control mechanization for aerospace vehicles at SAMTEC as the Project Test Director of the "Mobile Sensor Evaluation Series" (MOSES). Determined radar, telemetry, optical and safety, and diagnostic evaluation necessary for advanced guidance systems. Also, responsible for evaluations of real time and post flight data processing techniques for improvements of metric tracking capability.

1970 - 1972	Commander	776th Tactical Airlift Squadron, Taiwan

Responsibilities included serving sequentially as Assistant Operations Officer, Operations Officer and Commander of an operational C-130E Tactical Airlift Squadron, Flying missions throughout the Far East and Southeast Asia.

1965 - 1970	Associate Professor of Electrical Engr	Air Force Institute of Technology, Dept of EE Wright-Patterson AFB,Ohio

Responsibilities included teaching engineering courses in the Graduate Aerospace Guidance and

Control Program, directed research activity for students in this category and accomplished individual research on advance topics of optimal control applications using digital and hybrid computers.

1952 - 1965 Served with U.S. Air Force

Performed diverse management and planning functions related to research and development. Included is four years of teaching experience at the undergraduate level at the U.S. Air Force Academy as Assistant Professor of Astronautics. Also, accumulated 4600 hours of flying time in 21 different single and multiengined aircraft.

AFFILIATIONS:

Member, Sima Xi
Member, Tau Beta Pi
Senior Member, Institute of Electrical and Electronics Engineers, Inc.
Associate Fellow, American Institute of Aeronautics and Astronautics, Inc.
Registered, Professional Engineer, Ohio

PERSONAL DATA:

Date of Birth: July 1, 1928
Citizenship: United States
Marital Status: Maried
Health: Excellent
Clearance: Current - Secret, Previous - Top Secret

CURTIS R. LISLE

EDUCATION: M.S., Computer Science, The University of Central Florida, 1990
B.S., Electrical Engineering, Georgia Institute of Technology, 1986

EXPERIENCE SUMMARY:

Mr. Lisle has several years of experience with visual simulation technology. He has been involved in hardware design as well as database production tools for a variety of high-end visual systems. His background also includes digital design, software engineering, computer graphics algorithms, and signal processing.

APPLICABLE EXPERIENCE:

1989 - 1991 | Visual Systems Scientist | Institute for Simulation and Training

Mr. Lisle is employed by the Institute for Simulation and Training of the University of Central Florida. He is currently focusing on the production of terrain databases for Computer Image Generators (CIGs) and is managing IST's effort to produce a software tool suite capable of developing databases for multiple CIGs. He has developed a CIG simulation running on the Silicon Graphics UNIX workstation and integrated this with a prototype helicopter cockpit constructed at IST. He has been involved in Constructive Solid Geometry modeling techniques. Mr. Lisle has been an actively reviewing the progress of the Tri-Service Project 2851 which is constructing a database development system for future government training systems.

1986 - 1988 | Engineer | General Electric

Mr. Lisle was a hardware designer on GE's CompuScene PT-2000 CIG system. He prototyped a custom design first through software simulation on Sun workstations and then developed a hardware system now in production in the PT-2000; Studied visual simulation issues including texture mapping, anti-aliasing, hidden-line removal algorithms, and pipelined hardware design. After the PT-2000 project, Mr. Lisle focused on Computer Aided Design (CAD) systems, including VALID Logic's SCALD system, to develop a productive hardware prototyping and design capability for GE.

1981 - 1986 | Data Specialist | DBA Systems, Inc.

Mr. Lisle developed image processing and cartographic software on VAX VMS systems in Fortran. He ported in-house operating system to a target PDP 11 workstation along with application software and developed PLM and Fortran drivers under RMX-86 to interface an Intel 80286 to a video disk and graphics processor.

PATRICK J. MOSKAL

EDUCATION:

Ph.D., Experimental Psychology/Psychophysics, The University of Notre Dame, 1986

M.A., Experimental Psychology/Sensory Processes and Perception, The University of Notre Dame, 1984

B.A., Psychology, The University of Notre Dame, 1981

EXPERIENCE SUMMARY:

Dr. Moskal has a number of publications and presentations, both academic and military. His technical knowledge includes sensory processes, perception, psychophysical scaling, performance under stress, performance measurement, training systems design and analysis, intelligent tutoring systems, and quantitative methods.

APPLICABLE EXPERIENCE:

1989 - Present	Research Psychologist	Institute for Simulation & Training/ University of Central Florida

Dr. Moskal is employed by the Institute for Simulation and Training of the University of Central Florida. He is currently involved with the following research projects: a) determining selective fidelity requirements in networked/distributed simulators, b) developing research to generate guidelines and recommendations for providing embedded training into the instructor/operator stations of Navy training devices, and c) creating a readiness assessment package for chemical warfare defense training, and d) conducting research to advance intelligent tutoring systems by employing the principles of cognitive learning theory and instructional systems design.

1986 - 1989	Research Psychologist	Naval Training Systems Center, Human Factors Division

Dr. Moskal was employed in the Human Factors division of the Naval Training Systems Center. He was principle investigator for the Electronic Warfare continuum Assessment Program (EWCAP) and the Radio Instruments Radiological Defense (CBR-D) Training Program; and served as a statistical design and Navy's aviation community and make reports and recommendations to the Chief of Naval Operations. RIOT is also an ongoing project to develop a part-task trainer to teach Navy primary flight students how to perform instrument navigation.

ERNEST A. SMART

EDUCATION: B.S. Education, University of Maine - 1955
Flight Training, Fixed Rotary Wing - 1957
National War College - 1974
Command and General Staff College - 1968
Dept. of Defense, Personnel Mgmt. Course - 1969

EXPERIENCE SUMMARY:

Mr. Smart has in excess of 25 years experience in managing multi-million dollar military and industrial programs. He was the President of Combat Arms Training Board (CATB) and second Director of the Training Device Directorate, TRADOC's equivalent to PM TRADE. He has 5 years experience in running local Regional Corporate offices, supporting PM TRADE and DOD in simulation and training research. He was instrumental in the start-up of the Institute for Simulation and Training, and is responsible for procuring and managing all US Army work effort. Mr. Smart is responsible for developing plans and establishing research laboratories at UCF/IST; e.g., the SIMNET. While at UCF/IST, Mr. Smart has managed two major study efforts for the Training Performance Data Center (TPDC), and four research contracts for the Army.

APPLICABLE EXPERIENCE:

1986 - Present — Advanced Applications Manager — Institute for Simulation and Training

As the Advanced Applications Manager he is responsible of all new business development for the Institute. Mr. Smart is also the Manager, Army Programs. As Manager, he is responsible for developing business plans, procuring contracts, managing major study projects, assigning personnel tasking and developing methodologies and strategies for task accomplishment.

1985 - 1986 — Manager, Orlando Operations — Hay Systems Inc., Orlando Operations Group

As Manager, established policies and procedures for the operation and administration of the Hay Systems, Orlando office. Developed and managed the business development plan, cost proposals and contract status reports. Provided oversight on the development of cost model studies and data base design in support of the Training Performance Data Center. Directly involved in an in depth analysis of the Services' material acquisition and appropriations processes in support of training device procurement. Participated in the ACATT front-end analysis study.

1983-1985 — Manager, Training Device Engineering Center — BDM International Inc.

Manager of an autonomous corporate regional office whose principal business was as Service Support Contractor for PM TRADE, the US Army's Project Management Office for Training devices. Supervised a staff of 15 technical engineers, mathematicians, computer scientists, training analysts and logisticians conducting front-end studies and analyses supporting the acquisition process and life-cycle management of US Army training devices. In addition to the responsibility of running a regional office, serve as Program Manager integrating multi-disciplinary skills, teams, scheduling, costing, technical assessment, quality control and customer interface.

1978 - 1981	Chief, Organization Directorate	U.S. Army Training and Doctrine Command

Managed a staff of 50. Developed strategies and methodologies to further Department of Defense Force Modernization goals. Directed the U.S. Army system for planning, developing, documenting and implementing new organizations and equipment. Chaired multi-million dollar study program for a new streamlined, automated personnel authorization system. Guided the development and implementation of a program which systematically integrates new defense equipment with appropriate support personnel in the proper organization. Managed an ADP facility supporting executive decisions-making processes.

1976-1978	Chief, Training Dev. Directorate	U.S. Army Trg & Doctrine Doctrine Command

Organized and managed a staff of 34 personnel, responsible for and processing of Army-wide requirements for training devices. Developed methodology for determining training device requirements for developing cost-effective weapons systems and devices.

1974-1976	President	U.S. Army Combat Training Board (CATB)

Served as President, Combat Arms Training board, the Army's central agency established to determine training problems (unit and institutional) analyzed the problems and provided innovative solutions. These efforts pioneered the Army's current training development doctrine, methodology and processes. Responsible for providing direction, methodology and processes. Responsible for providing direction to the initiations of Tactical Engagement Simulation System; ISD, innovative training, gaming and simulation.

CURRENT STATUS: Full time employee--University of Central Florida

KEVIN ULIANO

EDUCATION: M.S. Industrial/Organizational Psychology, UCF, 1985
B.A. General Experimental Psychology, UCF, 1983

EXPERIENCE SUMMARY: Mr. Uliano has over six years of experience as a research psychologist working on a variety of behavioral research programs for the Department of Defense including providing technical support to the Visual Technology Research Simulator (VTRS) facility at the Naval Training systems Center (NTSC), and performing training effectiveness analyses on 2F29 and EA3B flight simulators for NTSC's Human Factors Laboratory. Mr. Uliano has several publications and professional presentations in the area of human factors psychology, and is a member of several professional organizations.

APPLICABLE EXPERIENCE:

NOV. 1987 - Present Principle Investigator Institute for Simulation & Training

Current duties include providing management and technical direction in IST laboratory research for the U.S. Army in the simulation and training domain as it relates to human factors psychology. Other research activities have included assessing the impact pact of individual characteristics on performance, designing effective human-computer interfaces for computer-based training, and evaluating training devices from the Army's MANPRINT perspective.

Feb. 1987 - Sept. 1987 Human Factors Hay Systems, Inc.
Orlando, Fl

Provided human factors engineering technical support to the U.S. Department of Defense and private industry. Areas of specialization included (2) MANPRINT --a methodology aimed at the effective integration of manpower, personnel, training, and other issues early in the systems acquisition process; and (2) evaluation of human-computer interfaces for training and management application. Mr. Uliano also served as Marketing Coordinator for Hay's Executive Assessment and Development Simulations.

May 1985 - Feb. 1987 Research Psychologist Essex Corporation
Orlando, Fl

Provided technical support for the Visual Technology Research Simulator (VTRS) facility at the Naval Training Systems Center. Completed tasks included research planning, data collection, and quantitative analyses on experiments examining factors which induce simulator sickness as well as visual-vestibular interactions in simulator flight training situations. Investigated the operability of various simulator flight training situations. Investigated the operability of various simulator design features including field-of-view, scene detail, and motion cuing for landing helicopters on small ships.

May 1983 - Feb. 1985 Research Associate Human Factors Lab
NTSC, Orlando, Fl

As an on-site contractor for the University of Central Florida, Mr. Uliano performed training effectiveness on 2F29 and EA-3B flight simulators. Planned and developed two prototype computer-aided instruction systems using intelligent systems methodology for teaching navigational rules and for team training diagnosis and feedback.

Aug. 1984 - Present	Training Consultant	Assessment Designs Int'l, Maitland, Fl

Continuing projects include designing and producing simulation exercises and assessing potential candidates for managerial selection and training. This requires expertise in assessment center methodology and its application to selection, placement and training procedures. Clients have included Fortune 200 companies such as General Motors, American Express and Data General.

CURRENT STATUS: Full time employee--University of Central Florida

AMY F. VANZANT-HODGE

EDUCATION: M.S., Computer Science, University of Central Florida, 1989
B.S., Computer Science, University of Central Florida, 1983

EXPERIENCE SUMMARY: Ms. Vanzant-Hodge has over four years of cumulative experience in systems/application programming, database design, and hardware setup, procurement, and administration. She has completed research in the area of routing algorithms for Very Large Scale Integrated (VLSI) circuit design. These algorithms can also be applied to simulated force routing. Ms. Vanzant-Hodge gained experience in user interface design and implementation as well as customer support for problems resolution while working for Software Design Group, Ind. She is a member of IEEE Computer Society, IEEE Circuits and Systems Society and ACM.

APPLICABLE EXPERIENCE:

2/90 - Present	Research Associate	Institute for Simulation & Training

Current duties include investigation into expert system usage and behavior modeling for Intelligent Simulated Forces project. Responsible for management of entry-level employees and student workers, procurement of software and equipment, and aiding with design of testbed for Intelligent Simulated Forces project. Current assisting with transfer and testing of testbed software to a multi-tasking operating system along with design and implementation of a user interface for the testbed.

1986 - 1990	Lead Programmer/ Analyst	Software Design Group, Inc.

Administer planning and scheduling of new customer requirements and change requests and serve as customer liaison. Responsible for designing, coding and debugging shared logic applications running in a multi-tasking environment. Functioned as System Administrator over development system.

1985 - 1986	Teaching Assistantships	UCF, and World Information Systems Enterprises, Inc.

As a graduate teaching assistant, taught lab portion of "Computer Systems Concepts/Programming" and "Introduction to Computer Science" course. As a contractor, taught Microprocessor Development course at Beijing University and 68000 assembly programming.

1983 - 1984	Database Programmer	Computer Management Advisors

Developed database applications for architecture accounting packages (part-time position while at UCF).

1982 - 1983	Programmer and Change Control Operator	Martin Marietta Aerospace Corp.

Developed maintenance programs for various databases which kept track of software changes and a software library. Completed work necessary to implement changes in Low Altitude Night Targeting and Infra-Red Navigation (LANTIRN) project software design (part-time position while at UCF).

1989 - Present Programmer/Design Consultant University of Central Florida

Continuing work as a volunteer on a High Rise Fire Simulation trainer for training fire chiefs at a command post during a high rise fire. This trainer is being implemented in an oriented language and a PC.

CURRENT STATUS: Full time employee -- University of Central Florida