

1-1-1990

Statement Of Capabilities For Research, Development, Training, And Evaluation Support

University of Central Florida Institute for Simulation and Training

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INSTITUTE FOR SIMULATION AND TRAINING

STATEMENT OF CAPABILITIES
FOR
RESEARCH, DEVELOPMENT, TRAINING,
AND EVALUATION SUPPORT

SUBMITTED TO

UNITED STATES AIR FORCE
HUMAN SYSTEMS DIVISION HRL/PRP
BROOKS AFB, TX 78235-5601
ATTN: DR. SUZANNE LIPCOMB

IN RESPONSE TO

COMMERCE BUSINESS DAILY ANNOUNCEMENT
DATED OCTOBER 2, 1990
SOURCES SOUGHT SYNOPSIS
PMRS 90-25
FOR
RESEARCH, DEVELOPMENT, TRAINING,
AND EVALUATION SUPPORT

October 30, 1990

IST

SUBMITTED BY

INSTITUTE FOR SIMULATION AND TRAINING
UNIVERSITY OF CENTRAL FLORIDA
12424 RESEARCH PARKWAY, SUITE 300
ORLANDO, FLORIDA 32826

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1.0 INTRODUCTION

The University of Central Florida (UCF), Institute for Simulation and Training (IST), is pleased to provide the United States Air Force Human Resources Laboratory, Human Systems Division, HRL/PRP. (Dr. Suzanne Lipcomb) with this capabilities document in response to the Commerce Business Daily announcement Sources Sought Synopsis: Research, Development, Training and Evaluation Support, PMRS 90-25, dated October 2, 1990. UCF/IST is a university-based laboratory capable of performing research projects and advancing training and simulation technologies that are related to USAF Human Resources Laboratory Training needs. UCF/IST possesses the professional skills and laboratory resources to provide innovative research and development in the specified areas of interest. The diversity of professionals at UCF, IST, Florida State universities and required industry collaboration can be brought together in one location to support the research requirements of USAF Human Resources Laboratory in this application area. UCF's and IST's ability to work with other universities and a variety of private industrial clients, as well as the military, has been demonstrated historically and will continue to be fostered by UCF/IST.

The proposed research would be accomplished via a sharing of resources. Figure 1 illustrates the networking between UCF/IST and others including other universities, industry, and the Department of Defense.

1.1 Summary of Capabilities

The following sections of this document present UCF/IST capabilities. This section will summarize these capabilities and direct the reader to specific sections for further detail.

1.1.1 Simulation and Training Technologies

IST has an established record in conducting advanced research and development in numerous simulation and training technologies. IST has extensive expertise in the technical areas applicable to this project including:

- Computer Based Training
- Embedded Training
- Intelligent Tutoring
- Human Performance
- Cognitive Modeling
- Adaptive Learning
- Team Training
- Job Skills Analysis
- Manpower, Personnel and Training
- Artificial Intelligence/Intelligent Systems
- Instructional Technologies
- Occupational and Training Requirements
- Footprint/Crosswalk
- Readiness, Exercises and Joint Service
- Interoperability Training

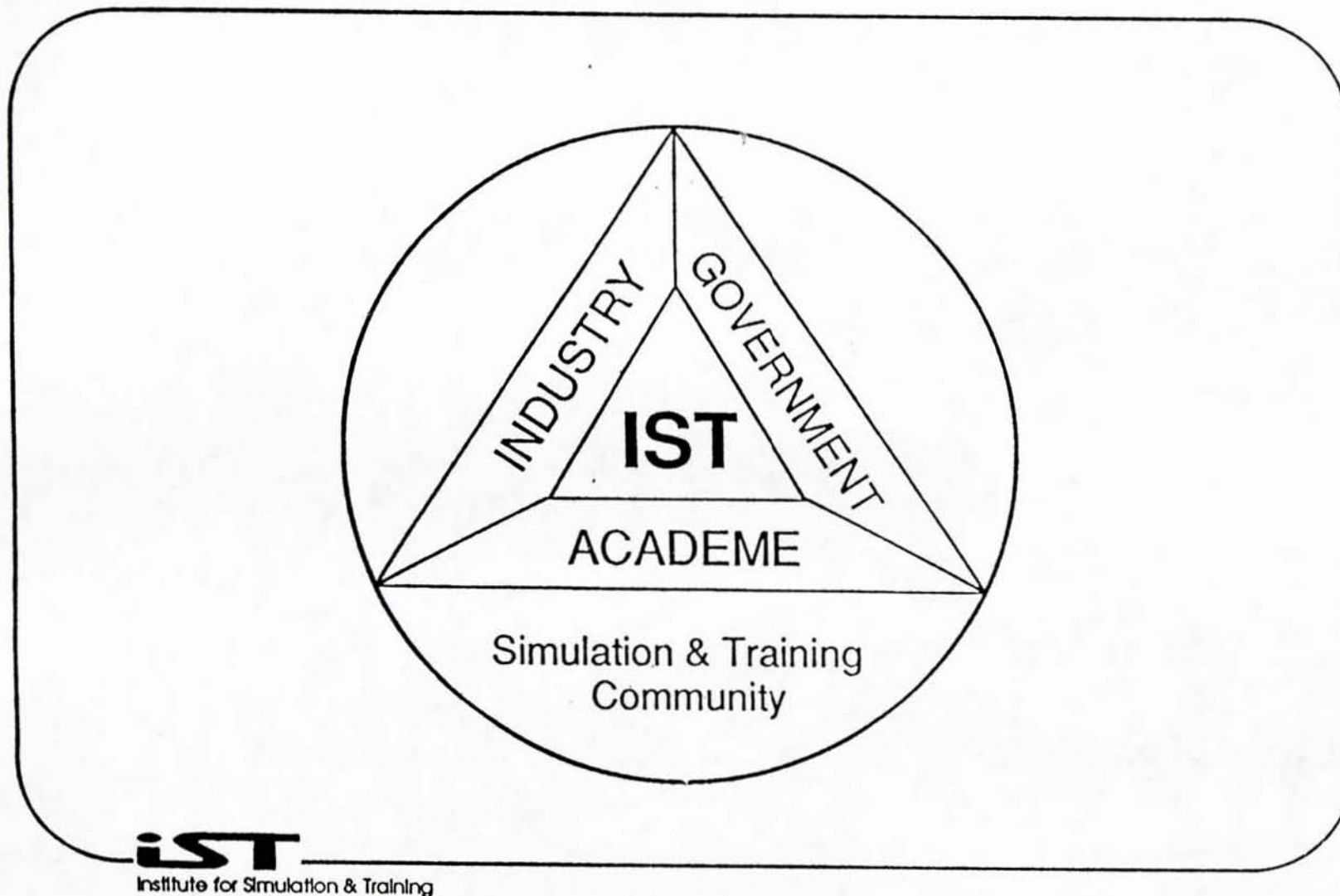


FIGURE 1

NETWORKING BETWEEN IST, GOVERNMENT, ACADEME AND INDUSTRY

IST has a long history of coordination and cooperation with industry, other universities and government laboratories. IST has an Industrial Advisory Board which consists of the following companies:

Burtek	Hughes Simulation Systems
CAE-Link	Loral Defense Systems
Encore Computer	McDonnell Douglas
Evans & Sutherland	Perceptronics
G.E. Aerospace	Reflectone
Grumman Electronics	Star Mountain
Harris	Systems & Simulation
Westinghouse Electric	

This board meets twice a year to advise IST on industry problems, share state-of-the-art technology information, and critique IST's research efforts.

IST was asked by Navy Total Force Training and Education Policy Division (OP-11) to assemble an industry task force to specify the training research needs to meet Navy training requirements in the year 2000. IST assembled the following companies and produced a report for OP-11.

Harris Corporation	IBM
General Electric Corporation	Digital Equipment Corporation
Grumman Sim. & Trng. Products	Eagle Technology
Evans & Sutherland	Gould
McDonnell Aircraft	Hughes
Perceptronics	Paragon
Reflectone	

IST has been tasked by DARPA and PM TRADE to develop a standard for interoperability of Defense Simulations. Workshops hosted by IST involved over 90 different organizations. As a result of these workshops, IST has established a strong working relationship with following members of industry:

BBN	SAIC
IBM	SYSCON
Martin Marrietta	AAI
McDonnell Douglas	Raytheon
Hughes	STI
General Dynamics	Boeing
Lockheed Sanders	Mitre
CAE Link	Northrop

As part of IST's technology development efforts, we have established a working relationship with the following universities:

Georgia Tech
University of Iowa
University of South Florida
Carnegie-Mellon University
University of Alabama

IST has also developed a working relationship with the following government agencies and laboratories:

PM TRADE
DARPA
TPDC
USA HEL
NTSC
NATC
ONR
NASA Ames
ARI Ft. Rucker
Naval Oceans Systems Center
SIMNET D Site Ft. Knox
USA CECOM
USA ETL
USA DCA

1.1.2 Interdisciplinary Research

IST is currently conducting interdisciplinary simulation and training research involving the physical, engineering, behavioral and computer sciences. IST is a multidisciplinary organization with a permanent staff of research specialists from a wide variety of disciplines including human factors, cognitive psychology, education, human performance, computer science, computer engineering, mathematics, electrical engineering, aerospace engineering among others. In addition, IST regularly draws upon the expertise of faculty within all colleges of the University of Central Florida, other institutions within the Florida State University System and industry to supplement its core technical base. This provides access to numerous areas of critical technical expertise including management, logistics, physical, instructional technology, industrial/organizational psychology, etc. It should be noted that a large portion of the institute's staff have extensive experience in industry or government agencies. Integration with the academic environment provides a unique industrial/government/academic perspective on simulation and training research. IST can provide the innovative multidisciplinary research available only from academia with the understanding of application requirements.

Table I lists some of IST present and completed projects and the scientific disciplines which supported that research effort.

Table I
Sample IST Projects and Sciences Involved

Project	Science			
	Physical	Engineering	Behavioral	Computer
Training Technologies Integration	•	•	•	•
Unit Performance Assessment System Test Bed		•	•	•
Tactical Electronics Simulation Test System	•	•	•	•
MANPRINT Decision Options			•	
Team Training Test Bed			•	•
ASTAR Operational Evaluation			•	
Training Transfer in Tank Gunnery Training Program			•	
Cost and Training Effectiveness Research in Support of Simulation and Training Technology			•	
A Cognitive Model of Instruction			•	
Intelligent Tutoring System			•	•
CAD Tools in Battle Simulation				•
Neural Network Data Base Generator				•
Application of Animation Technology to the Training of Multidimensional Concepts			•	•
Classroom of the Future		•	•	•
Visual Display Technology		•		•
Computer Animated Films for Training and Simulation			•	•
Training Technologies for Situational Awareness			•	•
Footprint/Crosswalk			•	•
Low Cost Language Training			•	
Foreign Language Training Technology			•	
Simulation Networking		•		•
Networking Protocol Alternatives		•		•
Interoperability of Network Standards		•		•

2.0 DESCRIPTION OF THE ORGANIZATION

IST is a research institute established by the State of Florida. The Institute is a part of the University of Central Florida and reports to the Associate Vice-President of Research. Since the Institute became a reality, it has grown from a small on-campus organization to a major research facility employing over 200 researchers, support staff and students. IST currently occupies over 19,00 square feet of office space and approximately 8,000 square feet of laboratory space in the Central Florida Research Park. The Research Park is located adjacent to the University of Central Florida and represents the largest concentration of simulation and training technology in the country. The focal points of the Research Park are PM TRADE, NTSC, and TPDC, IST's largest customer's.

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 these 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 and outside the DoD, and to provide an environment for simulation and training education.

2.1 Mission

The mission of IST is to become the nationally and internationally recognized center for research and education in simulation, modeling and training technologies.

2.2 Objectives

In order to achieve its mission, IST has established four objectives:

- To be the leading academic institute for performing research in simulation and training (S&T)
- To work collectively with academic, industrial, and government organizations to advance the state of the art in S&T.
- To transfer defense/government funded S&T technology to broad sectors of our society such as education, environment, public safety, and medicine.
- To provide an environment for S&T education.

2.3 Goals

IST has established the following goals to fulfill its role of bringing together Industry, Government, and Academe:

Assemble a core of expertise in the simulation and training disciplines using faculty and Institute personnel.

Build research and development facilities in mainline technologies to serve as test beds for concept development and evaluation within associated simulation and training technologies.

Foster the growth of simulation and training expertise through the development of university curriculum and degree programs and the development of internships for students.

Communicate research results to industry, government, and academic audiences by way of publications, seminars, courses, and other transfer methods.

Promote internally funded faculty research programs to take the lead in developing technology to meet the future needs of the simulation and training industry.

2.4 Formation of IST

The Institute for Simulation and Training was formed in 1982 in response to two Government studies proposing the centralization of simulation and training research and development in Central Florida. The principal Army and Navy agencies for training system development were already in Orlando, along with related industry. These studies showed that a university-affiliated institute was needed to provide a range of research services and to communicate the results to government, academic and industry audiences.

2.5 Management

The day-to-day operation of the Institute is conducted by the Executive Director of the Institute. Because IST is an interdisciplinary institute, its Executive Director is responsible administratively to the Associate Vice-President for Research (serving as designee for the President of UCF) and does not report to the Dean of a specific College. Figure 2 illustrates the IST organization.

IST's management philosophy is to utilize the Institute's experienced, success oriented managers to manage the programs, while drawing from the pool of professional researchers and students at UCF, other state and national universities, and industry to conduct the research. IST accepts full responsibility for the management of all research projects.

The following IST policies illustrate this philosophy:

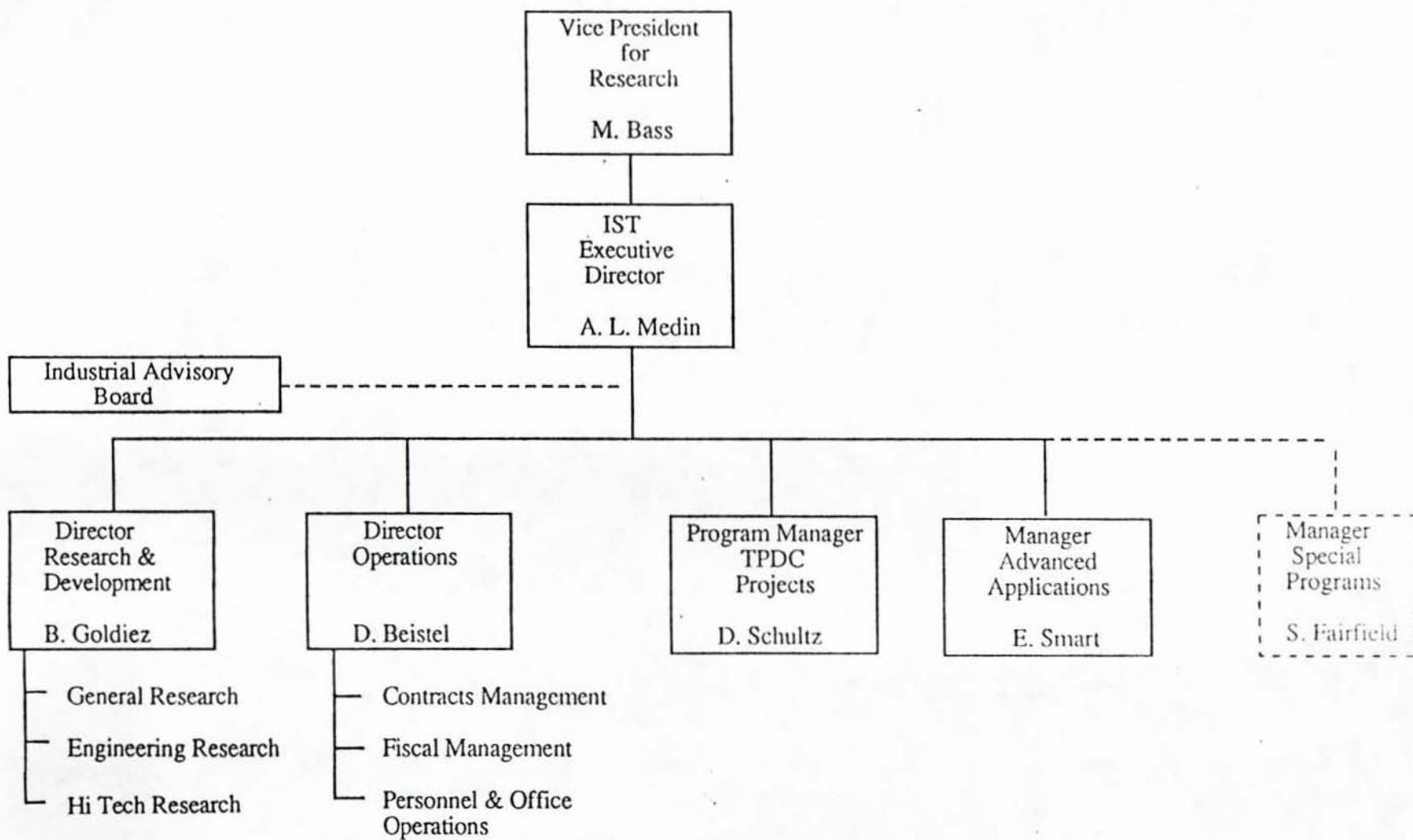


FIGURE 2
IST ORGANIZATION

Program Management

Local facilities with dedicated resources for PM Trade task performance
Management team responsibilities clearly defined
Project management approach to task accomplishment
Matrix management of personnel to assure optimum use of personnel resources
Technically qualified working managers in key positions
Proven technical program management procedures highlighted by frequent technical reviews
Formal relationships with resources within the university system of the state of Florida and throughout industry nationwide
On-site contracts, subcontracts and financial management capability
Access to qualified personnel for added flexibility, responsiveness, and increased depth and special technical expertise

Task Management

Program/task manager appointed for each delivery order
Program/task manager with fixed responsibility, with dedicated resources and project plan
Task execution in accordance with proven fundamental research approaches
Quality control in accordance with sound research practices

2.5.1 Project Management

Activities under this effort would be managed and coordinated through the General Research Department within IST. This department is managed by Dr. Michael Companion. The department has the primary responsibility for all behavioral research within the Institute including research in the areas of human performance, information processing, cognitive processes, intelligent systems, intelligent tutoring systems, artificial intelligence, human factors and other related areas. Personnel from other areas within IST and faculty from UCF will be matrixed into the project as required to support specific tasks.

3.0 WHY UCF/IST?

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 these 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.

There are significant benefits associated with UCF/IST conducting simulation and training research. The following benefits provide "value added" to U.S. Government research dollars.

3.1 State of Florida Support

Annual Budget

The State's annual budget provides for salaries for faculty, key research professionals and some capitalization. IST's budget line increased from \$500,000 in 1985 to \$1.5 million in 1989 and an additional \$500,000 has been requested .

FHTIC Applied Research Grants

The twofold purpose of the Florida High Technology and Industry Council Applied Research Grants Program is to strengthen applied research efforts in seven basic areas of technology and to foster relationships between universities and industry. Grants are provided on a competitive basis to university faculty members for research which has commercialization potential. Proposals are judged by a panel of peer reviewers composed of high-tech company executives and university researchers. Military agencies are also participating members in the selection process, providing a leveraging effect on military research needs. Research funded by this program includes simulation and training, biomedical devices, biotechnology, lightwave and electro-optics, microelectronics, computer software, and robotics. For 1988-89, IST was extremely successful in pursuing advanced research with the Florida High Technology and Industry Council. Of nine proposals submitted in the simulation and training category, seven awards were received by IST for a total of \$505,000. For 1989-90 this total came to \$400,500.

3.2 Grants for Faculty and Professional Researchers

One of IST's objectives is to provide research grants and other assistance to UCF Colleges to strengthen their capacity to make contributions to the simulation and training community. The IST grant policy is similar to a BAA; i.e., when a UCF faculty or IST research professional proposes a unique or novel research project, that is determined by IST's selection process to have value to simulation and training technologies the project will be funded by IST. During the past three years, IST has awarded

a number of research grants including:

- Human Factors Designs Utilizing Advanced Simulation
- Application of Statistical Techniques to Improved Automated Keywording Systems
- Use of Surrogate Measurements for the Prediction of Flight Training Performance
- Cognitive Processing of Synthetic Speech
- Studies of Team Training: Identifying Targets for Team Skills Training
- Advanced Training Algorithms for Neural Networks
- Interfacing and Using Small AI Expert systems with Interactive Laser-Optical Technology
- Quantitative Analysis of Manprint Decision Options

3.3 Technical Expertise/Human Resources

The Institute for Simulation and Training draws from a broad range of both physical and human resources. The diversity and depth of these resources enable IST to conduct research that would not be cost effective for many companies in the private sector. The combination of Doctoral and Master's level researchers supported by a cadre of experienced graduate and undergraduate research assistants provides a strong, cost effective research team.

An extensive in-house knowledge base and the expertise at UCF and the other schools in the State University System are assets that allow the Institute to carry on research in most areas related to simulation and training.

IST's research staff consists of over 200 research scientists, faculty, and students, in addition to support personnel (See Figure 3). Their diverse backgrounds provide the necessary technical expertise to work on projects in key technologies that are the basis of simulation and training research. In addition, there are approximately 30 faculty members from UCF and other institutions working on projects at IST.

Figure 4 lists core personnel who provide expertise relevant to the requirements specified in the sources sought synopsis. The figure indicates degree level, project experience by military service and technical expertise related to the sources sought requirements. This summary clearly indicates that UCF/IST can provide the necessary technical expertise to support the research needs of the USAF Human Resources Laboratory, Human Systems Division (HRL/HSD).

3.4 Research Expertise

The following sections provide brief descriptions of some of the research expertise within IST identified as related to the requirements within the sources sought. These descriptions are included to provide a complete description of IST's capabilities to support the HRL/HSD effort and to demonstrate that IST has the necessary resources to successfully accomplish the research support outlined in the sources sought synopsis. These

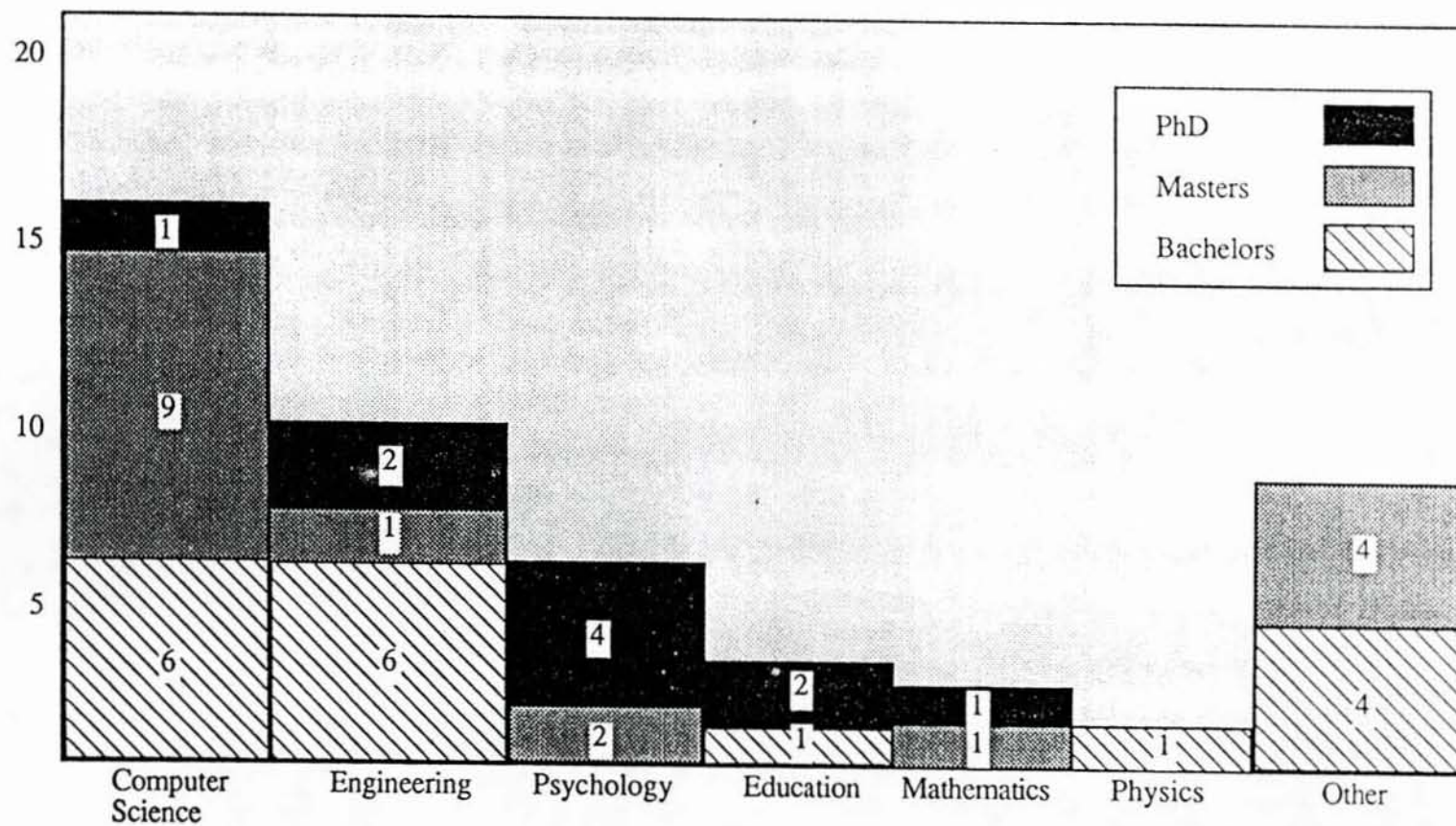


FIGURE 3
IST PROFESSIONAL STAFF BY DISCIPLINES

	Education			Project Exp.				Expertise												
	Doctoral	Master's	Bachelor's	Air Force	Army	Navy	Marine	Computer Based Instruction	Intelligent Tutoring Systems	Human Performance	Information Processing	Logistics	Manpower, Personnel, Training	Human Factors	Job Performance	Training Strategies	Embedded Training	Authoring Systems	Intelligent Systems	
Michael Companion	X			X	X	X		X	X	X	X	X	X	X	X	X		X		
David Hosley	X			X	X		X				X	X			X	X				
Peter Kincaid	X			X	X	X	X		X	X		X	X	X	X	X	X			
Janet Turnage	X			X								X	X	X						
Bruce McDonald	X			X	X	X	X						X			X				
Patrick Moskal	X					X	X	X		X			X			X				
Shau Lang	X					X		X									X	X		
Oscar Dorr		X		X	X	X					X		X							
Thomas Carolan		X				X		X		X					X	X	X	X		
Patsy Anglin		X				X		X									X	X		
Rupert Fairfield		X		X	X	X	X				X		X							
Kevin Ullano		X		X	X		X		X				X							
Brenda Bradley		X				X	X					X		X	X					
Steven Kass		X		X						X			X					X		
Joann Rullo			X			X		X	X				X				X			
Lisa Shrestha			X			X		X	X								X			
Hyun Kim			X		X													X		
Mary Ann Frogge			X		X													X		

FIGURE 4

IST RESEARCH EXPERTISE

descriptions are limited to expertise associated with projects conducted at IST. It should be noted that IST's technical staff have extensive experience in additional technical areas while in industry or government service prior to joining IST.

3.2.1 Intelligent Tutoring Systems

Current work at the Institute for Simulation and Training (IST) in the area of intelligent tutoring systems has been funded by the Office of Naval Research and the Naval Training Systems Center. This research effort is being lead by Mr. Thomas Carolan. This Work has focused on the training of tactical decision-making skills. A variety of instructional strategies and techniques have been developed for basic research in cognitive psychology and computer science and are being implemented in a testbed for multi-threat warfare (e.g., anti-submarine, anti-surface, and anti-air warfare). These techniques involve embedding and automating numerous instructor functions, such as lesson sequencing, lesson pace, and the presentation of feedback. Because of the successful results from these projects to date (e.g., Williams, Reynolds, & Carolan, 1989), the Navy has expressed interest in transitioning this work.

IST research interests related to intelligent tutoring systems include intelligent instructional strategies for adaptively sequencing lessons, intelligent feedback techniques, simulating other team members in the training environment, and simulating intelligent adversaries (smart targets) in a simulated scenario. Scenarios will demonstrate coordinated and non-coordinated tactics among targets.

IST is in the processing of transferring this technical expertise to other agencies and application areas. IST has several outstanding proposals in the area of intelligent tutoring including the two described below.

3.2.1.1 Intelligent Tutoring in Power Plant Applications

IST has submitted a proposal to Florida Power Corporation (FPC) entitled "An Intelligent Tutor for Boiler Trip Emergency Operating Procedures." This research project will take an intelligent tutoring system previously developed for the Navy and incorporate it into one of FPC's computer-based training systems for power plant console operators. This system, as an initial demonstration of its potential, will train console operators how to handle emergencies involving a boiler shutdown (i.e., boiler trip). A boiler shutdown is an emergency for which it is crucial that operators be trained properly, because if they respond incorrectly to an equipment problem, the result can be millions of dollars worth of damage in a matter of minutes. Presently, a power company may spend over \$100 million annually to provide refresher training to their plant operators.

In addition to being expensive and time consuming, traditional refresher training systems do not have the capability to address the strengths and weaknesses of individual operators, largely because of insufficient training time and instructor

availability. therefore, because of the complex nature of power plant operations, IST has proposed to develop and evaluate an intelligent tutoring system for training for console operators. It will employ an artificial intelligence architecture, and state-of-the-art learning and design principles derived from research in cognitive science and instructional systems design. When completed, this system will provide: a) self paced operator training that alleviates the need for basic instructor/operator interaction, allowing the instructor to provide more individualized attention to trainees; b) isolation of specific trainee strengths and weaknesses; and c) personalized lessons specifically tailored to meet an individual's training needs. Employing this system will increase training efficiency and improve operator task knowledge, comprehension, and performance.

3.2.1.2 Intelligent Systems for Flight Training

A proposal, entitled "Intelligent Performance Assessment and Training Event Selection System for Flight Training Devices", has been submitted to FHTIC. This three year project will focus on the application of intelligent systems technology to new FAA flight training requirements.

The FAA has been in the process of upgrading and extending the requirements for flight training over the last few years to improve flight safety. This activity has dealt with both the curriculum requirements and the training device requirements, i.e., simulators and flight training devices. Because of the expensive acquisition and operational cost of the flight simulators and flight training devices, the cost impact of these FAA changes may be significant. To efficiently implement these increased requirements, more effective methods of accomplishing flight training conducted in flight simulators and flight training devices will be required.

In addition to the high initial cost of flight training devices, there is increasing concern over the consistency of training provided by flight instructors. There is a need to find ways to make that portion of flight training using simulators or training devices more efficient and more consistent to maximize the impact of training on flight safety. Modern computer based training technologies integrated with existing training devices can achieve these goals given the framework provided by new FAA training event authorizations for training devices, both flight simulators and flight training devices.

This proposal investigates new instructional technologies utilized in the development of a computer based system that can intelligently select and present all required training events based on pilot performance. This intelligent system would be able to measure and evaluate pilot performance on FAA required training events in real time. In a fully implemented system, diagnostic capabilities and feedback could also be incorporated to assist in the acquisition of flight skills. The system could be integrated into flight simulators and flight training devices

to guide the pilot optimally through the training event curriculum.

Generally, self-paced training approaches impose tremendous logistics problems, such as increased instructor demands, which have inhibited their widespread use. New training approaches based on intelligent systems technology, i.e., intelligent computer aided instruction (ICAI) or intelligent tutoring systems (ITS), offer the potential to inject personalized, self-paced training into a wider variety of applications. This technology reduces the instructor demands of individualized training by creating a "computerized instructor".

3.2.2 Logistics

The Institute can provide outstanding expertise and knowledge in the field of logistics. Our logistics program is led by Mr. Oscar J. Dorr, Certified Professional Logistician (CPL) and a Fellow of the Society of Logistics Engineers. Mr. Dorr serves on the adjunct faculty of the University in Logistics Engineering, and is internationally recognized as a lecturer, author and manager in the field of Logistics.

The Integrated Logistics System (ILS) elements of support as defined by DODD 5000.39 and AFR 800-8, and the Institute's approach to solving multidisciplinary problems and providing new concepts and ideas are described below.

Reliability and Maintainability (R&M) Interface

While R&M are engineering design parameters and normally the prerogative of engineering, the Institute believes the logistics function should take a pro-active role in defining and achieving R&M goals. Allocation of R&M requirements (the top-down approach) and the R&M predictions (the bottom-up approach) are properly within the logistics discipline and the Institute has the engineering and logistics staff to undertake that role.

Maintenance Planning

All maintenance planning starts with the development of the maintenance concept which should be defined as early as possible, during the concept phase of the acquisition process. Maintenance planning then proceeds to define the actions and support necessary to ensure the system/equipment attains the specified operational capability. Criteria for repair levels and times, testability, logistics reliability and maintainability characteristics, support equipment requirements, manpower and personnel, and facility requirements are then developed. Task analysis is performed to establish required maintenance tasks, and workloads are determined.

Support Equipment

The purpose of ILS in support equipment is to ensure that the required equipment is available to operating, training and maintenance activities when and where needed. As a corollary to this effort, it is a responsibility of the ILS function, the Institute believes, to make a maximum effort to reduce or elimi-

nate support equipment wherever possible. In particular, it is desirable to eliminate the requirement for special support equipment which is expensive in both the long and short term.

Supply Support

The provisioning for initial support, as well as acquiring, distributing, and replenishing inventory spare and repair parts is essential to the successful support of systems and equipment. The Institute staff has unique qualifications in understanding the provisioning process and acquisition of resources, and is experienced in such programs as Spares Acquisition Integrated with Production (SAIP).

Packaging, Handling, Storage and Transportation

The preservation, packaging, transportation, handling and storage of systems, equipment, and support elements is essential to the successful support process and a critical element of ILS. The Institute is well qualified to handle studies and actions in this area.

Technical Data

Providing the information to translate system and equipment requirements for operation, maintenance and support into a format and technical level both accurate and understandable to the personnel using the information is an essential task of the ILS function.

Facilities

The planning and acquisition of facilities to support operating and support activities is both necessary and challenging due to fiscal constraints and lead times. The Institute is qualified to conduct the related studies to support ILS activities such as types of facilities, location, space requirements, environment, duration and frequency of use, personnel interfaces, security, training requirements, test and maintenance functions, and applications to existing facilities.

Manpower and Personnel Requirements

The determination of personnel skills and manpower requirements is based primarily on the task identification analysis process conducted during the logistics support analysis process. The goal is to accomplish the mission in the most efficient and economical way without suboptimization.

Training and Training Support

The special strength of the Institute is its special expertise in the training process. We feel uniquely qualified as experts in determining the qualitative and quantitative requirements for training of operating and support personnel throughout a system's life cycle. The management of initial and sustainment training, and development of training support requirements such as training aids or equipment, is a critical element of logistics support. The Institute understands the integration of training requirements with the total logistics support process to maximize support effectiveness.

Logistics Support Management Information (LSMI)

LSMI includes all information generated for or used by both Government and contractor ILS managers in planning for and acquiring the other elements of ILS. The Logistic Support Analysis (LSA) process, as defined by MIL-STD-1388-1A and 2A, is the primary source of logistics data. Many other information sources are available, however, and the Institute is familiar with their use.

Computer Resources Support (CRS)

Computer resources form a significant element of most new systems and equipment, and the Institute has a special understanding of the efficient use of computer resources and related documentation. The ILS Plan, Integrated Support Plan, and Computer Resources Integrated Support Plan (CRISP) must all be complementary so that computer resource support requirements such as facilities, hardware, firmware, software, and manpower are properly planned and programmed.

Energy Management

ILS must consider energy requirements and their conservation. Energy use, particularly in the light of current resource limitations and costs, has become an inseparable aspect of system support. The Institute is qualified to conduct trade studies and analyses to provide the most efficient approach to resource utilization. ILS is fundamentally a conservation effort and the efficient management of energy, like all resources is an appropriate ILS task.

Survivability

The prime consideration in mission success is survivability. An integral part of ILS planning is to preserve the survivability design features during the life cycle and not allow them to be diluted by change. Proper coding in technical data and emphasis in training on survivability features is essential. Where required and appropriate, support and test equipment should be developed to verify survivability features.

ILS Test and Evaluation

This element addresses the validation and verification of system/equipment supportability. Over and above reliability, maintainability, testability, and availability, the aspect of ultimate supportability is paramount in the ILS process. A high performance system or equipment which is not supportable is useless and the performance unavailable. The support planning must include provisions for test and verification of all supportability aspects.

3.2.3 Computer-Based Training

In addition to the application of artificial intelligence technology to computer-based training (CBT), there is an equally strong interest and expertise at the Institute for Simulation and Training, University of Central Florida, in the non-artificial intelligence-based components of computer-based training. These

include applications of advanced interface technologies, hypermedia, direct manipulation, animated graphics, simulation, speech, and networked environment. IST's TPDC group has been heavily involved in various aspects of CBT in support of this government agency.

Current or proposed research areas include the implementation of various instructional strategies via animated simulation, the integration of perceptual and conceptual learning via hypermedia, and qualitative and case-based reasoning. Applications areas include mathematics and science education, language instruction, underwater acoustics, and laser technology. Brief descriptions of two of the ongoing CBT research projects at IST are provided below.

3.2.3.1 Language Training Technology

IST's Language Technology Project, directed by Dr. J. Peter Kincaid, Senior Scientist, is well on the way to solving problems related to configuring a low cost language lab and developing effective courseware for it. Funded by research grants (so far totaling \$210,000) a team is in place consisting of computer scientists, research psychologists, and language educators. Many of these team members are bilingual (English-Spanish). The team has already produced courseware.

Courseware. Courseware for oral language instruction is just now showing up in the marketplace to take advantage of interactive speech. Virtually all of this runs on the MacIntosh computer equipped with a MacRecorder. The UCF team is developing courseware for a variety of applications, including:

- . Survival Level Arabic and Spanish
- . Survival English
- . Proficiency testing which includes listening to natural speech from the computer.

IST is working cooperatively with the Naval Training Systems Center and Orange County Public Schools to develop Spanish courseware for the elementary school level.

Instructional Objectives are to:

Develop and implement curriculum providing an opportunity for language teachers to study, develop new curricula, conduct research and conduct other professional development activities away from their normal assignments and duties.

Form partnerships with schools for the purpose of demonstrating innovative low cost approaches to language instruction in which native speaking tutor "resides" in the computer,

Provide technical assistance to teachers by supporting them in

- . implementing language training curricula.
- . restructuring language training programs to focus on meaningful applications, appropriate content and interactive teaching strategies.

3.2.3.2 Animated Simulation for Learning Complex Concepts

Applied science and engineering continue to transform work places from low to high technology environments. Employers are often faced with the task of providing job-specific technical training to employees who lack a basic understanding of fundamental concepts. And science educators are faced with the challenge of making complex concepts interesting and relevant to all students. Interactively integrating the abstract conceptual material and the operational context allows the trainee to develop a deeper understanding of the task environment. Bringing real-world technical challenges into the classroom and presenting them in an interesting manner will stimulate more students to seek careers in science, mathematics, and engineering.

As interactive animation and simulation technology becomes more accessible, its use in education and training becomes more widespread. The challenge is to use the technology to develop effective learning environments. Funded by the State of Florida's High Technology and Industry Council, researchers at the Institute for Simulation and Training are using recent advances in cognitive and perceptual learning theory to guide the development of dynamic interactive environments for teaching complex concepts. The goal of this animated simulation-based system is to provide a learning environment which will allow students to explore basic science concepts in applied situations at multiple levels of analysis: qualitative and quantitative, abstract and applied.

The current test domain involves factors affecting sound transmission underwater. This topic provides a rich source of basic science concepts which must be understood for effective performance in an applied setting (sonar operation). A simulation module and an instructional module have been developed, and initial tests indicate that this is an effective environment for learning complex material. The objectives include: the development and evaluation of a prototype trainer for concepts in underwater acoustics; an ongoing research program to evaluate the effectiveness of animated simulation technology for training complex science concepts; the development of instructional guidelines for using interactive animation and simulation for training complex concepts; transitioning the first year's research and development effort to additional domains including basic science education. A proposal which focuses on applied science applications has been submitted for the next year of funding. A related outstanding proposal focuses on the development of a prototype interactive environment that can be used as a tool for guiding the integration of the domain and strategic knowledge required for expertise. The content area to be developed will be laser technology.

3.2.4 Manpower, Personnel and Training

IST expertise in the area of manpower, personnel and training issues include both research and practical experience. An example of the practical knowledge of manpower, personnel and training issues is exemplified in that Dr. David Hosley served two years in a personnel management position with Western Electric Company focusing on recruitment, selection, classification and placement of management and engineering personnel. Furthermore, Dr. Hosley's Air Force career included key management positions at base, command, headquarters, Secretary of the Air Force, and Office of the Secretary of Defense levels. He served as action officer, supervisor, advisor, and commander in a variety of positions that required specific detail about manpower, personnel and training. He chaired command and headquarters level manpower and training committees, and served on similar level personnel committees. He directed the development of the Air Force Technology Management School and Air Force Wargaming Center. And, he directed the implementation of computer-based training in a number of University environments. Mr. Rupert Fairfield has similar practical experience during his military service.

In the research domain, IST expertise is exemplified by its work in the development of Footprint/Crosswalk in association with TPDC and funded research from HEL on a MANPRINT Decision Options project. IST researchers have been involved in basic selection, classification and utilization issues on a wide range of projects both at IST and prior to joining IST. For example, Dr. Companion was involved with Air Force manpower, personnel and training issues as part of his normal activities while working for the Lockheed Aeronautical Systems Company - Georgia. IST's understanding of these issues is a strong asset in meeting the requirements of HRL/HSD research needs. A brief description of IST MANPRINT project is provided below to demonstrate a portion of our research expertise in this area.

3.2.4.1 MANPRINT

IST's MANPRINT activities initially began as an IST IR&D effort to perform a feasibility investigation and literature review to locate document, record, and informally examine the predictive utility of empirically-based literature on task performance as a function of select Army MANPRINT variables. Although MANPRINT is typically directed toward operational systems, the logic is equally relevant to tradeoffs in the design of training devices and simulators. Namely, performance on simulators and devices could be used as an "intermediate" criterion to estimate how well an individual trainee would perform in the actual system (the "ultimate" criterion).

The conclusion of this initial study was that the existing literature base is not sufficient to support the development of quantitative methods to predict or estimate system or soldier performance. Four requisite data requirements were outlined: adequately quantified performance, varying levels of one or more

variables of interest, identifying information on individual participants, and design and analysis as a predictive study, with these data properties, tools and methodologies could be developed which addresses the question: What are the expected benefits in system performance for each of the possible training system design options?, Aptitude of the trainee influences the amount of training time required and the appropriate methods of instruction, and thus affects requirements for types and sophistication of training equipment. Decisions about the skill mix and manning levels needed to operate and maintain a system will drive training strategies and in turn the features of simulators and devices. Relationships among these and other variables in the MANPRINT domains are not well-understood. For effective tradeoffs among relevant variables, these relationships should be better quantified; in particular, for purposes of estimating performance, the shapes of underlying functions must be better defined.

The Army 's Human Engineering Laboratory (HEL) provided follow-on funding to identify data gaps and the properties of needed data, and to search for relevant, existing data sets. A premise of the HEL-sponsored effort was that useful data might exist at simulator field sites which could be adapted or reanalyzed to provide tradeoff relationships for device design. Virtually every piece of data about an individual that can be acquired as part of accession, training, and career progression has potential value in some forecasting context. Information on ability/aptitude, job experience, prior education and training, training progress and performance, where and how training was received (i.e. , training type, equipment used, etc.), on-job performance tests and so forth, can all be brought to bear on the problems of whom to select, where to assign, and how to train. The difficulty in providing forecasts of future performance on important criteria lies less in the existence of potential predictor data than in the obtaining of those data in a form suitable for statistical evaluation of the important forecasting variables. In other words, before one can determine which variables in an individual's record should be maintained in an automated data base for example, it is necessary to have access to complete data records. Four critical properties that data sets must exhibit to be useful for forecasting and quantitative research purposes were identified:

Large enough sample sizes to develop and validate quantitatively sound prediction equations.

Reasonably complete records on the same entities (i.e., individuals, groups) on all key variables across the period of time for which predictions are to be made.

Variability in the sample on some of the important variables (e.g., aptitude, experience, equipment configuration, etc.).

A continuing "institutionalized" source of complete

records for regular application of the forecasting techniques as part of the MANPRINT decision process.

Unfortunately data sets reviewed for the HEL, effort lacked one or all of the properties listed above. Work to date on MDO suggests that if the ultimate objective is to be achieved, one or more of three optional approaches might be selected:

Design and conduct a series of field studies which experimentally manipulate variables of interest.

Collaborate with existing data systems for recording training information to create a new data base with the required comprehensiveness and completeness.

Select an approach which is less dependent on completeness of data records on individuals. The structured use of expert opinion derived from instructors and other training personnel and the generalization of predictor/criterion relationships from other domains offer promising alternatives when detailed data on individual performances cannot be economically collected and maintained.

3.2.5 Human Factors

IST and the UCF Department of Psychology have a strong human factors component. IST has three Ph.D. and one Masters level Human Factors professionals with a combined total of over forty years of experience in industry and/or government agencies. These human factors professionals have experience in conducting research for all branches of the military service and have experience in a broad range of applications including, manpower and personnel areas, language training, maintenance, support subsystems, crew systems design, ergonomics, instructor station design, human performance, training effectiveness and instructional technology. These human factors specialists provide the technical lead in the areas of human factors, human performance, instructional technology, ergonomics, maintenance training within the Institute. Dr. Companion is the Manager of the General Research department within IST. This department has cognizance over all behavioral activities within the Institute, among other research areas.

The UCF Department of Psychology offers a recognized Doctoral Program in Human Factors. The program is administered by a staff of three nationally recognize Human Factors professionals all holding the academic rank of professor. Each of these faculty members is regularly involved in research activities within the Institute. This core of expertise is augmented by additional faculty from the department and two members of the IST Human Factors staff who hold appointments as adjunct faculty. The program currently enrolls approximately 18 students, many of which already hold Master's degrees from other universities. Over half of all the students in the program have been involved in IST research projects. This provides a highly capable body of

research assistants to augment the professional staff within the university.

3.2.6 Human Performance/Information Processing

Two of the human factors professionals at IST have specialization in the area of human performance and/or information processing. In addition, one of the UCF faculty members closely involved in Institute projects specializes in the area of human performance. These professionals are supplemented with two Cognitive Psychologists within the Institute to provide a balanced perspective in this topic area.

The expertise in this area focuses on human performance assessment, modeling of human information processing or cognitive processes, and the development of training technologies to enhance human performance.

Dr. Michael Companion and Mr. Thomas Carolan provide the lead for IST's activities in the development of information processing models. Both researchers have extensive experience in the development of information processing models. Mr. Carolan's expertise derives from a Cognitive Psychology background and focuses on the development of cognitive models which underlie the development of intelligent tutoring systems. Dr. Companion's emphasis is in the traditional human information processing area. Dr. Companion is currently involved in research to develop a information processing model of the cognitive processes underlying situational awareness skills. This research also involves the development of neural network models to simulate these cognitive processes. The underlying goal of this effort is to develop new training strategies to enhance the acquisition of situational awareness skills. In addition, Dr. Companion has taught part of a short course offered by The Georgia Institute of Technology on Modeling in Training and Simulation. His portion of the course covers "Technical Approaches to Designs for Training Simulations of Human Decision Making."

Mr. Kevin Uliano, Dr. Peter Kincaid, Dr. Patrick Moskal, Dr. Michael Companion, Dr. Janet Turnage, and Ms. Brenda Bradley have extensive backgrounds in the are of human performance assessment. Recent efforts have examined methods for performance assessment in training environments, validation of performance data in flight simulators and transfer of training studies in gunnery training.

3.2.7 Embedded Training

The military services have researched, developed, and implemented numerous devices and techniques to support our military readiness. All of the techniques are directed at promoting the acquisition of skills and knowledge, and at maintaining a continuous level of proficiency. However, training is time-consuming and expensive in terms of manpower requirements, and many of the tasks which an individual is trained to perform are infrequently used in peace time, resulting in significant skill degradation. To counter this degradation, the Navy must require

additional training in those areas where infrequent application of specific behavior leads to the perishability of skills and knowledge.

With the ultimate goal of delivering this training, training systems of all types have been developed to address the goal of personnel readiness. These systems range from shore-based, full-mission simulators to desk-top microcomputers. Any given training device may vary with respect to its degree of fidelity, the number of devices made available and accessible, and the degree to which principles of learning and instruction have been integrated in the device design. Training currently emphasizes high levels of fidelity to maximize transfer to the operational device, high levels of accessibility and availability to trainees, and increased integration of learning principles in the development of curriculum and the conduct of training. However, it appears that in many cases fidelity issues weigh more heavily than the instructional requirements (e.g., Hinton & Komanski, 1982). The expense incurred by producing training devices of a high fidelity and in sufficient quantities has motivated the search for a solution to the problem of maintaining high levels of personnel readiness at a lower cost. A solution, which is now espoused by the services, has come to be known as Embedded Training (ET).

There are numerous definitions of ET, but we refer to the one provided in the draft OPNAVINST on ET, paragraph 4. 1, developed 14 November 1985 by the Task Force on Embedded Training. They define ET as "training that is provided by capabilities built into or added onto operational systems, subsystems, or equipment, to enhance and maintain the skill proficiency of fleet personnel."

Given the training goal of achieving readiness and the financial goal of reducing training cost, ET has become a popular candidate for implementation. Numerous studies and analyses have examined the kinds of capabilities ET should incorporate to produce an effective solution to the problem of skill perishability or skill retention (for a review of research related to retention of skill, see Farr, 1987). Most of these studies relate to surveying existing ET-like technology or existing components that can be adapted to support ET. These studies have emphasized the engineering requirements for safe, reliable equipment stimulation, with lock-out to weapon firing and immediate transfer from training mode to full system operational mode, on demand. The studies have focused on fidelity and ready accessibility of training. However, these studies have rarely considered interjecting instructional strategies and learning principles into any training device, let alone into an ET environment (Williams, Reynolds, & Carolan, 1989).

Current work at IST consists of a Naval Training Systems Center contract to assess the potential for providing embedded training for the instructors who control sophisticated shore-based Navy Training systems and simulators. The hypothesis is that embedding

training into an instructor/operator station (IOS), the primary interface between the instructor and the trainer, will enhance an instructor's teaching effectiveness by: a) utilizing 100% of the instructional features that were designed into the device, b) providing enhanced performance measurement and debriefing capabilities, c) reducing instructor workload, and d) decreasing instructor training costs. Embedded training should be an acceptable and effective alternative to the classroom and on-the-job training (OJT) currently employed by the Navy. Therefore, the primary focus of this ET research project is to address two key issues: a) determining design guidelines for a generic IOS, based on instructional rather than engineering requirements; and b) planning a comprehensive program of research that will assess state-of-the-art training technologies using a generic IOS as a testbed, and that will provide recommendations for embedding these technologies into future instructor/operator stations.

3.2.8 Job Skills Analysis

IST has a number of researchers with expertise in job skills analysis. Their backgrounds encompass job skill analysis in support of both system design and training over a wide variety of weapons systems. Dr. Janet Turnage and Ms. Brenda Bradley provide the Industrial/Organizational Psychology perspective in this area, while Dr. Michael Companion and Dr. Peter Kincaid provide the Human Factors perspective. The following write-up provides a brief synopsis of IST's methodological approach to job skills analysis.

Job Analysis Techniques

The first step in making any systematic change within an organization is conducting a job analysis. Discovering what a job entails and fully understanding the requirements placed on the job incumbents is vital before beginning any organization wide change. To develop training programs, the organization must have a thorough understanding of what is required for successful performance on the job. To do this, each behavior performed, the equipment used, and all of the knowledge, skills and abilities (KSA'S) required must be collected and documented. There are several approaches that can be taken to perform job analyses. For the job analysis to be most effective, it should be tailored to meet the individual needs and goals of the end user. Issues such as the amount of data available, the scope and variety of jobs to be analyzed, and the degree of accessibility of job incumbents and other subject matter experts all effect which approach or methodology is chosen. Also, the needs of the customer and the end uses of the job analysis data drive which type of job analysis is to be performed. The steps below are one approach to perform job analyses.

Gather job/task data
direct observation
critical incidents
interviews
narrative descriptions
existing literature

Analyze position
list major responsibilities
equipment used
working conditions

Develop objectives
list behaviors performed under each objective
list KSA's required for each behavior

Categorize KSA's
essential for successful performance of job
directly measurable
rankers (increases job performance)

Weight KSA's
rank order KSA's in order of importance

Database Development

Once the data has been collected through the use of a job analysis, a data base will need to be developed to utilize the data in a way compatible with needs. To develop requirement definitions, training curriculum, and training evaluation programs properly, and to make them effective and useful, a data base should be developed for storage, retrieval and manipulation.

- * Application driven - the needs and goals of the end user will determine the structure and content of the data base.
- * Taxonomy driven - an organized structure specifically designed to meet the special needs and goals of the end user(s) will be developed.
- * User friendly - expert system technology will be used to create the data base for individuals with many different levels of computer expertise. For example, a specific computer language or syntax would not be necessary to operate the data base.
- * Relational rather than flat - incorporating interaction between different areas within the data base, a user will be able to update information throughout the data base while only having to input the information once. For example, if a particular job task occurs in several different jobs, the user would only need to input the task once, but it would be added throughout the data base.

4.0 PERTINENT ACTIVE AND COMPLETED PROJECTS AT IST

The following sections describe IST projects pertinent to the subjects addressed in the Sources Sought notice.

4.1 MANPRINT Decision Options (HEL)

The major purpose of the MANPRINT Decision Options (MDO) project was to locate existing data which could be used to selectively study relationships between MANPRINT variables and performance criteria, particularly those involving simulators and training equipment during the training process. The work involved acquiring and analyzing partial data sets with the objective of identifying predictors which should be studied further or eliminated from further study, thus providing an economical means of bypassing the resource intensive approach of field data collection studies. This effort explored in detail approaches to the problem of data collection and management of MANPRINT decision options.

.2 Team Training Testbed (NTSC)

Technology necessary to support the design, conduct, and evaluation of team training is inadequate at this time. Research is needed to address issues related to team "learning," the acquisition of teamwork skills, and training that emphasizes teamwork. A systematic, problem-oriented, laboratory-based research program is needed to test the applicability to team training of many of the learning principles, hypotheses, and suggestions of prior studies of teams. This testbed will test the efficiency of instructional methods and of design approaches, and will give empirically-based guidance for designing team training systems.

The objectives of this research effort are: 1) to design and develop a low cost, microcomputer based team training laboratory; 2) to design, develop, and conduct a series of investigations on Navy relevant team training and performance R&D issues; and 3) to provide Navy relevant training systems with specific instructional and technological design recommendations.

The methodology for a Team Training Assessment Battery (TTAB) has been developed and the testbed is set up. After testing, evaluating, and modifying the system, the TTAB is being used to investigate a variety of team training and performance variables.

4.3 A Cognitive Model of Instruction (NTsc/Battelle)

This project involved a survey of cognitive learning and motivation research. The research was then organized in accordance with several key concepts. Within each concept, a variety of principles integrating curriculum design and student/tutor interaction were specified. The result was a model of instruction based upon empirical research. The principles identified and described can be implemented in intelligent tutoring systems or other training devices.

4.4 Embedded Training Instructional Technology Research (NTSC/ONR)

IST has been involved in a multiyear effort funded by the Office of Naval Research and the Naval Training Systems Center on the application of Artificial Intelligence Technology to Embedded Training. The objective of this effort has been to develop and evaluate candidate instructional technologies for embedded training. These technologies, although capable of being implemented, had not been evaluated to determine their impact upon acquisition and retention of skills and knowledge. Because the instructional dimension is a significant component in the training equation, it is important to evaluate how these technologies affect what is learned, how rapidly learning takes place, and how well learned skills and knowledge are trained. Specific technologies that have been implemented include automated expository feedback, missing team members, intelligent targets, and intelligent adaptive instruction.

Automated expository feedback applies primarily to rule utilization tasks, as in decision making. The purpose of this form of feedback is to expose a trainee's error by identifying specific preconditions which were not attended to or were erroneously emphasized, and which consequently triggered inappropriate actions. This form of feedback employs expert systems technology and knowledge engineering techniques to formulate a prescribed rule base for decisions, given a specific set of scenario conditions. The objective of this form of feedback is to promote the development of timely and accurate decision making within the constraints imposed by tactics doctrine. Automated expository feedback capability has been implemented on an ET testbed baseline system, employing the same software process used for the intelligent platform implementation. Tactical rules were engineered based on subject matter expert interviews. A knowledge base of tactical rules were constructed around the evolutionary phases of engagement with an enemy in a hot war situation: detection, classification, localization, and engagement.

Missing team member simulation also involves the application of expert systems technology to training. This feature involves simulating other members of a combat team, such that a team training environment can be approached when other team members are absent. Team training exercises can be conducted with a single individual while the training team members are being simulated. This technology eliminates the need to have subteam members actively participating in team training exercises, which reduces the manpower requirement to conduct team training. More importantly, the application of this technology allows one to control the level of expertise of the simulated member(s). This capability demonstrated the feasibility of a production system architecture to implement synthetic speech generation consistent with LAMPS, ATACO, and Anti-Submarine Warfare Officer (ASWO).

Intelligent targets make decisions (independent of an instructor, simulating maneuvers and actions characteristic of target(s))

during a dynamic training exercise. Intelligent adaptive instruction continuously assesses student strengths and weaknesses in an ongoing process of diagnosis. Upon determining strengths and weaknesses, the system automatically plans a course of instruction that presents the student with exercises which focus on the student's specific strengths and weaknesses. This process is known as adaptive sequencing. This automated adaptive instruction capability was implemented employing an existing embedded trainer.

4.4.1 Application of Intelligent Tutoring System Technology to Embedded Training (NTSC/ONR)

In addition to the application of artificial intelligence technology, the Office of Naval Research and the Naval Training Systems Center has contracted IST to develop and evaluate intelligent tutoring system technology for embedded training. In ET environments, the skills and knowledge to be learned are very task- or objective-specific, and their application has a specific outcome on the environment. Training is goal-directed; knowledge and skills to be learned and applied are logically associated with specific goals or objectives. As a result of cognitive science research, many learning processes and principles have been formalized. These cognitive learning principles and intelligent tutoring strategies are implemented as instructional features under control of the software. Many instructional activities, such as adapting the sequencing of exercises to the existing knowledge base of the trainee, and performance feedback, can be automated. There is evidence that adapting the sequence of information or exercises to the existing knowledge base of the trainee helps the trainee acquire new knowledge and skills.

This ongoing project involves the development of a set of methodological guidelines for cognitively engineering the instructional content for an intelligent tutoring system, and application of these guidelines to the training of tactical console operations; the development of an adaptive sequencing heuristic that takes as input the trainee's performance on practice frames and answers to diagnostic questions and selects the most appropriate next exercise, based on the performance history; and evaluation of the training effectiveness of these instructional dimensions when added to an existing ET system.

An embedded training (ET) instructional technology testbed was established at the Naval Training Systems Center (NAVTRASYSCEN), Orlando. This testbed consisted of a Lesson Translator (L-TRAN) Naval Tactical Data System (NTDS) console emulator system. The L-TRAN system is an ET system for the general purpose tactical consoles supporting NTDS sensor and weapons operations. The L-TRAN emulator system was modified to run an adaptive sequencing heuristic and to support the cognitively engineered lesson. This modified L-TRAN system was then used to experimentally compare the effectiveness of the cognitively engineered and adaptively sequenced lessons with the lessons currently in use. Once validated, the ITS approach was evaluated with NTDS and non-NTDS instructors using NTDS training consoles.

The goal of on-board ET is to efficiently and effectively maintain a maximum level of performance and readiness. In the on-board situation, the trainee has already been exposed to initial training and enters an ET session with varying degrees of development of knowledge structures. The goal of the ET session is to diagnose and correct deficiencies in knowledge and skills as efficiently and effectively as possible. The results of this research indicate that the combination of cognitively structured and adaptively sequenced exercises provides an effective and efficient method of increasing learning in ET systems. The cognitive engineering process provides a powerful methodology for structuring exercise content, especially for procedural information, and the adaptive exercise sequencing provides a strategy for increasing the efficiency of computer-based training.

4.5 ASTAR Operational Evaluation(NTSC/JSCMTT)

The Automated Simulator Test and Assessment Routine (ASTAR) is an automated decision aid designed to assist a training system analyst to predict the effectiveness of a training device during its development. ASTAR was developed to provide a systematic and analytic evaluation procedure to aid training device design and acquisition. Prior to implementation as a standard evaluation technique, it was necessary to conduct field tests with operational analysts to determine user acceptance of ASTAR.

A contract was administered to IST by the Naval Training Systems Center which was sponsored by the Joint Service Committee on Manpower and Training Technology. The objective of the research was to compare and contrast ASTAR to other automated Device Effectiveness Technologies and formulate a plan to implement ASTAR as a standard evaluation technique within the DoD Instructional System Development process.

An operational evaluation was accomplished through a series of integrated tests using operational training systems and their analysts. The tests assessed the operational utility and impact of ASTAR on existing and new training systems. A single test could not adequately or efficiently address the scope of the evaluation criteria required to assess the operational tests and a longitudinal test. These tests examined performance, utility and user issues with regard to ASTAR.

4.6 Application of Animation Technology to the Training of Multidimensional Concepts(FHTIC)

A proposal entitled "Qualitative Simulation for Applied Science Training" has recently been submitted to the State of Florida High Technology and Industry Council (FHTIC) Applied Research Grants Program. Because of a nationally recognized need to improve mathematics and science education, an innovative instructional approach is proposed that will foster an intuitive understanding of concepts, develop an interest in scientific discovery, and motivate students to continue their education in science and technology. This approach, when completed, will

utilize animation and dynamic simulation technology in an interactive instructional tool. The software will be developed and tested in IST's experimental "Classroom of the Future."

4.7 Classroom of the Future (FHTIC)

The Classroom of the Future is a project, funded by the State of Florida High Technology and Industry Council's grant programs, with the objective of creating an Experimental Technology Classroom as an education and training research testbed. This IST effort focuses on the development of a functional specification of hardware and software technologies to be implemented in a classroom environment. The specifications describe the capabilities necessary to apply advanced technologies in cognitive science and artificial intelligence to classroom instruction. The key to this project is the ability to convert curricula into a format that will allow errors in the way information is organized to be diagnosed by the system. Once this is done, the computer would suggest remedies including varying the presentation media and degree of difficulty, and providing alternate ways to explain errors so they are understood. The instructor could then efficiently make the changes necessary to correct individual learning problems. Other work on this project includes developing the total classroom environment so that neither teachers nor students are intimidated. This research should accelerate learning for all students and make good teachers even better.

The first year of the effort focused on the development of a functional specification of hardware and software technologies to be implemented in a classroom environment. The specifications describe the capabilities necessary to apply advanced technologies in cognitive science and artificial intelligence to classroom instruction. During the second year, the effort has focused on integrating the hardware and software technologies and demonstrating the instructional approach for a mathematics curriculum.

Two core software processes form the foundation of the system; namely, a production system architecture and a blackboard control architecture. The production system architecture is used to structure lesson content according to research relating to knowledge representation and the organization of memory. The blackboard control architecture is used to control the interaction, or discourse, which should take place between the teacher and student to promote the acquisition of these knowledge structures and their organization in memory. These two core processes, along with other software tools and applications programs, are embedded in three distinct subsystem modules which make up the classroom. They are the Lesson Development Station (LDS), the Instructor Station (IS), and the Student Station (SS).

Lesson Development Station

The core process of the LDS is a production system. The production system guides an instructor or subject matter expert (SME) through the process of cognitively engineering lesson

content into a network of exercise packets. Each exercise packet consists of a specification of knowledge (i.e., fact, rule, or sequence of rules) explicitly described; a test of the application of this knowledge; and, when the student fails the test, a diagnostic. The diagnostic evaluates the student's acquisition of knowledge. Specifying knowledge in this way allows for a precise diagnosis of what the student knows and does not know, as well as providing a cohesive, organized Structure to curriculum content. These rules combine to form a model of expert knowledge. Each student's knowledge can then be compared to this model as the student progresses through the exercises, building a model of the knowledge embodied in the curriculum.

Once a knowledge base is built representing the content of the curriculum, the SME can access a number of different applications packages. These packages allow the SME to create or edit exercise frames consistent with the information specified by a fact, rule, or sequence of rules. The SME may choose to represent the knowledge by employing graphics (dynamic or static), video, logic flow diagrams, charts, tables, audio, interactive simulation, and text. Applications packages can be assigned to a set of exercises. Such packages can include statistical, financial, and mathematical applications, word processing, or graphics. All of these capabilities can be linked to an exercise or set of exercises employing hypermedia. The SME may access data bases which contain previously developed material that can be merged with other lessons. The system provides the capability to store and retrieve lesson or exercise content as well as assessments of student performance relative to that content. The SME is capable of selecting a variety of assessment test formats for any exercises developed, and these formats can be assigned to the associated lesson.

Instructor Station

The instructor station will provide the instructor with the capability to monitor students as they interact with the courseware. The IS provides the instructor with the capability to take courseware developed at the LDS, select it, and download it to any SS. The instructor may link the IS and/or any number of student stations for group demonstrations, competition, or communication. Additionally, the IS provides the capability to interrupt the exercises at any given student station. The IS supports the ability to display any work created by a student on the large screen display or output it to a printer. Similarly, the instructor can display any text, graphics, video, or simulation associated with any lesson on the large screen display and interact with that information. A remote control device is provided to the instructor, allowing mobility throughout the classroom. The device provides control over selection of information to be presented to the class, presentation of information on the large screen display, and hard copy printout of any display.

A student monitoring capability at the IS will be provided by the blackboard control architecture. This software process provides

advisories, makes control decisions concerning instructional activities, and provides information concerning these activities for each student. The instructor can override any of the control decisions made by this process, and activities can be inserted that are based upon the instructor's own decision, provided they are a part of the blackboard architecture control logic.

Student Station

The student station is capable of presenting courseware developed by the instructor employing the lesson development station capabilities, as well as courseware developed externally. The students will have a variety of interface capabilities, such as touch screen, light pen, mouse, joystick, keyboard, and voice. The type of interface employed during a lesson is under the control of the SME and is inherited with a lesson when it is assigned to a student station. Student interactivity with the system is limited to the interactivity defined by the instructor.

4.8 Training Technologies for Situational Awareness (FHTIC)

IST has been involved in a two year effort funded by the State of Florida High Technology and Industry Council Applied Research Grants Program to conduct research in the area of Situational Awareness. Situational awareness is the process by which a person extracts, integrates, assesses, and responds to task relevant information from the total environment.

The objectives of this project were to develop training strategies and tools that enhance the acquisition and utilization of situational awareness skills. In addition, During the first year a generic cognitive model was developed to provide the basis for the expert system development of a tactical weapon system. This model was designed to provide a functional framework for the development of expert system models in this project and the concurrent PM TRADE Simulated Forces project. The approach was to develop a modular structure which identifies the major functional areas which pertain to intelligent behavior. The model was then used to identify those functional areas to which the situational awareness concepts will be applied through neural network models. The theoretical approach to training situational awareness skills proposed by IST was validated at the close of the first year in a simulated battlefield environment utilizing SIMNET.

The second year effort focused on the development of a model of human decision making in a tactical environment. This expert system was designed to allow a user to designate a tactical mission and create a terrain via a graphics interface. Utilizing a hybrid rule-based/neural network program, the expert system generates a Go/No Go response as to whether that mission can be accomplished and the reason it can or cannot given the specified input mission and terrain. The program then generates and graphically presents the optimum route to complete the mission.

4.9 Defense Training And Performance Data Center (TPDC)

The Institute for Simulation and Training (IST) , University of

Central Florida, is under contract to the Defense Training and Performance Data Center (TPDC) to conduct a variety of research projects that relate directly to this Air Force Human Resources Laboratory (AFHRL) research and development need.

TPDC is a mission support agency to the Office of the Assistant Secretary of Defense for Force Management and Personnel (OASD/FM&P) and is the Department of Defense (DoD) focal point for training and performance data. TPDC develops analytical tools and methodologies in support of the entire DoD training community including active, reserve, and civilian work force. TPDC gathers data focusing on the three major aspects and users of training data: occupations, weapon systems, and users. Attributes of training (performance, technology, and resources) are found at each of the three major aspects and detailed data is gathered on each. The system is designed to help users address real training problems and issues.

There is a special TPDC group within IST that conducts a variety of research projects for TPDC. Some examples are: Computer Based Instruction; Simulation Training Devices; Occupational and Training Requirements and Standardization; Automated Data Processing Technical Review and Evaluation; Data Management Technologies; Footprint/Crosswalk (manpower, personnel and training data) Project; Course Data Exchange; System Prototype Occupation and Training Related Data; Readiness, Exercises and Joint Service Operability Training; and Foreign Language Training Technology.

5.0 FACILITIES

The following sections describe IST's laboratory facilities in general and provides additional detail on laboratories relevant to this sources sought.

5.1 Laboratory Facilities

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 large networked laboratories: Networking and Communications technology Laboratory, Visual Systems Laboratory, Low Cost Flight Trainer Laboratory, Mathematical Simulation Laboratory, Intelligent Simulated Forces Laboratory, and the Classroom Educational Laboratory, supplemented by a number of specialized laboratories: Human Performance Modeling Laboratory, Classroom Educational Technology Laboratory, and Team Training Laboratory. Figure 5 illustrates the architecture of the network laboratories.

5.1.1 Experimental Classroom

The classroom of the future contains sophisticated computer hardware (See Figure 6) and software that supports intelligent system development. The classroom is composed of three distinct subsystem modules: the Lesson Development Station, the Instructor Station, and the Student Station.

The core process of the Lesson Development Station (LDS) is a production system that guides a subject matter expert (SME) through the process of cognitively engineering lesson content. The result is a network of exercise packets. Each exercise packet includes three components: one specifies and describes knowledge (i.e., a fact, rule, or sequence of rules), another can test the application of the knowledge, and a third can diagnose and evaluate the student's acquisition of knowledge. The diagnostic is used when a student fails the test, to locate the source of error.

Once the SME has completed the process of building a knowledge base, the SME can access various applications packages. Using these packages, the SME can create and edit exercise frames. The SME can choose to represent knowledge with graphics (dynamic or static), video, logic flow diagrams, charts, tables, audio, interactive simulation, or text. The SME also uses hypermedia at the LDS to assign the type of student station interface associated with each lesson frame.

In addition to software application packages, the LDS provides the SME with various input devices for inserting text, graphics, and video. Short and long haul networks give the SME access to information from sources external to the LDS. The LDS controls

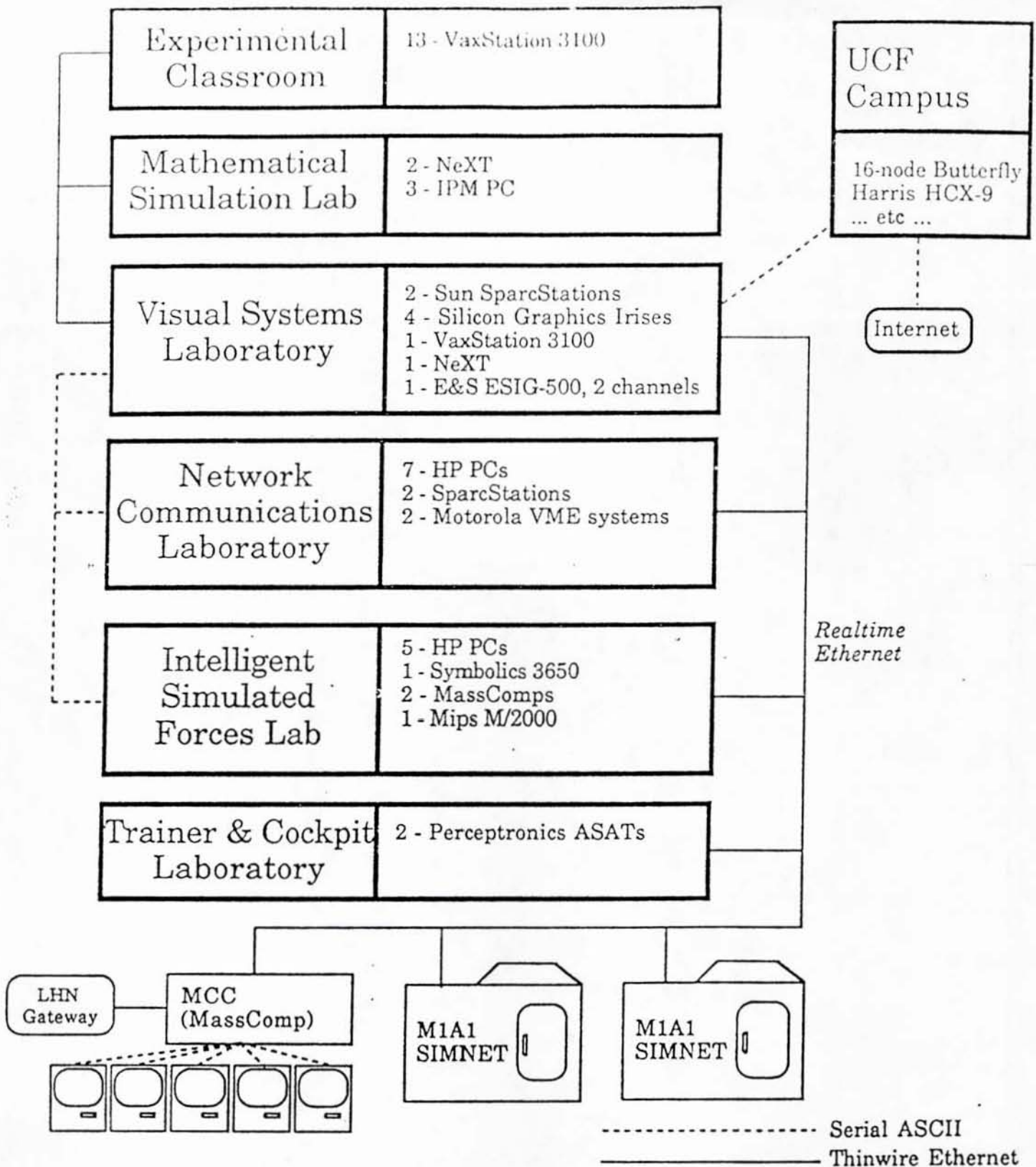


FIGURE 5
IST's Networked Laboratories

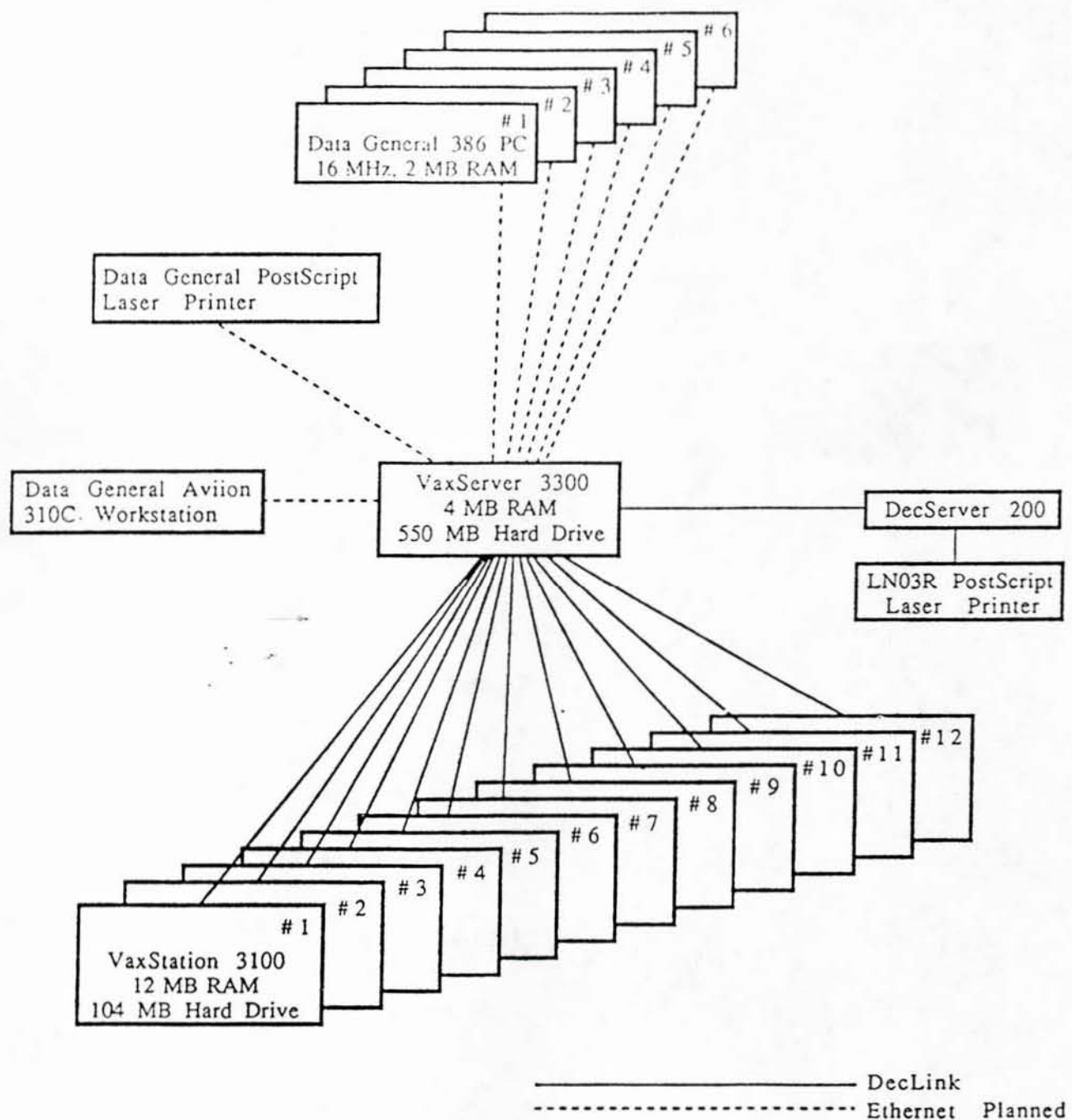


FIGURE 6
Experimental Classroom

startup, operation, and shutdown of the system. It also controls any function that can be controlled at the Instructor Station or at a Student Station.

Data General Corporation has provided for the LDS one 386SX model microcomputer station, with 6 mb RAM, 100 mb hard disk, and one laser printer.

At the Instructor Station (IS), the instructor can control the flow of courseware and communication. The IS allows the instructor to select courseware developed at the LDS and download it to any student station. At the IS, the instructor can also link the IS and one or more student stations; the instructor can also link student stations to each other. The instructor can interrupt any student's work from the IS.

A blackboard control architecture allows the instructor to monitor the students as they interact with courseware. This software process provides advisories, makes control decisions about instructional activities, and provides information about these activities. However, the instructor can override control decisions and insert independent decisions, as long as the decisions inserted conform to the blackboard architecture control logic.

Digital Equipment Corporation has provided for the IS on 3300 model VAX file server, with 20 mb RAM, 550 hard disk, and laser printer. Data General Corporation has provided for the Instructor Display (ID) one Avion model work station, with 16 mb RAM and 662 mb hard disk.

The Student Station (SS) presents courseware developed at the LDS, as well as courseware developed externally. The students are given various interface capabilities, such as touch screen, light pen, mouse, joystick, keyboard, and voice. However, the type of interface a student uses on any given lesson is controlled by the SME, and the instructor controls student interactivity with the system.

Digital Equipment Corporation has provided for the SS twelve 3100 model VAX work stations with 12 mb RAM and 104 mb hard disk. Data General Corporation has provided for the SS five Dasher 386 model microcomputers with 4 mb RAM and 40 mb hard disk.

5.1.2 Human Performance Modeling Laboratory

The Human Performance Modeling Laboratory is involved in the development of computer models of human decision making processes. The current area of emphasis is in aspects of situational awareness in an applied tactical environment. The model approach is based on earlier research investigating the cognitive basis of situational awareness. The objective is to demonstrate that these basic information processing concepts can be integrated into a proof of concept expert system which could be used to augment situational awareness training. The laboratory has the capability to develop models using

algorithmic, rule-based, neural network technologies. A significant strength of the laboratory is the capability to develop hybrid models which simultaneously incorporate mixtures of modeling technologies.

Hardware resources:

Northgate 33MHz 80386 Workstation with
16" High Resolution Monitor
33MHz Math Coprocessor
150M hard disk with a 15M/sec data transfer rate

IBM Model 30/286 with
30M hard disk

DeskLink Networking Package

Software resources:

ANSPEC - A concurrent specification language for
defining and implementing parallel distributed
processing systems
NETS - A NASA developed back propagation neural
network routine
CARL/BP - A callable artificial neural system
routine hosted on the Delta II FPP
NeuroSym - A library of ten neural network
models
OWL Neural Network Library - A library of ten
neural network models
ExploreNet 3000 - A graphical interface neural
network development shell
GCLISP - LISP programming language
TurboProlog - Prolog programming language
Turbo C++ Development Package - Object oriented
programming environment
PC Consultant Plus - Expert system shell

The laboratory has a wide variety of software resources including multitasking software, expert system software, neural network software, and numerous programming environments including C, C++, Prolog, and LISP. The laboratory neural network software capabilities range from high level neural network shells to software which provides the capability to develop custom neural networks from scratch. An important feature of this software capability is the ability to develop nested neural network models which are more modular, efficient, and applicable to modeling cognitive processes. Together, the hardware and software environments which comprise the Human Performance Modeling Laboratory provide the capability to develop and evaluate complex models of cognitive processes in real-time simulations.

5.1.3 Classroom Educational Technology Laboratory

The purpose of the Classroom Educational Technology Laboratory is to develop and demonstrate affordable techniques whereby microcomputers and other advanced technology can be used to

improve classroom instruction. Results of the research will be used to increase the effectiveness of classroom instruction and to lessen the administrative workload that takes away from instructor contact time with the student.

Areas of study include instructor support features, visual representation of complex concepts in math and science, expert systems to improve student instruction and feedback, embedded training, learning retention, and refresher training.

Laboratory resources:

- NeXT computers
- Macintosh IICX computers
- EIDS computers
- Symbolics computer
- IBM PCs
- Amiga computers

Research applications:

- Public Schools
- Vocational Schools
- Military Reserves
- Military Schools

5.1.4 Team Training Laboratory

The Team Training Laboratory was created to perform research and develop cost-effective means for training individuals to work together as a well coordinated cohesive unit. IST is also developing intelligent interactive simulated forces to serve as opponents and missing team members, leading to lower cost team training systems.

Laboratory resources:

- Five IBM 386 units
- Ethernet connections

The networking of hardware in the Team Training Laboratory is illustrated in Figure 10.

Research in this laboratory is applicable to:

- Command, Control, Communications and Intelligence (C3I)
- Anti-Submarine Warfare
- Air Traffic Control
- Manufacturing Plant Operations
- Emergency Team Operations

5.1.5 Language Technology Laboratory

IST's Language Technology Laboratory has several externally funded research projects which apply instructional technology to the teaching of languages (primarily through IST's Language Technology Project). Funding sources include the Florida High

Technology and Industry Council, the Florida Technological Research and Development Authority, the U.S. Marine Corps. (Pending), and the U.S. Customs Service (pending). In addition, a contract for development of an English as a second language (ESL) series with a major publisher is in the final stages of negotiation. A prototype of this courseware, "Picture This . . . School System.

The Language Technology Laboratory contains the following equipment:

IBM-compatible 386 PC, VGA color monitor, 80 megabyte hard drive and several voice interface devices (COVOX VoiceMaster, COVOX "SpeechThing" and Forte Audio F/X). Special software includes Windows 3.0, Matrix, and PC Quizzer, as well as authoring shells for "The Language Professor" and "Language Workbench", which are produced by IST.

NeXT Computer equipped with built-in voice interface and 900 megabytes of memory, including 260 megabytes of writable optical memory.

Macintosh IICx PC, 21" high resolution monochrome monitor, 80 megabyte hard drive (voice interface is the MacRecorder). Special software includes SuperCard and software for the MacRecorder.

Matrox Interactive Video Disk Device (EIDS). Special software/courseware includes EIDS Assist 3.0 authoring language and "Deutschland" Interactive Videodisk.

Macintosh Plus with 20 megabyte hard drive. Special software includes SuperCard and Hyper Animation.

5.2 University of Central Florida Support

As part of the University of Central Florida, IST is able to draw upon the expertise and research resources of a variety of departments within the five Colleges of the University. These departments provide the technical expertise, students, and basic research laboratories that augment the resources of the Institute. The ready accessibility of these resources provides the multidisciplinary depth needed to address simulation and training issues. Resources resident in the various departments relating to simulation and training research are discussed below.

5.2.1 Psychology

Research in the Department of Psychology has included visual simulation training, effects of biofeedback upon performance, cognitive learning theory applications, simulation and training subsystem requirements, user interfaces for computer aided instruction, operations research employing simulation, expert systems applications to training systems, cognitive modeling, decision-making in the tactical environments, team training, workload assessment, performance measurement, skill development,

and human information processing. A new doctoral program in Human Factors has been developed as a result of Central Florida's growing needs in simulation and training.

The Visual Performance Laboratory is part of the Human Factors Laboratory in the Department of Psychology and conducts research in both the basic and applied aspects of vision and visual perception. Apparatus exists for the examination of the effects of foveal loading on perceptual sensitivity. The apparatus for this research consists of a microcomputer-controlled CRT display and perimeter.

The UCF Psychology department has nationally recognized experts in visual science, team training, and applied aviation psychology. The Department has laboratories available for research in human factors, visual performance, and aviation psychology. Special equipment includes state-of-the-art computer generated image equipment, a Singer-Link GAT-1 flight simulator, networked computers for team training, a six channel Maxwellian-View Optical System, and equipment to examine spatial contrast sensitivity, peripheral vision, and visual adaptation.

5.2.2 Computer Science

UCF's Computer Science (CS) Department was created as Florida's designated Center for Excellence in Computer Science. With 27 faculty members and over 200 graduate students, the CS Department is recognized as a major technology resource in Central Florida. The Department offers Ph.D., M.S. and B.S. degrees. The department has two recognized authorities on object-oriented programming, which is fundamental to advanced graphics technology. Endowed chairs are held by leading authorities on advanced parallel computing architectures.

The Computer Science Department of UCF was designated a State Center for Excellence and housed Florida's first Ph.D. program in Computer Science. The Department has a growing international reputation for original contributions to research in parallel processing, artificial intelligence, and image processing, databases, system software, graphics, VLSI architecture, and graph theory. In 1988, CS faculty members authored proposals which garnered over \$900,000 in new research funding.

The Department houses the Center for Parallel Computation, which is directed by Dr. Narsigh Deo, an internationally respected expert on algorithms for parallel machines. Five faculty members conduct research on parallel computation, using the Center's BBN Butterfly machine and other systems around the country.

The Department's computer laboratories include a Harris HCX-9 and VAX 11/780 computer, numerous Sun workstations, and a variety of Macintosh and IBM personal computers.

In addition, the Department has research groups working in networking, graphics and simulation, databases, object oriented software, artificial intelligence, machine vision, and

theoretical computer science.

A number of CS faculty members have worked on projects in conjunction with IST. One CS faculty member (Dr. Michael Moshell) has a joint appointment with IST, serving as the Director of IST's Visual Systems Laboratory.

5.2.3 Computer Engineering

The Computer Engineering Department has ten faculty members and around 100 graduate students. The Department offers Ph.D. M.S. and B.S. degrees. The Department offers courses in Ada programming to support DoD programming environments. The Artificial Intelligence Laboratory was developed with and funded by Symbolics, Inc. The laboratory contains six state-of-the-art Symbolics LISP machines. The Department Laboratories are equipped for research in parallel processing and real-time simulation with access to a Gould DeAnza 800 Image Processing System, XTAR real-time graphics system, and a Symbolics LISP machine.

The current research interests of the program include parallel computation, embedded computer systems, computer graphics and simulation, software engineering, digital signal processing and artificial intelligence.

Several Computer Engineering faculty members have been involved with IST projects. Dr. Chris Bauer, Department Chair, was the first acting Director of the Institute.

5.2.4 Industrial Engineering and Management Systems

The IE Department has an extensive background in geographical information systems related to terrain data base development. The Department also participated in an IST study on the cost effectiveness of training systems. There are established laboratories in ergonomics and robotics within the Department. The Department has done extensive research for the Federal Aviation Administration involving the use of artificial intelligence to train air traffic controllers. The Department has a unique graduate degree program in Simulation and Training.

5.2.5 College of Education

The Instructional Technology Laboratory and The Educational Research Institute within the college provide a focal point for research in advanced instructional systems. IST and the College of Education have teamed a number of times on projects related to low cost simulation in the classroom.

5.2.6 Business Administration

The College of Business Administration has laboratory capability under development to support research on the applications of expert systems to simulation and training in business. The laboratory is headed by a nationally recognized authority in the area of expert systems. The faculty are involved in a number of ongoing cost/benefit analysis programs and systems.

5.3 Additional University Support

Though IST is affiliated with UCF, its charter provides access to resources throughout the State University System (SUS) and universities across the nation. No university can provide the expertise required to address all the research issues in a given area. Research capabilities and faculty available, through liaison with other universities within the State of Florida, augment the capabilities of UCF/IST, and solidify its technology base. Major SUS institutions which have programs possibly related to the subject area include Florida State University and University of South Florida.

5.3.1 Florida State University

Florida State University (FSU) is a recognized national leader in research related to instructional and educational technology. FSU has established research centers devoted to the development and evaluation of computer-based and other media instructional systems including the Center for Educational Technology and the Evaluation Training Center. The University has an established base of experience in training and education research programs for the Department of Defense, Navy, Army and Air Force.

5.3.2 University of South Florida

The University of South Florida (USF) provides access to a pool of highly qualified faculty with research interests and experience in a variety of training and simulation areas. Simulation experts at USF include one of the pioneers in the determination and specification of visual parameters for Navy flight simulation devices. Departments and research centers involved in simulation and training related research include:

5.3.2.1 Center for Interactive Technologies, Applications, and Research

In this laboratory the faculty conduct research and develop technology and applications in the area of interactive human/machine interface. Current training related research programs include an Adaptive Computer Managed Instruction System. This system is designed to adapt instructional strategies and materials based on individual differences.

5.3.2.2 Department of Psychology

Research in this department is focused on the psychology of learning.

5.3.2.3 Department of Industrial and Management Systems Engineering

Personnel in this department have expertise in human factors engineering and modeling of training system performance.

6.0 FINANCIAL STATUS

IST has experienced steady growth over the last four years, primarily through increased work for PM TRADE. IST funding sources and quantities appear in and Figure 7 and Table II.

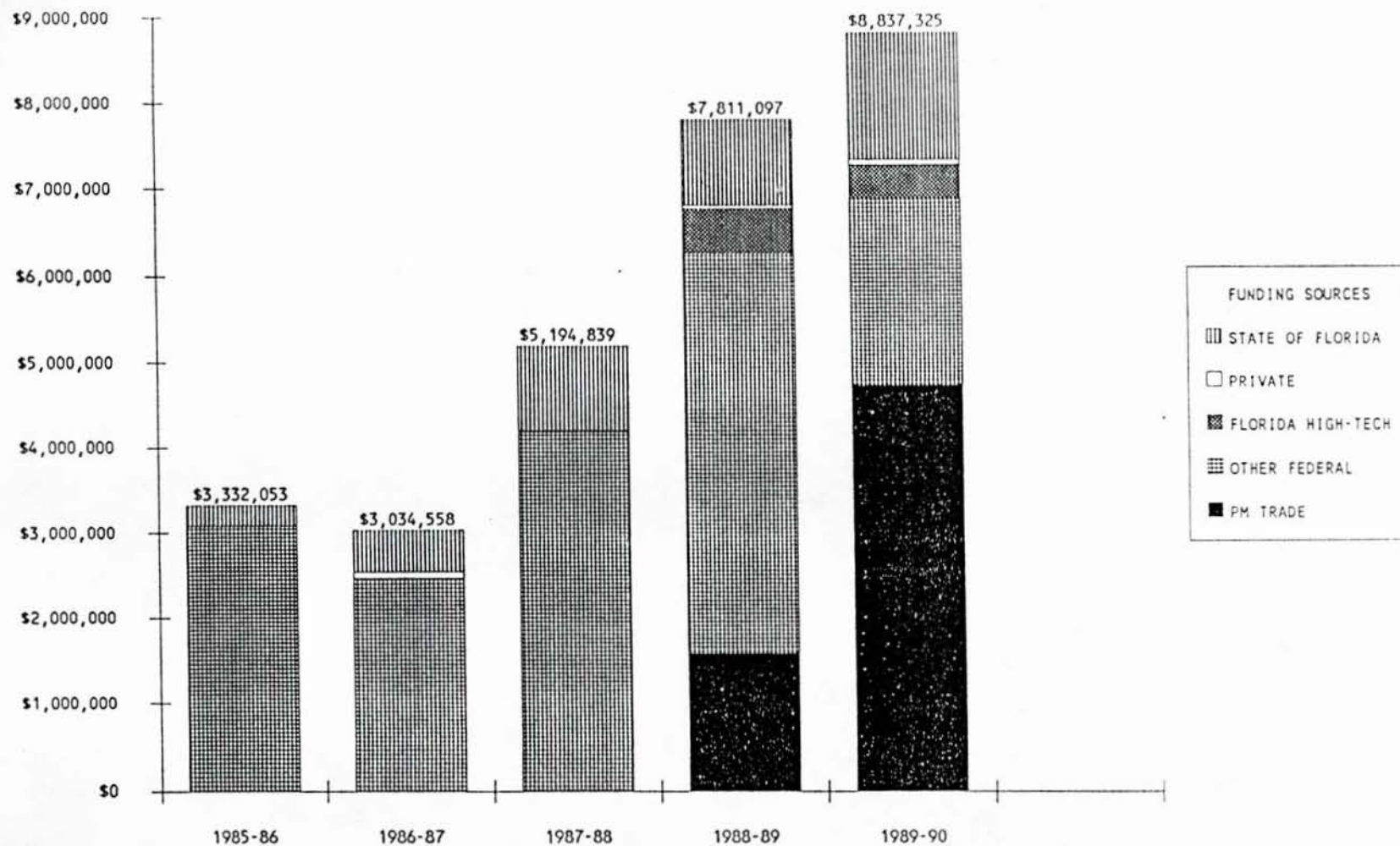


FIGURE 7
 IST FUNDING
 FEDERAL, PRIVATE, AND STATE OF FLORIDA

TABLE II
IST FUNDING
FEDERAL, PRIVATE, AND STATE OF FLORIDA

	1985-86	1986-87	1987-88	1988-89	1989-90
PM TRADE	\$0	\$0	\$9,900	\$1,577,087	\$4,720,755
NAVY	\$261,997	\$12,636	\$147,000	\$680,886	\$282,814
TPDC	\$1,940,000	\$1,295,424	\$2,601,723	\$3,353,684	\$1,626,192
OTHER FEDERAL	\$880,056	\$1,153,627	\$1,421,897	\$653,436	\$249,673
FLORIDA HIGH-TECH	\$0	\$0	\$0	\$505,500	\$400,500
PRIVATE	\$0	\$72,871	\$14,319	\$40,504	\$57,391
STATE OF FLORIDA	\$250,000	\$500,000	\$1,000,000	\$1,000,000	\$1,500,000
TOTAL	\$3,332,053	\$3,034,558	\$5,194,839	\$7,811,097	\$8,837,325

UNIVERSITY OF CENTRAL FLORIDA FUNDING

SIMULATION AND TRAINING AREA (EXCLUDING IST)	\$468,200
TOTAL FEDERAL AND STATE CONTACTS AND GRANTS (FY 1989-90)	\$25,858,080

7.0 RESUMES OF KEY PERSONNEL

MICHAEL A. COMPANION, Ph.D.

EDUCATION: Ph.D., Engineering Psychology/Man-Machine Systems,
New Mexico State University, 1978.

M.A., Experimental Psychology/Human Performance,
New Mexico State University, 1976.

B.S., Applied Psychology, The Georgia Institute
of Technology, 1974.

CURRENT POSITION: Manager, General Research Department,
Institute for Simulation And Training

EXPERIENCE SUMMARY: Dr. Companion has more than 11 years teaching, research, and industrial experience. He has worked in both the aerospace and computer industries in the area of advanced system development. He has extensive experience in the area of advanced crew system and flight station design for transport and high performance aircraft with emphasis on the application of advanced electronic display technology and visual information presentation. He has also had extensive experience in the evaluation and specification of computer aided design and evaluation techniques. He has conducted research in a number of different areas, both applied and basic. His basic research has focused on human performance of visual tasks. At UCF/IST his activities involve advanced planning proposal development for new research opportunities and examination of advanced weapon system design activities to determine training and simulation research requirements necessary to support advanced technology systems. His areas of interest include Human Factors/Engineering Psychology, visual display and workstation design, advanced flight station design, human performance, human information processing, artificial intelligence and software ergonomics.

APPLICABLE EXPERIENCE:

1988 - Present Research Associate Univ. of Central Florida/
Institute for Sim. & Trg.

Dr. Companion's activities involve advanced planning and proposal development for new research opportunities. Areas of advanced research with UCF faculty include training and simulation concepts related to situational awareness, visual taxonomies, and rapid prototyping. He is also examining advanced weapon system design activities to determine training and simulation research requirements.

1985 - 1988 Human Factors Eng./ Lockheed Aero. Sys.
Specialist Company - Georgia

Dr. Companion was part of the Advanced Crew Systems/Human Factors

Organization. His primary activities included coordinating the requirements definition and development of the crew station and crew systems necessary to support the Lockheed/Air Force Pilot's Associate Program and acting as focal point for Lockheed's crew system and human factors activities for the C-130 gunship programs. His activities on both of these programs included task analysis, information requirements analysis, function allocation, control/display definition, and display format development.

1983 - 1985 Mgr. Human Factors Burroughs Corporation
Office Auto. & D. P.

Dr. Companion was responsible for managing all human factors activities for Burrough's office workstations and associated products, including both hardware and software human factors issues. He served on both U.S. and European Industry Standards Committees and was a member of both the ANSI and ISO (International Standards Organization) committees drafting ergonomic standards for visual display terminal workstations.

1980 - 1983 Human Factors Eng./ Lockheed Aero. Sys.
Specialist Company - Georgia

Dr. Companion was the lead human factors engineer on the Lockheed/NASA Advanced Concepts Flight Station Program. This program involved the complete design and fabrication of a research flight simulator for a conceptual 1995 commercial transport aircraft.

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DAVID L . HOSLEY, Ed.D

EDUCATION: Ed.D., Education Administration, University of
 Arizona
 M.S., Education, Baylor University
 B.A., History, University of the Ozarks
 Diploma Armed Forces Staff College
 Diploma Industrial College of the Armed Forces

CURRENT POSITION: Project Manager, Institute for Simulation and
Training

EXPERIENCE SUMMARY: Retired Air Force Colonel. 475 combat
missions in vietnam. Commander, Leadership Management and
Development Center. Commander, Center for Professional
Development. Deputy Chief of Staff, Plans and Programs,
Headquarters Air University. Directed implementation of Wargaming
Center and operation of Headquarters USAF Alternate Command Post.
Division Chief, Doctrine and Concepts Division, Headquarters
USAF. Program Manager, Program 8 (Education and Training), Office
of the Secretary of Defense. Special Assistant for Education and
Training, Office of the Secretary of the Air Force. Program
Element Monitor, Education and Training, Deputy Chief of Staff,
Personnel, Headquarters USAF. Instructor, Flight Training, Air
Training Command, and Faculty, Professional Military Education,
Air University. Extensive experience in planning, programming,
budgeting, personnel, manpower, education and training. Designed
and implemented, using Instructional Systems Development (ISD),
many education and training programs. civilian undergraduate and
graduate school faculty. Extensive research and project
management experience. Numerous publications.

At IST, Dr. Hosley is one of the Project Managers within the
Training and Performance Data Center Group.

J. PETER KINCAID, Ph.D.

EDUCATION: Ph.D., Experimental Psychology Human Factors,
Ohio State University, 1971

M.A., Experimental Psychology, Roosevelt
University, 1966

B.A., Psychology, Oberlin College, 1964

CURRENT POSITION: Senior Scientist, Institute for Simulation And
Training

EXPERIENCE SUMMARY: Dr. Kincaid has over 20 years research
experience working for each of the three military services. He
also has more than 15 years teaching experience. His current
research activities include computer techniques for authoring and
delivering technical information, training and cost-effectiveness
of training devices and systems, visual systems of training
devices; and human factors design of training devices with
emphasis on computer-user interface. Dr. Kincaid has published
extensively with more than 60 journal articles and technical
reports. He is a consulting editor for the Journal of
Instructional Development.

APPLICABLE EXPERIENCE:

June 1988 - Present Senior Scientist Institute for Simulation
and Training

Primary duties with IST involve planning and direction of
projects related to training and human factors. Responsibilities
include liaison with faculty in the College of Education and
Department of Psychology and direction of research projects
related to training effectiveness/cost of gunnery and armor
training devices, embedded training, and design of technical
information for comprehensibility.

June 1985 - 1988 Senior Research Army Research Institute
Psychologist Orlando Field Unit

Responsible for two of the field units major contracting
vehicles, the Indefinite Quantity Contract and Board Agency
Announcement. Conducted research in authoring and electronic
delivery of technical information, embedded training, gunnery
training and cost and training effectiveness of training devices.

1978 - 1985 Team Leader/Psychologist, TAEG NTSC

Led team which developed Computer Readability Editing System.
Acted as Project Manager for a series of tasks related to basic
skills. Monitored research contract to universities and directed
graduate student research assistants.

1977 - 1978	Human Factors Psychologist	Martin Marietta
1970 - 1977	Assoc. Prof. Psychology	Georgia Southern Col.
1966 - 1969	Research Psychologist Human Resources Lab	Wright-Patterson Air Force Base

Initiated and monitored research contracts in human factors and military training; conducted research in human memory, human factors, and readability of technical manuals.

PUBLICATIONS

Schurman, D., and Kincaid, J.P. Army Field Test of the Personal Electronic Aid for Maintenance. Army Research Institute Technical Report, (in press).

Wisher, R., and Kincaid, J.P. Program Summary: Personal Electronic Aid for Maintenance. Army Research Institute Research Report, (in press).

Ramesh, R., Babu, A.J.G., and Kincaid, J.P. Efficient algorithms for variable depth trie index optimization: theory and experimental results. ACM Transactions on Database Systems, (in press).

Kincaid, J.P., and Kniffin, J.D. Issues of Electronic Presentation of Technical Information for International Use. Proceedings of the Fourth International Logistics Congress, Luxembourg, April 1988.

Kincaid, J.P., Braby, R., and Mears, J. Electronic authoring and delivery of technical information. Journal of Instructional Development. 11(2), 8-13, 1988.

Kincaid, J.P., and Braby, R. Computer-aided authoring and editing. Proceedings of the International Conference on Military Personnel and Training, Luxembourg, 1987.

Kincaid, J.P., Andrews, D.H., and Gilson, R. A prototype taxonomy for designing training device visual systems. Proceedings of the 31st Annual Meeting of the Human Factors Society, New York, 1987.

Hofer, R., Ozkaptan, H., and Kincaid, J.P. Training systems R&D program: Progress and challenges. Proceedings of the 9th Interservice/Industry Training Systems Conference, Washington, D.C., 1987.

Kincaid, J.P. and McDaniel, W. C. A Preliminary Analysis of User Computer Interface for the Multiple Object Location System (MOLS). Special Report No. 85-001. Orlando, FL: Naval Training Systems Center, 1986.

Kincaid, J.P. Use of the Computer Readability Editing System.

Proceedings of the 7th Interservice/Industry Training Equipment Conference, Orlando, 1985.

Kincaid, J.P., McDaniel, W.C., and Pierce, M. Word Lists to Simplify Vocabulary of Technical Information. TAEG Report 164. Orlando, FL: Training Analysis and Evaluation Group, 1985.

Braby, R., Kincaid, J.P., and Scott, P. Computer aided authoring of procedural training documents. Proceedings of the 6th Interservice/Industry Training Systems Conference, Washington, D.C, 1984.

Kincaid, J.P., Braby, R., and Wulfeck, W.H., II. Computer aids for editing tests. Educational Technology, 23, 29-33, 1983.

Braby, R., Kincaid, J. P., Scott, P., and McDaniel, W. Illustrated formats to teach procedures. IEEE Transactions on Professional Communications, 25, 61-66, 1982.

Swope, W.M., Copeland, D.R., and Kincaid, J.P. Cost/Benefit Analysis of Three English Language Training Programs for Potential Navy Use. TAEG Report 134. Orlando, FL: Navy Training Analysis and Evaluation Group, 1982.

Systems conference Technical Paper Review Committee. White team observer onboard USS Mount Whitney during FLEETEX I-86.

1980 - 1985

President

McDonald & Associates

Supervised systems analysts, psychologists and electronic technicians on the following projects. Literature review and field data gathering on passive acoustic analysis target classification techniques and development of more effective means for learning and retaining target classification procedures. Designed curriculum for AN/SQQ-89 (V) Common Equipment Shipboard Maintenance course. Determination of the effectiveness of an operator manual versus the embedded training capabilities of a computer-based maintenance aid. Analyzed MK-116 MOD 5 Fire Control System Maintenance requirements and developed functional description for the maintenance trainers. Conducted experimental study of transfer of training for six levels of maintenance trainer simulation fidelity. Analyzed Sonar Operator tasks and developed functional description and detailed specification for AN/SQQ-89 (V) Basic Sonar Operator and Basic Diagnostics Trainer. Analyzed ASW shipboard electronics maintenance tasks and developed functional description and specifications for maintenance trainers. conducted function allocation analysis and developed human factors recommendations for Battle Group Tactical Trainer. Responsible for test plan development, experimental design, pilot briefing and debriefing, data analysis and report presentation in a simulation study of low-level night assault mission using Helicopter Night vision System on a CH-53 helicopter. Developed Society of Automotive Engineers recommended design practices for operator stations on underground mining equipment. Consultant to various private companies and government agencies.

1976 - 1980

Technical Manager

Allen Corporation of
America

Performed training requirements analysis and developed specifications for the Trident Submarine Integrated Radio Room training equipment. Developed design specifications for instructor consoles in C-141 cockpit procedures trainer. Developed experimental test plan for simulator performance testing of various configurations of Helicopter Night Vision System on CH-53 helicopter for Martin Marietta Aerospace. Literature review and field data gathering to develop design specifications for automatic fire suppression systems on underground and surface mining equipment. Literature review and field data gathering to develop standardized and optimized control configurations for coal mine roof bolter machines. Created major training program for roof bolting operations in underground coal mines.

1973 - 1976

Senior Human Factors
Engineer

Midwest Research
Institute

Principal Investigator on four studies for the Bureau of Mines.

Two studies involved literature reviews, underground data gathering in metal and nonmetal mines and hazard analyses to develop design criteria for automatic fire suppression systems. A third study involved on site visits to surface metal mines to determine the cause of and remedies for alertness-related high accident rates. A fourth study involved underground data gathering and the recommendation of a cost-beneficial training program for equipment operators in coal mines. In charge of fulfilling maintainability, reliability, human factors, safety and instruction manual development requirements in gas detector procurement contract for the U.S. Army.

PATRICK J. MOSKAL, Ph.D.

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:

1989 - present Institute for Simulation and Training, University of Central Florida.

1988 - 1989 Naval Training Systems Center, Human Factors Division.

1986 - 1988 Naval Training Systems Center, Human Factors Division, Postdoctoral Fellowship via the U.S. Dept. of Energy.

WORK EXPERIENCE SUMMARY:

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) developing an experimental classroom of the future, employing the principles of cognitive learning theory and instructional systems design.

During the three years prior, 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 Orientation Trainer (RIOT) program; he provided support for the Chemical, Biological, and Radiological Defense (CBR-D) Training Program; and served as a statistical design and analysis consultant. The EWCAP is a program to assess operational readiness of the 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.

He 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, and quantitative methods. He is a member of Sigma Xi, the Central Florida Chapter of the Human Factors Society, and the

Society for Aviation Psychologists.

PUBLICATIONS

- Moskal, P. J. & Allen, J. H. (1989) Radio Instruments Orientation Trainer (RIOT), in Independent Research and Independent Exploratory Development (IR/IED). Programs Annual Report FY88. Orlando, Fl: Naval Training Systems Center.
- Moskal, P. J., Mulligan, C. P., & Carson, R. (1988) Improving navy recruit confidence expectancies and knowledge in a simulated chemical warfare environment. (Report No. NAVTRASYSSEN TR88-010). Orlando, Fl: Naval Training Systems Center.
- Moskal, P. J. (1987) Radio Instruments Orientation Trainer (RIOT) in Independent Research and Independent Exploratory Development (IR/IED) Programs Annual Report FY87, Orlando, Fl: Naval Training Systems Center.
- Moskal, P. J., Driskall, J. E. & Carson, R. (1987) Preliminary assessment of the Navy's Chemical, Biological, and Radiological Defense Common Skills Training. (Report No. NTSC TR-87-031). Orlando, Fl: Naval Training Systems Center.

JANET J. TURNAGE, Ph.D.
UCF

EDUCATION: Ph.D., Industrial-Organizational Psychology, Iowa State University, 1978.
M.S., Industrial Relations, Iowa State University, 1974.
B.A., Psychology, Connecticut College, 1961.

EXPERIENCE SUMMARY: Dr. Turnage teaches graduate and undergraduate courses in applied psychology and industrial psychology (Industrial/ Organizational Psychology, Careers in Psychology, Practicum and Professional Problems, Organizational Psychology and Motivation, Current Topics and Applied Problems in I/O Psychology). She prepares research proposals and conducts research (human performance measurement research, subjective mental workload, stress research, goal-setting studies, assessment center research, survey of job satisfaction of psychology graduates). She also supervises students in practicum placements. Dr. Turnage has published extensively in professional journals such articles as decision making, motivation, risk management, perception, thermal reactor safety, industrial radiography, job performance and human factors engineering design. Dr. Turnage keeps abreast of the state-of-the art by her activities in such professional associations as the American Psychological Association, Human Factors Society, Southeastern Industrial-Organizational Psychological Association and others. She has been the recipient of a number of research grants (among them a grant from the Army Research Institute for behavioral and Social Sciences).

APPLICABLE EXPERIENCE:

January 1982-Present	Assistant Professor Industrial-Organizational Psychology	University of Central Florida
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As Assistant Professor in the Psychology Department, Dr. Turnage teaches graduate and undergraduate courses in applied and industrial psychology. She supervises the research of advanced students of psychology. Dr. Turnage is also involved in the preparation of research proposals and the conduct of individual research projects in the areas of psychology and human factors.

March 1981-July 1981	Deputy Project Manager and Office Manager	KARA Office Ames, Iowa
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As Deputy Project Manager, Dr. Turnage managed the Ames office of KARA, a Saudi-Arabian company specializing in international commerce, industry, and contracts. Project management for joint U.S.-Saudi program to design and build a commercial-size solar greenhouse. Selection and coordination of international personnel, project planning, subcontract administration, management and cost control, supervision of technical efforts. Outgrowth of previous contract work between KARA and Science Applications, Inc.

July 1979-March 1981

Scientist and
Deputy Manager

Science Applica-
tion, Inc
Ames, Iowa

Dr. Turnage assisted in personnel administration, cost analysis and cost control, programmatic strategy planning, and office management. Contributed to technical contract work in nuclear safety and human factors analysis, solar systems design and development, market research, decision analysis. Was responsible for solicitation of new business, proposal preparations, paper presentations.

Consulting Activities

September 1984-Present City of Orlando Fire Department,
Orlando, Florida

Designed and developed of job related promotional procedures for the ranks of Captain and Assistant Chief. Activities included developing technical paper and pencil tests as well as developing and implementing and assessment center program for eligible candidates.

June 1982-Present Policy Administration and Employee
Relations, General Motors Corporation, Detroit Michigan

Provided outside analysis of assessment center data on a company-wide foreman selection program. Conducted research on possible adverse impact to support and implement GM consent agreement.

July 1980-Present Consultant to Office of Nuclear Regulatory
Research, U.S. Nuclear Regulatory Commission, Washington,
D.C.

Industrial psychology consulting, primarily on motivation to perform safely to avoid radiation overexposure accidents. Review of a radiography training manual for inclusion of positive incentives for safety. Development of instructor's manual to accompany radiography safety training manual. Evaluation of current psychological research to provide recommendations for training procedures, internal safety auditing, personnel selection and staffing.

EDUCATION: Ph.D Mathematics, Pennsylvania State University,
1979
M.S. Computer Science, Pennsylvania State
University, 1981
B.S. Mathematics, National Taiwan

APPLICABLE EXPERIENCE:

Dr. Lang is currently teaching undergraduate and graduate courses on Operating Systems, Systems Programming, Data Structures, and Discrete Structures. He has supervised five master's projects in the area of Concurrent Programming under 4.2 BSD Unix operating system, and has served on a master's thesis committee for eighteen other master's students.

Taught undergraduate courses on Pascal Programming, Linear Algebra, Systems Programming, and Data Structures.

Assisted and taught College Algebra, Trigonometry, Calculus, and Differential Equations.

OSCAR J. DORR, C.P.L.

EDUCATION: M.B.A., Xavier University, Cincinnati, Ohio, 1975

B.S. in Business Administration,
(Major in Industrial Management)
Franklin University, Columbus, Ohio, 1972

Industrial College of the Armed Forces
National Security Management, 1976

University of Houston, Clear Lake, TX
Graduate studies in Computer Information Systems,
1979-80

University of California, Los Angeles, 1981
ILS Short Engineering Course

Society of Logistics Engineers Workshops
Logistics Support Analysis (40 hrs.)
Life Cycle Cost Analysis (40 hrs.)

AAI Corporation Management Training Courses
Systems Design
Theory and Management of Systems
Program Management

APPLICABLE EXPERIENCE:

1989 to Present: Adjunct Faculty (Logistics),
University of Central Florida,
Department of Industrial
Engineering,

April 1989 to Present: Independent Consultant in Logistics
Configuration Management (CM), and
Data Management (DM).

Full time preparation of proposals, and presentation of seminars
and workshops on international basis. Specialize in maintenance
planning, reliability and maintainability computations, CM/DM
functions and development of maintenance concepts. Clients:
Harris Corp., Tech Services Div.; Honeywell Inc., and Tekontrol,
Inc.

1984 - 1989: Operations Manager, Orlando Support Operation
AAI Corporation, Orlando, FL

Manufacturer of training and simulation devices. Organized and
staffed new logistics, configuration management, and data manage-
ment departments. Trained new staff in CM and DM procedures.
Established change control board, drawing file and controls, and
new software CM function. Responsible for the management and
direction of all logistics support effort including technical

publications, training, R&M, LSA, CLS/COMS, provisioning, and software documentation for multi-million dollar maintenance trainer and flight simulator programs. Managed Configuration Management, Data Management, and Instructional Systems Development (ISD). Extensive proposal experience. Developed maintenance concepts and plans, and spares support for Navy, Marine, and Air Force training devices.

1978 - 1984: Manager, Integrated Support Services Dept.
Singer-Link, Houston, TX

Manufacturer of training and simulation devices. Organized and staffed integrated support operation. Responsible for management of four major departments: Quality Assurance, Configuration/Data Management, Publication Support Services, and Integrated Logistics Support. Extensive proposal experience. Supported programs included LAMPS Mk III helicopter OFT, Navy UNFO ground mapping and air-to-air intercept trainers, F-16 flight simulator, and NASA Shuttle Mission Simulator. Received commendation from NASA for support in configuration and data management. Trained CM/DM and logistics support staff. Developed maintenance concepts and plans, and spares support for NASA, Navy, and Air Force training devices.

1956 - 1978: Logistics Program Manager, Trainer Aircraft
Rockwell International, Columbus Division,
Columbus, OH

Managed the total maintenance and support program for jet trainer aircraft manufactured at the Columbus division. As Logistics Program Manager also managed configuration and data management for all company documentation associated with programs under my control. Had extensive experience in both domestic (DOD) and foreign (FMS) programs. Participated as company representative for logistics in site surveys in Venezuela and Greece planning the maintenance and spares support program. Commended by the Venezuelan and Hellenic Air Force commanders, and NAVAIR Program and Logistics Managers, for developing innovative support methods, including management of technical publications and training. Prior to this position, held various logistics support positions as Technical Training Instructor, Field Service Engineer, and Logistics Engineer. Conducted maintenance training for U. S. Navy and Air Force personnel on military aircraft manufactured by company, and in-plant aircraft systems training for company engineers and mechanics. Served in position of senior responsibility at field locations including Senior Representative in Charge, Navy Board of Inspection and Survey (BIS) trials, NATC Patuxent River, MD., on the T-2B jet trainer program. Headed the company maintenance team for Flight Test, Carrier Test, Service Test, and Weapons Test divisions. Served as company Technical Representative with Navy squadrons, and aboard Navy aircraft carriers, maintaining Rockwell jet aircraft (RA-5C Vigilante, T-2B/C Buckeye, OV-10A Bronco, T-28B/C Trojan). Managed the field office at SAAMA, Kelly AFB, TX, from 1967 to 1970, providing technical and maintenance advice on OV-10A to Air Force.

Assisted Air Force personnel in coordination of spare parts requirements to support company aircraft in combat in Vietnam. From 1961 to 1964 was company liaison representative at the Bureau of Naval Weapons in Washington, DC. Provided technical advice to NAVAIR program management personnel and engineers on technical aspects of company aircraft manufactured for Navy. During this period also provided liaison with Navy Aviation Supply Office (ASO), Philadelphia solving spares acquisition problems. Made bi-weekly visits to ASO contacting program managers for spares support.

1948 - 1956: Ground Training Officer (civilian)
 U.S. Naval Air Training Command, Pensacola, FL,

Trained student naval aviators and foreign flight students in aircraft systems, flight physiology, navigation, and instrument flying techniques in classroom and with aid of flight simulators. Taught fundamentals of aircraft electrical and mechanical systems to Navy flight students as part of ground school. Established ground school technical library for training support.

1945 - 1948: U.S. Navy

Aircraft radio technician and aircraft mechanic. Was graduated from Link Instrument Trainer Instructors School, October 1946. Trained Naval Aviators and Students in instrument flying skills with flight simulators and with classroom lectures.

PUBLICATIONS

"Needle, Ball, Ripcord, " Flying Magazine, December 1956.

"Software Logistics," Journal of the Society of Logistics Engineers, Spring 1984.

"Software Logistics: A New Challenge for Logisticians," Society of Logistics Engineers, 19th Annual Symposium, Minneapolis, MN, August 1984.

"Information Transfer During a Foreign Military Sales Aircraft Support Program," Society of Logistics Engineers, 20th Annual Symposium, San Diego, CA, August 1985.

"Pigeon Logistics," Journal of the Society of Logistics Engineers, Fall 1988.

"Logistics-Peace Dividend with Interest," Journal of the Society of Logistics Engineers, Spring 1990.

THOMAS F. CAROLAN

EDUCATION: Ph.D. (in progress), Experimental Psychology,
University of Connecticut.

M.A., Experimental Psychology, Connecticut
College, 1980.

B.A., Communications/Psychology, Western
Connecticut State University, 1977.

CURRENT POSITION: Research Psychologist, Institute for
Simulation and Training

EXPERIENCE SUMMARY: Mr. Carolan has been a member of the University of Central Florida faculty since 1988, working as a Research Psychologist at UCF's Institute for Simulation and Training. His research interests include: Application of cognitive and perceptual learning research, Cognition and instruction, Figurative thinking, Intelligent tutoring systems, Application animation and simulation to learning complex concepts, Perceptual guidance of action. Current research projects include:

Application of Animated Simulation to Learning Complex Concepts

In 1989 Mr. Carolan was awarded a grant from the State of Florida's High Technology and Industry Council to initiate a program to research the application of cognitive and perceptual learning principles in the use of animation and simulation technology in computer based learning environments. This research has focused on the implementation of specific instructional strategies via animated simulations in a computer based classroom environment, and on the experimental evaluation of animated simulation as a vehicle for learning complex concepts in underwater acoustics. Funding for this research program was continued for 1990.

Embedded Training Effectiveness Research

Since 1988, Mr. Carolan has been co-investigator on a series of projects developing intelligent tutoring system technology for embedded training environments. This project, funded through the Naval Training Systems Center, has as its objective, the software implementation and effectiveness evaluation of cognitive task analysis and intelligent tutoring principles for embedded training. He has been responsible for the experimental design and implementation of the effectiveness evaluation, for the cognitive task analysis process, and for day to day project management. Mr. Carolan is currently the principal investigator on this project.

Experimental Technology Classroom

Mr. Carolan is currently the principal investigator on the development of an experimental technology classroom. This project combines intelligent tutoring system technology, expert teacher instructional strategies, and the use of graphics, animated simulation, and hypermedia in an integrated advanced

technology classroom.

APPLICABLE EXPERIENCE:

1988 - Present Research Scientist Univ. of Central Florida/
Institute for Sim. & Trg.

Mr. Carolan is involved in a variety of projects as part of his duties at IST. His focus is on cognitive psychology and its application to training. His projects include animation characteristics for use in CAI, applied cognitive learning principles simulation for complex concepts, the classroom of the future, and situational awareness.

1987 Independent Consultant Alpha Tech, Inc.
Boston, Mass.

During his association with Alpha Tech, Mr. Carolan was involved in the development of interfaces for tactical decision making.

1983 - 1986 Research Assistant/
Associate Univ. of Conn
Storrs, Connecticut

Mr. Carolan was associated with the Perception Laboratory in the Department of Psychology. His activities included experimental design, data collection and analysis, software development for complex computer graphics transformation.

SELECTED PUBLICATIONS:

"Knowledge Engineering Domain Knowledge for an Intelligent Computer Aided Instruction system", Williams, K.E., Reynolds, R.E. & Carolan, T.F., Proceedings of the Second Florida Artificial Intelligence Research Symposium. 1989.

"An Evaluation of a Methodology for Cognitively Structuring and Adaptively Sequencing Exercise Content for Embedded Training", Williams, Reynolds, Carolan, Anglin, & Shrestha, Naval Training Systems Center Technical Report 89-035, 1989.

"the Experimental Classroom of the Future: functional Description", Williams, Vaughn, Hammell, Anglin, Carolan, Rullo, & Moskal, Florida High Technology and Industry Council Research Report, 1989.

PATSY D. ANGLIN

EDUCATION: M.S., Computer Science,
University of Central Florida, 1988

B.S., Computer Science,
University of Central Florida, 1986

CURRENT POSITION: Research Associate/ Institute for Simulation
Computer Scientist and Training

EXPERIENCE SUMMARY: Ms. Anglin is involved in the development of an experimental classroom of the future, employing the principles of cognitive learning theory and instructional systems design. The classroom will employ a cognitively engineered model of the instructional curriculum using a production system approach. State-of-the-art technology will be used in the classroom development. In her fellowship position with the Naval Training Systems Center, she was part of a team responsible for the maintenance and software development of a large embedded training system. She is currently working with NTSC to design, implement, and evaluate an intelligent tutoring system for a multi-threat surface warfare tactical training device. She is also the software developer for the FHTIC classroom of the future project.

APPLICABLE EXPERIENCE:

1989 - Present: Research Associate/ Institute for Simulation
Computer Scientist and Training

Responsibilities include software development and integration, and system management. Ms. Anglin was also involved with embedded training effectiveness research aimed at investigating and evaluating a cognitively engineered training curriculum for the Navy. The project involves the restructuring of lessons for an operator console in an effort to improve trainee learning.

1987 - 1988 Graduate Research Fellow Naval Training Systems
Center, Human Factors

Duties included implementation of a system tutorial and tactical feedback, extension of tactical geoplots graphics capabilities, and improvement of interactive targets. Ms. Anglin's computer knowledge includes the following: UNIX, VAX/VMS, and MS-DOS operating systems; numerous software languages, including C, OPS-5, Ada, Lisp, Pascal, Fortran, and Basic. Her specialization includes the software development and maintenance of large scale training systems, expert systems, relational data bases.

RUPERT E. FAIRFIELD

EDUCATION: M.A., Military Art and Science
U.S. Army CGSC, Ft. Leavenworth, KS.

DoD Program Managers Course
DSMC, Ft. Belvoir, VA.

Naval Flight Training (1964)
NAS, Pensacola, FL.

B.A., (NROTC Scholarship)
University of Mississippi

CURRENT POSITION: Senior Strategic Planner, Institute for
Simulation and Training.

EXPERIENCE SUMMARY: Mr. Fairfield has nearly 30 years experience in naval aviation, varying from operational and combat service in both fixed and rotary wing aircraft to procurement billets at NAVAIRSYSCOM and NTSC. For the past ten years, he has been directly involved in the training and simulation industry and has managed a number of aviation simulation programs, many with EW application. He has held positions of responsibility in government agencies as well as in the simulation industry. Mr. Fairfield has been involved in all phases of advanced systems acquisition, ranging from concept studies and research through prototype development, production, and support. He has coordinated the efforts of several project managers simultaneously and exercised upper level management responsibility of over \$200 million worth of simulators and training devices in a single year.

APPLICABLE EXPERIENCE:

1988 - 1990	Senior Director Government Marketing	Reflectone, Inc.
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Mr. Fairfield's responsibilities included the pursuit and capture of all Government programs. He supervised eight marketing managers and directors to achieve annual bookings of \$35-50M. One of two Reflectone personnel, he was assigned to a joint working group with British Aerospace to assess corporate technologies and develop joint business plans. Contributed to the ultimate decision by British Aerospace to make \$48M investment in Reflectone stock and business base. He also collaterally served on R and D committees and product improvement groups.

1985 - 1988	Manager Systems Requirements	Rediffusion Simulation, Inc.
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Managed the Orlando Field Office with primary cognizance over all Army, Navy, and Marine Corps training programs. Conducted

frequent technical liaison visits with government agencies to discuss visual system design issues to meet specific training requirements. Mr. Fairfield offered RSI/E&S visual products to prime training contractors. He achieved a total of over \$100M in potential bookings in less than one year and assisted RSIs entry into the computer-based training and front-end analysis/study market areas. Collaterally served as the Management Subcommittee Chairman for the 8th Interservice-Industry Training Systems Conference.

1983 - 1985 Manager AAI Corporation
 Systems Requirements

Served at the executive level with responsibility to monitor all ongoing Navy and Marine Corps contracts at AAI. Conducted technical discussions with AAI and government engineers to develop best conceptual approach to individual training programs. As the designated principal development specialist, Mr. Fairfield contributed to fourteen wins out of fifteen competitive programs which AAI pursued.

GOVERNMENT EXPERIENCE:

1981 - 1983 Marine Corps Naval Training
 Liaison Officer Systems Center

Coordinator of technical and contractual aspects of program management for all Marine Corps aviation training device procurements, aviation training analyses, and syllabus developments. Monitored all Air Force, Navy, and Army research activities and training developments for possible Marine Corps applications. He participated in the development of Headquarters Marine Corps POM/PPBS initiatives for aviation training (approximate value in excess of 100 million dollars annually).

1980 - 1981 Commanding Officer Marine Air base
 Iwakuni, Japan Squadron 15

Responsibilities included command and training of support personnel for a Marine fighter aircraft group. The functional sections included: administration, training, launch and recovery, security, fire and rescue, embarkation, base construction, food service, and communications. Had charge of establishing an advanced fighter base in Korea in support of Marine fighters during an international exercise. Requalified as pilot in Marine F4 and A4 series aircraft and participated in several air training deployments.

1977 - 1980 Coordinator for USMC Naval Air Systems
 Aviation Training Command (205)

Appointed as the initial billet holder at NAVAIRSYSCOM responsible for coordinating all Marine aviation training requirements with Headquarters Marine Corps, Fleet squadrons, and the Chief of Naval Operations Staff (OP - 05). Conducted daily

liaison with prime systems program managers and acted as Headquarters Marine Corps advisor on all aviation training issues. After attending Defense Systems Management College (DSMC), Mr. Fairfield selected to serve collaterally as special advisor to NAVAIR-01 on the Navy Undergraduate Pilot Training System (T-45). He participated in source selection process for T-45 as co chairman of the training effectiveness committee. Returned to DSMC as a guest lecturer on A-109 acquisition criteria.

1972 - 1976 Training Officer

Training Squadron 23
(VT-23) NAS

Activities included the management of the day to day training of basic jet students during a 42 month tour. During his tenure as training officer, VT-23 sent over 600 flight students to aircraft carriers for initial jet landing qualifications without a single accident or student disqualification. He set VT-23 flying record with over 47,000 accident-free hours. Mr. Fairfield was the first winner of Admiral Goldwaithe trophy for training squadron efficiency. In addition to assignment as Training Officer, he instructed in all phases of the basic jet syllabus and chaired flight disposition boards conducted for students experiencing flight difficulties. He is thoroughly knowledgeable in all aspects of syllabus development and implementation, training analyses, and instructional systems development.

1971 - 1972 Assistant G-4

First Marine
Aircraft Wing

Assigned as a Marine Captain to a billet normally held by a senior Lieutenant Colonel. Responsible for normal logistical support of an entire Marine aircraft maintenance, supply, engineer support, motor transport, embarkation, and avionics. He was the primary logistics planner for deployment of a Marine fighter group to Thailand and a Marine attack group to South Vietnam. Mr. Fairfield participated in negotiations for Interservice support with U.S. Army and Air Force.

KEVIN ULIANO

EDUCATION: M.S., Industrial/Organizational Psychology,
University of Central Florida, 1985

B.A., General Experimental Psychology,
University of Central Florida, 1983

CURRENT POSITION: Principal Investigator, Institute for
Simulation and Training

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:

1987 - Present Principal Investigator Institute for Sim. & Trg.

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 of individual characteristics on performance, designing effective human-computer interfaces for computer-based training, and evaluating training devices from the Army's MANPRINT perspective.

1987

Human Factors

Hay Systems, Inc.

Provided human factors engineering technical support to the U.S. Department of Defense and private industry. Area of specialization included MANPRINT - a methodology aimed at the effective integration of manpower, personnel, training, and other issues early in the systems acquisition process; and 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.

1985 - 1987

Research Psychologist

Essex Corporation

Provided technical support for the Visual Technical Research Simulator (VTRS) facility at the Naval Training Systems Center. Completed tasks including 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.

1983 - 1985 Research Associate Naval Training Systems
 Human Factors Lab Center

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.

1984 - Present Training Consultant Assessment Designs, Int'l

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.

BRENDA A. BRADLEY

EDUCATION:

M.S., Industrial/Organizational Psychology
University of Central Florida, 1990.

B.A., General Psychology
University of Central Florida, 1988.

A.A., General Studies
Seminole Community College, 1985.

CURRENT POSITION: Research Assistant, Institute for
Simulation and Training.

EXPERIENCE SUMMARY: Ms. Bradley has had practical as well as academic experience in the area of training effectiveness evaluation and job skill analysis. She has authored a number of technical reports and supported the development of several proposals. She has conducted and participated in experimental and analytic research studies.

APPLICABLE EXPERIENCE:

1989 to Present Research Assistant Univ. of Central Florida/
Institute for Sim. & Trg.

Actively contributed in the fulfillment of a training system effectiveness evaluation contract for the U.S. Navy. Co-authored several technical reports. Responsible for the design, development, implementation and analysis of empirical and survey studies. Contributed in the implementation and analysis of several operational field studies and the development of functional specifications for proposed system changes. Developed a demonstration program using Dan Bricklin's Demo 2 for the functional specifications. Contributed to various proposals including scheduling man power hours using Microsoft Excel.

1988 - 1989 Graduate Research Assistant Naval Training
Systems Center

Responsible for the preparation and delivery of demonstration of several on going training system projects to visiting representatives. Assisted with on-going research project development.

1986 - 1988 Senior Credit Authorizer Sears, Roebuck & Co.

Responsible for the examination of credit accounts and authorizing line of credit increases. Monitored risk reports, investigated problem accounts and decided upon proper action for accounts. Responded to customer questions regarding actions taken. Handled on-line calls from retail stores regarding

questions about customer accounts.

Technical Reports:

Bradley, B. (1990). Survey Results. Orlando, Fl: University of Central Florida/Institute for Simulation and Training.

Bradley, B. & Companion, M. (1990). Initial User Survey. Orlando, Fl: University of Central Florida/Institute for Simulation and Training.

Bradley, B. & Companion, M. (1990). Operational Test #3: Foreign Language Reading Comprehension. Orlando, Fl: University of Central Florida/Institute for Simulation and Training.

Bradley, B. & Companion, M. (1989). ASTAR: The Automated Simulator Test and Assessment Routine. Proceedings of the Cost Effectiveness Analysis Workshop. Held in Conjunction with the 11th Interservice/Industry Training Systems Conference.

Bradley, B. & Companion, M. (1989). The Automated Simulator Test and Assessment Routine (ASTAR) Abbreviated User's Manual. Orlando, Fl: University of Central Florida/ Institute for Simulation and Training.

GRADUATE STUDENTS

STEVEN J. KASS

Graduate Research Assistant-Psychology

EDUCATION: Ph.D. (in progress), Human Factors Psychology,
University of Central Florida.

M.A., Industrial/Organizational Psychology,
University of West Florida, 1989.

B.S., Psychology, University of Florida, 1986.

EXPERIENCE: Mr. Kass has several years experience in the analysis of human behavior to support expert system development. His recent activities have focused on the analysis of human behavior for tactical decision making for simulated forces and situational awareness. He has participated in the development of behavioral models based on those cognitive analyses. He has also served as the behavioral subject matter expert to support the computer scientists working on several projects. He has extensive experience in the preparation of manuscripts and reports describing research projects. Mr. Kass is a coauthor on several journal articles and several presentations.

APPLICABLE EXPERIENCE:

1989 - Present UCF/IST Graduate Research Assistant

Mr. Kass has been involved in research in the area of situational awareness and simulated forces. He has been supporting the FHTIC grant on Training Technology for Situational Awareness under which he has been helping to analyze cognitive behaviors and develop a cognitive model for situational awareness. He has conducted empirical studies in support of the program and assisted in the development of several manuscripts describing the project.

JOANN C. RULLO

Graduate Research Assistant-Psychology

EDUCATION: Ph.D. (in progress) Human Factors Psychology,
University of Central Florida, expected 1992.

B.A., Psychology
University of Central Florida, 1988.

A.A., Valencia Community College, 1985.

EXPERIENCE SUMMARY: Ms. Rullo has various research experience including collecting and analyzing data on the emergence of the memory "generation effect" under various experimental conditions. Research involving the development of innovative training techniques for computer visual simulation, and research to develop a design aid that would match visual displays of training equipment to training needs. Coauthored with Margaret Thomas,

and LoJuan Howard and presented "Overt Versus Covert Responding and the Size of the Generation Effect" at the 38th Annual Meeting of the Psychonomic Society, Seattle, 1987.

APPLICABLE EXPERIENCE:

1988 - Present	Graduate Research Assistant	Institute for Simulation and Training
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Currently conducting research applying human factors principles in the development of a "Classroom of the Future". Job aspects include the design of a student workstation as well as an instructor computer workstation.

1981 - 1987	Computer Operator	Repco, Inc.
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Responsibilities included scheduling and processing jobs on an IBM SYSTEM 38, daily backup of system files and libraries, and printing and distribution of reports and special forms.

LISA B. SHRESTHA Graduate Research Assistant-Psychology

EDUCATION: M.S., Industrial/Organizational Psychology,
University of Central Florida, expected 1990

B.A., Psychology/Business Administration,
University of Central Florida, 1987

EXPERIENCE SUMMARY: Related areas of study include: Industrial/Organizational psychology, interviewing and counseling, motivational psychology, computer programming, economics, marketing, accounting, finance, personnel and production/operations management, and management of organizations. Has been involved in extensive research in the computer-aided instruction area, and cognitively engineered training lessons utilizing cognitive learning theory.

APPLICABLE EXPERIENCE:

1987 - Present	Graduate Research Assistant	Institute for Simulation and Training
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Currently involved in developing various elements of graphic simulation and animation, cognitively engineering a number of classified lessons for the Navy, and participating in the development of a set of training guidelines for instructor operator stations. Conducted research dealing with the evaluation of user-computer interface characteristics in a computer-aided instruction (CAI) program. Developed a CAI program incorporating human factors principles which facilitate interaction with the computer, collected and analyzed experimental data, and performed research relating motivation and learning to CAI. Also, participated in developing an experiment intended to train individuals (at the Naval training Systems

Center) how to operate a tactical console through intelligent computer-aided instruction, collected, organized and analyzed experimental data; and assisted in writing the technical report. Ms. Shrestha also designed a procedural methodology detailing the steps required to effectively engineer a lesson in a computer-assisted environment; provided a detailed example of how to implement these steps; and developed a set of guidelines for lesson creation and development based on production modelling theories and cognitive theories of motivation and learning.

HYUN KIM

Graduate Assistant-Computer Science

EDUCATION: B.S. Computer Science,
University of Central Florida, 1990.

EXPERIENCE: Mr. Kim received his B.S. in computer Science, with a concentration in scientific methods, in august of 1990. His proficient in a wide variety of programming languages including C, Ada, Fortran, Prolog and Lisp. He has been heavily involved in the area of artificial intelligence with emphasis on the development of LISP programs for rule-based expert systems. during the last year he has been involved in the development and programming of rule-based models of decision making processes and the development of user interfaces to simulation environments. He is responsible for the development of a rule-based state space search program, written in a LISP variation, for selecting routes through a threat environment.

APPLICABLE EXPERIENCE:

1990 - Present UCF/IST Undergrad. Research Assistant

Mr. Kim has been involved in a FHTIC grant on Training Technology for Situational Awareness. Mr. Kim is responsible for the development and programming of rule-based models of the decision making processes involved in situational awareness and the simulation interface.

1989 - 1990 UCF/CREOL Undergrad. Research Assistant

MARY ANN FROGGE

Graduate Assistant-Computer Science

EDUCATION: B.S. (Expected Dec. 1990), Computer Science,
University of Central Florida.

EXPERIENCE: Ms. Frogge is an undergraduate major in Computer Science, minor in Mathematics, at the University of Central Florida where she is pursuing an Honors Degree. She will be entering the graduate program in Computer Science at the University of Central Florida. Ms. Frogge is a National Merit Scholar and UCF President's Scholar. Ms. Frogge is proficient in a variety of programming languages including Ada, Lisp, C and C++. She has been involved in her studies and research

activities in the area of artificial intelligence. Her activities in the artificial intelligence area include both rule-based systems and neural networks. During the last year she has been heavily involved in the development and programming of neural network models for decision making. She has experience in a number of neural network techniques and development packages including both neural network shells and custom development languages.

APPLICABLE EXPERIENCE:

1990 - Present UCF/IST Undergrad. Research Assistant

Ms. Frogge has been involved in a FHTIC grant on Training Technology for Situational Awareness. Ms. Frogge is responsible for the development and programming of neural network models of the decision making processes involved in situational awareness.

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