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Statement Of Capabilities For Development Of A Prototype Manpower, Personnel, And Training In Acquisition Decision Support System

University of Central Florida Institute for Simulation and Training

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INSTITUTE FOR SIMULATION AND TRAINING

STATEMENT OF CAPABILITIES
FOR
DEVELOPMENT OF A PROTOTYPE MANPOWER, PERSONNEL,
AND TRAINING IN ACQUISITION DECISION SUPPORT SYSTEM

SUBMITTED TO

UNITED STATES AIR FORCE
HUMAN SYSTEMS DIVISION HRL/MOD
BROOKS AFB, TX 78235-5601
ATTN: DR. BARBARA SORENSON

IN RESPONSE TO

COMMERCE BUSINESS DAILY ANNOUNCEMENT
DATED OCTOBER 11, 1990
SOURCES SOUGHT SYNOPSIS
PMRS 90-26
FOR
RESEARCH, DEVELOPMENT, TRAINING,
AND EVALUATION SUPPORT

November 7, 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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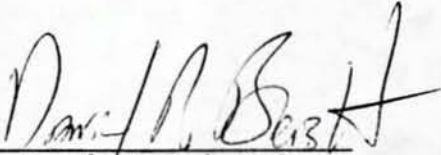
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Mr. Daniel Beistel
Director of Business Operations

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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, HRL/MOD, (Dr. Barbara Sorenson) with this capabilities document in response to the Commerce Business Daily announcement Sources Sought Synopsis: Research, Development, Training and Evaluation Support, PMRS 90-26, dated October 11, 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:

- Human Performance
- Job Skills Analysis
- Manpower, Personnel and Training
- Artificial Intelligence/Intelligent Systems
- Logistics
- Operations Research
- Occupational and Training Requirements
- Data Base Modeling
- Footprint/Crosswalk
- Software Development

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:

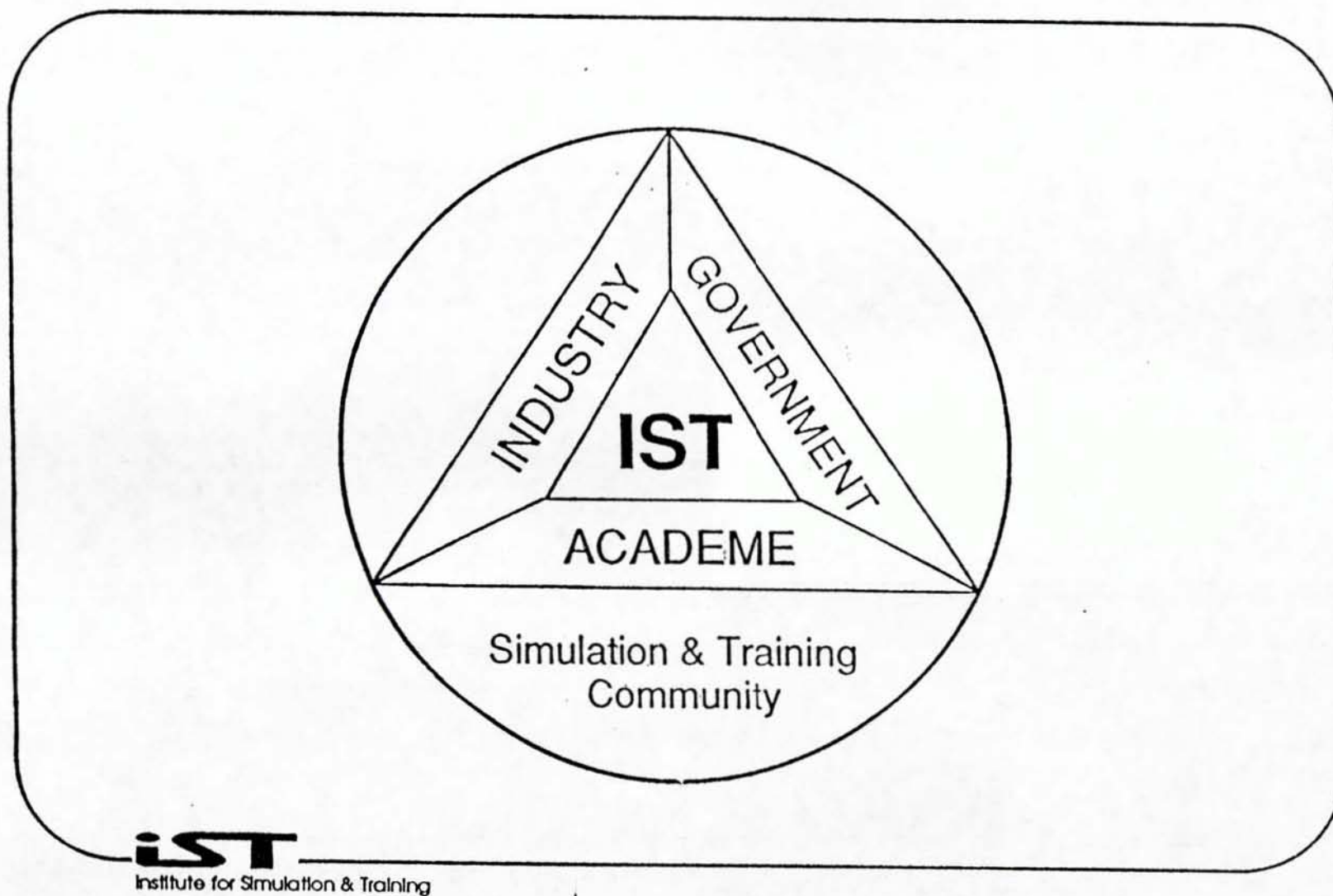


FIGURE 1

NETWORKING BETWEEN IST, GOVERNMENT, ACADEME AND INDUSTRY

Burtek
CAE-Link
Encore Computer
Evans & Sutherland
G.E. Aerospace
Grumman Electronics
Harris
Westinghouse Electric

Hughes Simulation Systems
Loral Defense Systems
McDonnell Douglas
Perceptronics
Reflectone
Star Mountain
Systems & Simulation

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
General Electric Corporation

Grumman Sim. & Trng. Products
Evans & Sutherland
McDonnell Aircraft
Perceptronics
Reflectone

IBM
Digital Equipment
Corporation
Eagle Technology
Gould
Hughes
Paragon

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
IBM
Martin Marrietta
McDonnell Douglas
Hughes
General Dynamics
Lockheed/Sanders
CAE Link

SAIC
SYSCON
AAI
Raytheon
STI
Boeing
Mitre
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 19,000 square feet of office space and approximately 8,000 square feet of laboratory space in the Central Florida Research Park. The IST facility holds a secret level clearance. 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 be 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:

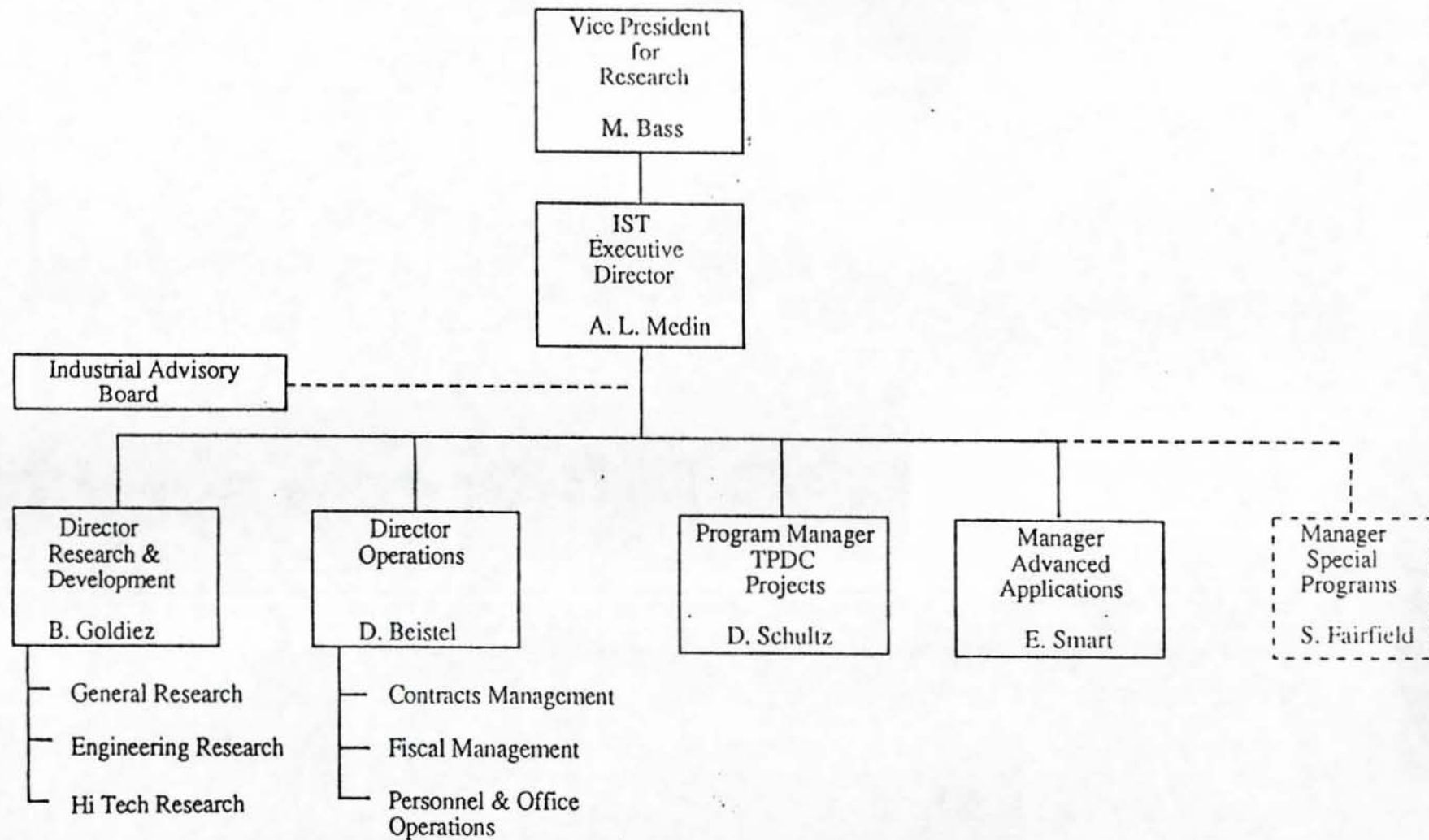


FIGURE 2
IST ORGANIZATION

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 Manager of New Programs and General Research Department within IST. The Manager of Special Programs, Mr. Rupert "Skeets" Fairfield will provide program management oversight for the project. The manager of the General Research Department, Dr. Michael Companion, will provide the technical management and coordinate the technical resources on the project. The General Research 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 requirements.

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 (AFHRL/MOD).

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 AFHRL/MOD effort and to demonstrate that IST has the necessary resources to successfully accomplish the research support outlined in the sources sought synopsis. These descriptions are limited to expertise associated with projects

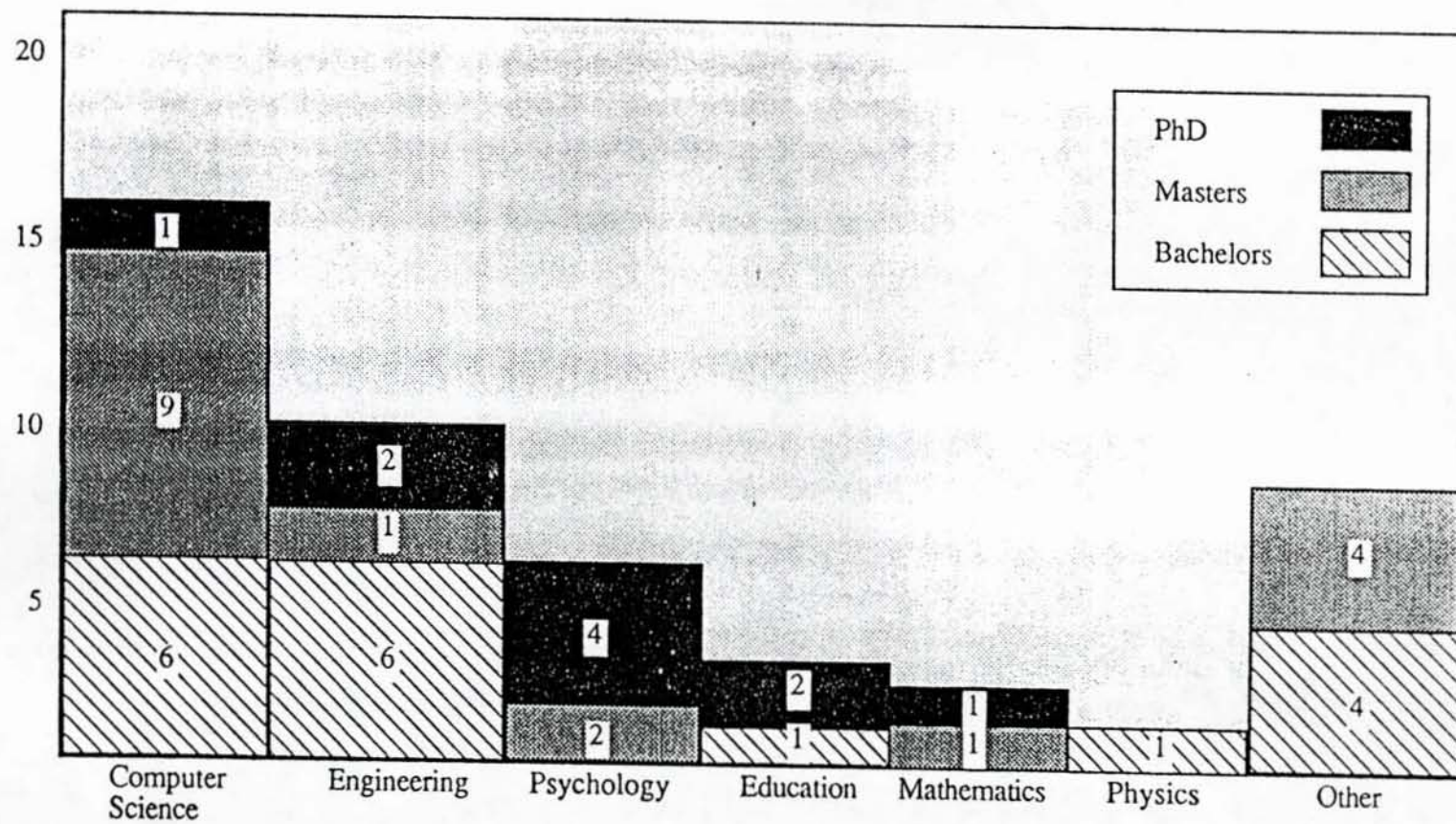


FIGURE 3
IST PROFESSIONAL STAFF BY DISCIPLINES

	Education			Project Exp.				Expertise									
	Doctoral	Master's	Bachelor's	Air Force	Army	Navy	Marine	Operations Research	System Acquisition	Human Performance	Software Development	Logistics	Manpower	Data Base	Personnel	Training	Industrial/Organizational Psy.
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		X	
Peter Kincaid	X			X	X	X	X		X	X		X		X	X		
Bruce McDonald	X			X	X	X		X	X								
Patrick Moskal	X					X				X							X
Oscar Dorr		X		X	X	X					X						
Patsy Anglin		X				X				X			X				X
Rupert Fairfield		X		X	X	X	X		X		X	X			X		
Kevin Ullano		X		X	X				X					X			
Brenda Bradley		X				X	X					X		X	X		
Steven Kass		X			X									X			X
Hyun Kim			X		X			X									X
Mary Ann Frogge			X		X					X							X

FIGURE 4

IST RESEARCH EXPERTISE

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.

3.4.1 Industrial/Organizational Psychology

The Institute for Simulation and Training employs several individuals with extensive experience in the area of Industrial/Organizational Psychology as well as access to the I/O faculty at the University of Central Florida. Personnel in this area include both senior and junior level members of the technical staff. Dr. Michael Companion and Dr. Peter Kincaid hold degrees in Human Factors Psychology, however, they both have experience and training in the area of Industrial/Organizational Psychology. In addition, there are three junior level members of the staff who hold Master's degrees in Industrial Psychology.

Mr. Kevin Uliano has a Master's of Science degree in I/O Psychology from the University of Central Florida and has over six years of experience as a research psychologist working on a variety of behavioral research programs for the Department of Defense. Which include providing technical support to the Visual Technology Research Simulator (VTRS) facility at the Naval Training Systems Center (NTSC). Past projects include designing and producing simulation exercises and assessing potential candidates for managerial selection and training, which requires expertise in assessment center methodology and its application to selection, placement and training procedures.

Mr. Steven Kass also has a Master's degree in I/O Psychology from the University of West Florida and is currently in the process of obtaining his Ph.D. in Human Factors Psychology. 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 extensive experience in the preparation of manuscripts and reports describing research projects. Mr. Kass is a coauthor on several journal articles and several presentations. He has also performed organizational development intervention, and has experience conducting job analyses.

Another individual working at the Institute with I/O Psychology background is Ms. Brenda Bradley, she is currently completing her thesis in I/O psychology for the Master's program at the University of Central Florida. Ms. Bradley has had practical as well as academic experience in the area of training effectiveness evaluation. She has made significant contributions to many proposals and technical reports. She has conducted and participated in experimental and analytic research studies, and actively contributed in the fulfillment of a training system effectiveness evaluation contract for the U.S. Navy. Ms. Bradley was responsible for the design, development, implementation and analysis of empirical and survey studies. She also contributed

in the implementation and analysis of several operational field studies and the development of functional specifications for proposed system changes.

In addition to the IST technical staff, IST has access to the Industrial/Organizational Psychology faculty in the Psychology department at the University of Central Florida. The research experience and interests of the faculty include the following: Assessment Center technology, electronic selection systems, human performance measurement, job analysis/criterion development, selection procedures, performance appraisal issues, and non-traditional work analysis.

3.4.1.1 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.

3.4.1.2 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.

3.4.1.3 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

Data Base 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.

3.4.2 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 eliminate support equipment wherever possible. In particular, it is desirable to eliminate the requirement for special support equip-

ment 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.

3.4.3 Operations Research Techniques

IST in conjunction with the UCF Department of Industrial Engineering can provide any required operations research support necessary for the project. IST has a number of staff members with previous experience in operations research techniques. IST's internal operations research experience focuses on the areas of decision analysis/decision making, simulation,

forecasting, game theory, dynamic programming and network analysis.

Operations research techniques have been utilized in a number of projects at IST, e.g., dynamic programming as an approach to optimized route selection for war gaming simulations and optimization modeling for ASTAR predictive equations. The one previous IST project which was heavily focused on operations research methods was "Cost and Training Effectiveness Research in Support of Simulation and Training Technology" conducted for ARI/PM TRADE. This project involved the development/modification and validation of cost and training effectiveness measures.

3.4.4 Software Development Practices

IST has extensive experience in the development of software for government contracts. IST software development practices embody current software practices for development and documentation of software. Since most of IST's previous activities have been research or prototype oriented, the specific software practices have been tailored to the contract objectives and, therefore, have not always been required to fully comply with government software standards. However, IST currently is under contract to the Naval Air Test Center to develop a simulation test tool which will require tailored compliance with DoD-STD-2167. IST has the knowledge and capability to develop software to government standards as required. Several IST staff members have been involved in programs requiring full compliance with DoD-STD-2167, DoD-STD-2168 and other related government standards prior to joining IST. IST's objective in the area of software development practices is to provide cost-effective software development and maintenance approaches which meet the intent of government standards and customer requirements. The following section provides the minimum standard set of software development guidelines used by IST on contract projects.

3.4.4.1 Software Development

Programming and Documentation Standards

Documentation should conform with the intent of DoD Manual 7935. Developers are encouraged to use computer based documentation for both documentation and code. This allows documentation to be archived along with the source code, providing better long term access.

The primary program documentation is the source code. Hence, it should be well documented. To the maximum extent possible, programmer documentation should be built into the source code. The following three items are recommended for inclusion in the program documentation.

1. Program Header- This section of the source code identifies the program's purpose and functions, version, related files/libraries needed for compilation or linking, and external file usage.

2. Module (Subroutine) Header - Where practical, each program module should contain a description of the module's function and methodology, description of the passed parameters, description of common blocks, and calls by information.
3. A list of modifications made since the previous baseline.

A Software Development Folder should be established at the beginning of the program. All information concerning the development of the program should be included in the software development folder. The software development folder should also include the test plan and test results for the program. If practical, computer copies of the test input and output should be maintained with the source code. The software development folder provides an audit trail for the development and operational verification of the program.

Programming Conventions

The following practices are recommended:

Modular coding - Small single function modules are the biggest contributor to good program development.

Extensive use of internal documentation - This includes the module header information, as well as liberally applied in-line comments.

Off-the-Shelf Routines - To the extent possible available off-the-shelf routines should be used.

DoD and other Standards

The development of the revised ASTAR should meet the intent of DoD-STD-2167A, Defense System Software Development, and DoD-STD-2168, Defense System Software Quality Program. These standards should be tailored to meet the objectives of the project. Tailoring shall follow the guidance of MIL-HBDBK-287, Tailoring Guide to 2167A, and MIL-HBDBK-286, Tailoring Guide to 2168.

The interface development of the revised ASTAR should comply with the guidelines in Section 5.15, User-Computer Interface, of MIL-STD-1472D, Human Engineering Design Criteria for Military Systems, Equipment and Facilities. Further guidance should be taken from Smith and Mosier 1986 "Guidelines for Designing User Interface Software", ESD-TR-86-278.

User Documentation

Computer-based user documentation is strongly recommended. Not only is this form of documentation much easier to maintain, but in many cases, it is much easier to distribute. The user

documentation should include the following information:

1. Where possible, discussion of program assumptions and limitations. This should include limits imposed by dimensioning and memory allocation.
2. Complete description of all user inputs and outputs.
3. List of all error messages, including recommended user actions.
4. Sample data sets and examples.

3.4.5 Data Bases

IST has been heavily involved in a variety of data base development projects for a number of years. One major thrust of IST's data base work has involved visual and terrain data bases for simulation environments. The second thrust of IST's data base activities has been in the development of manpower, personnel and training types of data bases for the DoD Training and Performance Data Center. This work is directly applicable to this sources sought. A brief synopsis of this work is provided in the following sections.

In addition to these basic data base capabilities, Dr. James Ragusa of the University of Central Florida provides IST with expertise in the development and access of mass data base storage technologies, such as video disk, compact disk, or digital interactive video. Dr. Ragusa has been involved in research for NASA on the development of expert system technologies to intelligently access data from these mass storage technologies. Two years ago, under funding from IST, Dr. Ragusa developed the first known successful integration of expert system and video disk technologies. He has successfully implemented a wide variety of rule based expert systems for data base access and is beginning to investigate the application of neural network technology to mass data base access.

3.4.5.1 Defense Training And Performance Data Center

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.

3.4.5.2 Sample Data Base Prototype Development

Under the sponsorship of the Training and Performance Data Center, IST research staff in combination with UCF faculty, students and specialized contractual support implemented the methodology which supplements a fully automated Training and Performance Data Center integrated package. This package satisfies one of the common issues submitted by DOD - the need for information related to the development, acquisition, use and disposal of training simulators and devices. This integrated package was developed by IST in combination with the Training and Performance Data Center in four (4) parts, two of which are the Footprint and Crosswalk projects:

FOOTPRINT - This project led to the development of an automated tool to support training analysis. This tool utilizes existing data bases to quickly define the training related characteristics of existing weapon systems or operational equipment and ultimately identifies associated training programs and equipment.

CROSSWALK - This project led to the development of an automated means that links operational equipment (end-items) with the military occupations needed to operate and maintain them and the military units which utilize them. Crosswalk permits the relating of operational equipment, via occupational specialty, to the associated training program/training equipment.

When completed, the integrated package will consist of a series of data files each related to a specific training equipment functional area and each containing specific linking data elements. In this manner, related information will be contained in manageable data files while complete interface capability will be provided between each of the equipment files. In addition, complete interface will be provided with other Training and Performance Data Center (TPDC) data files as specified within the overall TPDC data management architecture.

The Results

FOOTPRINT - Development of the prototype Footprint for the U.S. Army Enlisted Active and Components has resulted in a growing level of interest in its immediate applications as well as its

longer term potential. specific emphasis has been given to its use and institutionalization within the Army, as well as its development for the Air Force. Presently, IST supports this TPDC project through the development of new report generation routines. These report generation routines may (1) access the existing Footprint reference file, (2) require that additional data elements be added to existing Footprint reference file (possibly requiring the identification of and research into additional data sources), or (3) access other existing TPDC data bases.

CROSSWALK - One of the key files to link existing equipment oriented, Manpower, Personnel, and Training (MPT) oriented, and unit oriented data bases is the equipment-to-occupation Crosswalk data base. When a user needs data to address MPT issues that relate to specific weapon systems/equipment, he or she will need to know which occupations operate and maintain the equipment. Development of this project for the U.S. Army and the resulting data base are called the equipment-to-occupation Crosswalk. Presently, IST supports the existing TPDC Army Crosswalk capability and the prototype development of an automated capability to assemble "Notional" new weapon systems, add component (i.e., sub-end item) level of detail to the Crosswalk data base and an U.S. Air Force Crosswalk capability.

3.4.6 Decision Support Systems

IST has significant experience in the area of decision support system technologies. IST has been involved in both the evaluation and development of decision support systems. IST recently conducted an operational evaluation of a decision support system called ASTAR (Automated Simulator Test and Assessment Routine) for the Naval Training System Center. IST has developed decision support systems, e.g., JULLS (Joint User Lesson Learned System), Footprint, for the DoD Training and Performance Center. Other classes of decision support systems include expert systems to assist in the development of manuals using "Simplified English", intelligent tutoring systems, tactical decision support systems, and intelligent data base retrieval architectures. Additional detail on several IST projects and basic expert system capabilities are provided below.

3.4.6.1 ASTAR Operational Evaluation

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.

The results of the project concluded that ASTAR in its present form is not ready for operational use. However, to support the Navy's needs, IST developed a detailed conceptual design for a revised ASTAR which addressed the deficiencies in ASTAR and achieve operational acceptance.

3.4.6.2 Expert Systems Technologies

IST has been involved in a variety of projects which involve artificial intelligence as it applies to intelligent systems development or decision support systems. These projects have included the development of artificial intelligence front ends to data bases for TPDC to aid in data access, the development of smart targets, research and development in intelligent simulated forces, artificial intelligence tools for terrain data base generation, the development of expert systems concepts related to situational awareness training and artificial intelligence concepts within intelligent tutoring systems, among others. While IST has significant experience in rule-based intelligent systems, IST also has the ability and capability to develop neural network or hybrid expert systems. Dr. Michael Companion has lectured, as part of short course offered by the Georgia Institute of Technology, on technical approaches to modeling of decision making processes. The full range of expert systems technology expertise permits IST to optimize the design of expert systems technologies for any application. The following sections provide brief descriptions of several projects.

3.4.6.2.1 Embedded Training Instructional Technology Research

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.

3.4.6.2.2 Training Technologies for Situational Awareness

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.

4.0 FACILITIES

4.1 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 Laboratory, supplemented by a number of specialized laboratories: Human Performance Modeling Laboratory, Classroom Educational Technology Laboratory, and Team Training Laboratory. While none of these laboratories are specifically associated with the development of decision support systems, three of the laboratories are deeply involved in the development of expert systems technologies relevant to decision support systems. These three laboratories are the Human Performance Modeling Laboratory, the Intelligent Simulated Forces Laboratory, and the Classroom Laboratory. In addition, there are a wide variety of specialized expert system development platforms within the Institute. A brief description of the three related laboratories is provided below.

4.1.1 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.

4.1.2 Intelligent Simulated Forces Laboratory

This laboratory is used to investigate issues related to the implementation of intelligent opposing forces within the simulator networking (SIMNET) environment. Simulated opposing forces would eliminate the need for the massive personnel resources necessary for current opposing force training. Research includes studies of new software and hardware strategies for implementing opposing forces, limiting factors in this technology, and the networking of these elements together. The research in this laboratory is focused on advanced rule based intelligent systems implementations to improve the fidelity and useability of simulated forces models.

4.1.3 Experimental Classroom

The classroom of the future contains sophisticated computer hardware 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 current focus of this laboratory is in the application of artificial intelligence to the educational setting.

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 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 Avilion 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.

4.2 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.

4.2.1 Psychology

Research in the Department of Psychology has included visual simulation training, industrial/organizational issues, 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. The department has a well established graduate program in industrial/organizational psychology. A new doctoral program in Human Factors has been developed as a result of Central Florida's growing needs in simulation and training.

4.2.2 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. An endowed chair is held by a leading authority 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.

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.

4.2.3 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.

4.2.4 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. This department provides an additional source of expertise in operations research techniques which can be accessed by the Institute as necessary.

4.2.5 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.

5.0 FINANCIAL STATUS

IST has experienced steady growth over the last four years. IST funding sources and quantities appear in and Figure 5 and Table II.

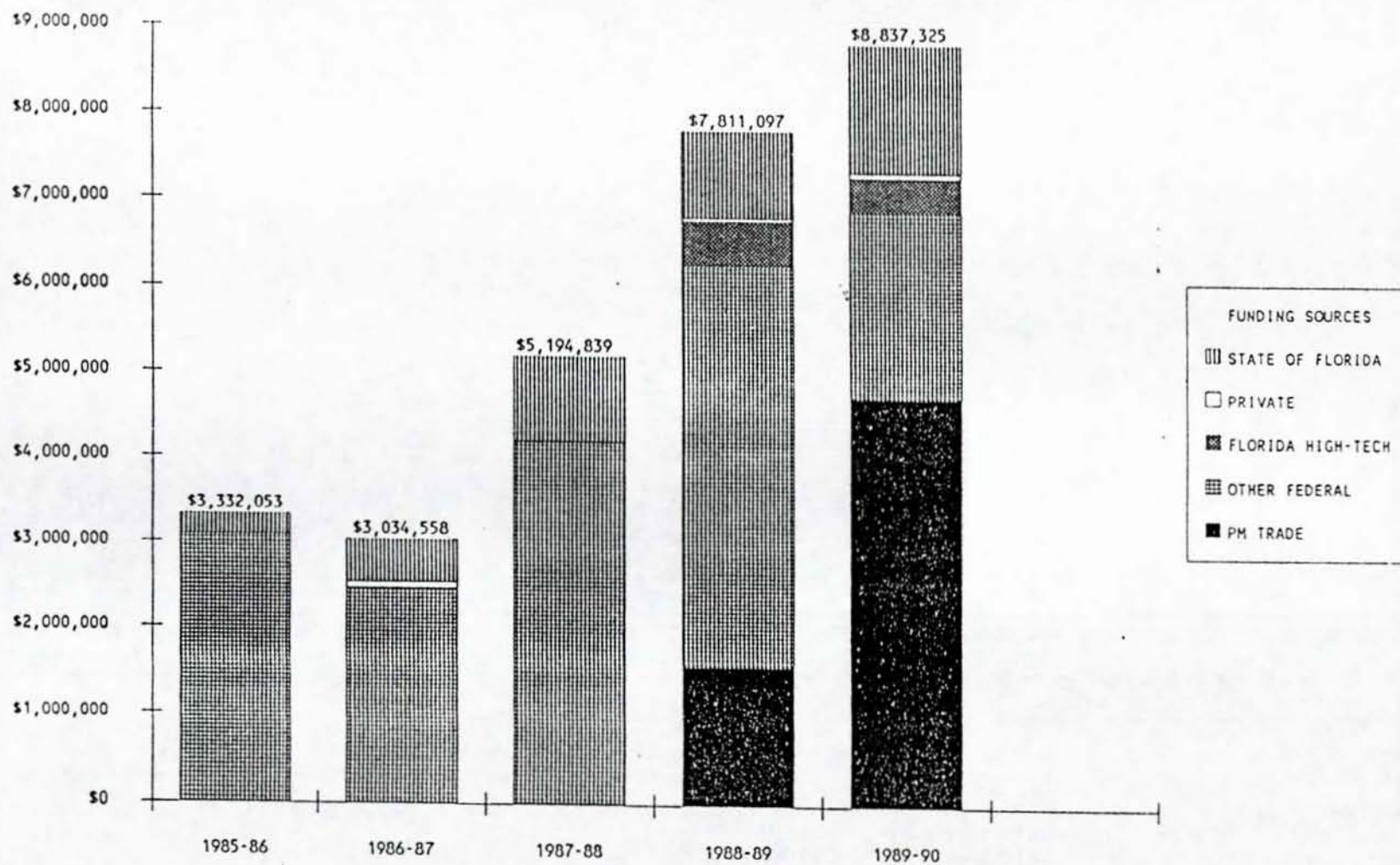


Figure 5
IST FUNDING
FEDERAL, PRIVATE, AND STATE OF FLORIDA

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

6.0 RESUMES OF KEY PERSONNEL

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 Systems Requirements	AAI Corporation
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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 Liaison Officer	Naval Training Systems Center
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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 Iwakuni, Japan	Marine Air base Squadron 15
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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 Aviation Training	Naval Air Systems Command (205)
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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.

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.

PUBLICATIONS

Companion, M.A. ASTAR Operational Evaluation Final Report Volume III: Functional Description. Contract No. N61339-89-C-0029, Naval Training Systems Center, Orlando, Fl. 1990.

Companion, M.A. & Jackson, D.I. Pilot-Vehicle Interface Design for the Pilot's Associate System. Volumes I & II, Contract No. F33615-85-C-3804, Lockheed Aeronautical Systems Company-Georgia, February 1988.

Corso, G.M. & Companion, M.A. Analysis of Display Parameters Affecting Pilot Performance on Manual Flying Tasks, Lockheed-Georgia Engineering Report, LG86ER0191, 1986.

Morrison, J. & Companion, M.A. Human Factors and Artificial Intelligence, Lockheed-Georgia Engineering Report, LG85ER0210, 1985.

Richards, J.M. & Companion, M.A. Computer Aided Design and Evaluation Techniques (CADET): Final Report. (AFFDL F33615-81-C-361), Lockheed-Georgia Company, December, 1982.

Companion, M.A. & Corso, G.M. Task taxonomies: a general review and evaluation. International Journal of Man-Machine Studies, 17, 459-472, 1982.

Companion, M.A. & Sexton, G.A. The role of pilots and automation

in future transport flight stations. Proceedings of the 1982 SAE Aerospace Congress and Exposition Symposium on Behavioral Objectives in Aviation Automated Systems, October, 1982.

Companion, M.A. & Wasson, R.L. Human factors in the application of large screen electronic displays to transport flight station design. Proceedings of the Human Factors Society 25th Annual Meeting, 1981.

Richards, J.M. & Companion, M.A. Computer Aided Design and Evaluation Techniques (CADET): Technical Literature Review. (AFFDL F33615-81-C-3612) Lockheed-Georgia Company, October, 1981.

Companion, M.A. Computerized Workload And Contractor Analysis Techniques, Lockheed-Georgia Reports: Engineering Report, LG80ER0134, 1980.

Companion, M.A. The effect of display load on processing formats in brief visual displays, Doctoral Dissertation, 1978.

Companion, M.A. & Corso, G.M. Task taxonomy: Two ignored issues. Proceedings of the Human Factors Society 21st Annual Meeting, 1977.

Companion, M.A. Display structure as organizational cue in visual information processing, M.A. Thesis, 1976.

Companion, M.A. & Teichner, W.H. Application of task theory to task analysis: Evaluation of validity and reliability using simple tasks, AFOSR F44620-76-C-0013. Las Cruces, New Mexico: New Mexico State University, Department of Psychology, January 1976.

Companion, M.A. Display load in visual search. In Ocular behavior variables and performance during visual search (ARI DAHC19-77-G-0007). Las Cruces, New Mexico: New Mexico State University, Department of Psychology, November, 1978.

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 Psychologist Army Research Institute
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.

EDUCATION: Ph.D. Industrial Engineering,
Texas A & M University, 1973

B.S. Psychology, North Texas State University, 1967

APPLICABLE EXPERIENCE:

Program Manager on research programs in the areas of embedded training, refresher training, low cost training devices and improved educational technology. Program Manager on development of Standard for Inter operability of Defense simulations.

In charge of man/machine interface and instructor support features on internal research and development program for Modular Instructor/Operator Station. Program Engineer on Catapult Launch Systems Trainer program (first Ada-based training system procured by NTSC.) Developed trainer design concept, developed schedule and budget, supervised team of engineers, software analysts and support personnel, presented design at customer reviews and directed filming on board the Aircraft Carrier USS Theodore Roosevelt.

Principal Investigator on Embedded/Organic Training Technology project to develop principles for embedding training in operational equipment. Principal investigator on program to develop improved instructor support features on training device acquisition projects for NAVTRASYSCEN and PMTRADE. Developed procedures for implementing MANPRINT requirements on training device procurement programs for PMTRADE and U.S. Army Human Engineering Laboratory. Member of DOD Human Factors Engineering Technical Advisory Group and Interservice/Industry Training

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.

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: Assistant Prof. (Logistics),
University of Central Florida,
Department of Industrial
Engineering, Brevard Campus

April 1989 to Present: Independent Consultant in Logistics
Certified Configuration Management (CCM)
Certified Data Management (CDM).

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 management 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.

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.

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
 Human Factors Lab

Naval Training Systems
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.

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
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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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