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Statement Of Capabilities For Support Of Research Projects

University of Central Florida Institute for Simulation and Training

Naval Training Systems Center (U.S.)

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Naval Training Systems Center
Code 633
Mr. Paul Morris
October 3, 1990

INSTITUTE FOR SIMULATION AND TRAINING

STATEMENT OF CAPABILITIES
For
SUPPORT OF RESEARCH PROJECTS

iST

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

University of Central Florida
Division of Sponsored Research

Y 03

STATEMENT OF CAPABILITIES
FOR SUPPORT OF RESEARCH PROJECTS

SUBMITTED TO

NAVAL TRAINING SYSTEMS CENTER
12350 RESEARCH PARKWAY
ORLANDO, FLORIDA 32826-3224
ATTENTION: PAUL MORRIS, CODE 633

IN RESPONSE TO

COMMERCE BUSINESS DAILY ANNOUNCEMENT
DATED AUGUST 24, 1990
SOURCES SOUGHT SYNOPSIS
FOR SUPPORT OF RESEARCH PROJECTS

SUBMITTED BY

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

OCTOBER 3, 1990

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1.0 Introduction

1.1 Overview

The University of Central Florida (UCF), Institute for Simulation and Training (IST), is pleased to provide the Naval Training Systems Center (NTSC) Code 633 (Mr. Paul Morris) with this capabilities document in response to the Commerce Business Daily announcement Sources Sought Synopsis: Support of Research Projects dated August 24, 1990. UCF/IST is a university-based laboratory capable of performing research projects and advancing simulation technologies that are related to Army PM TRADE Training needs. UCF/IST possesses the professional skills and laboratory facilities within close proximity to PM TRADE to foster various partnerships between PM TRADE, University and Industry personnel to promote innovation in the application of training systems. The diversity of professionals at UCF, IST, and state universities can be brought together in one location to support the research requirements of PM TRADE.

UCF/IST proposes to provide PM TRADE with an unbiased source to conduct research aimed toward optimizing the acquisition and performance of training systems. 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.

1.2 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.
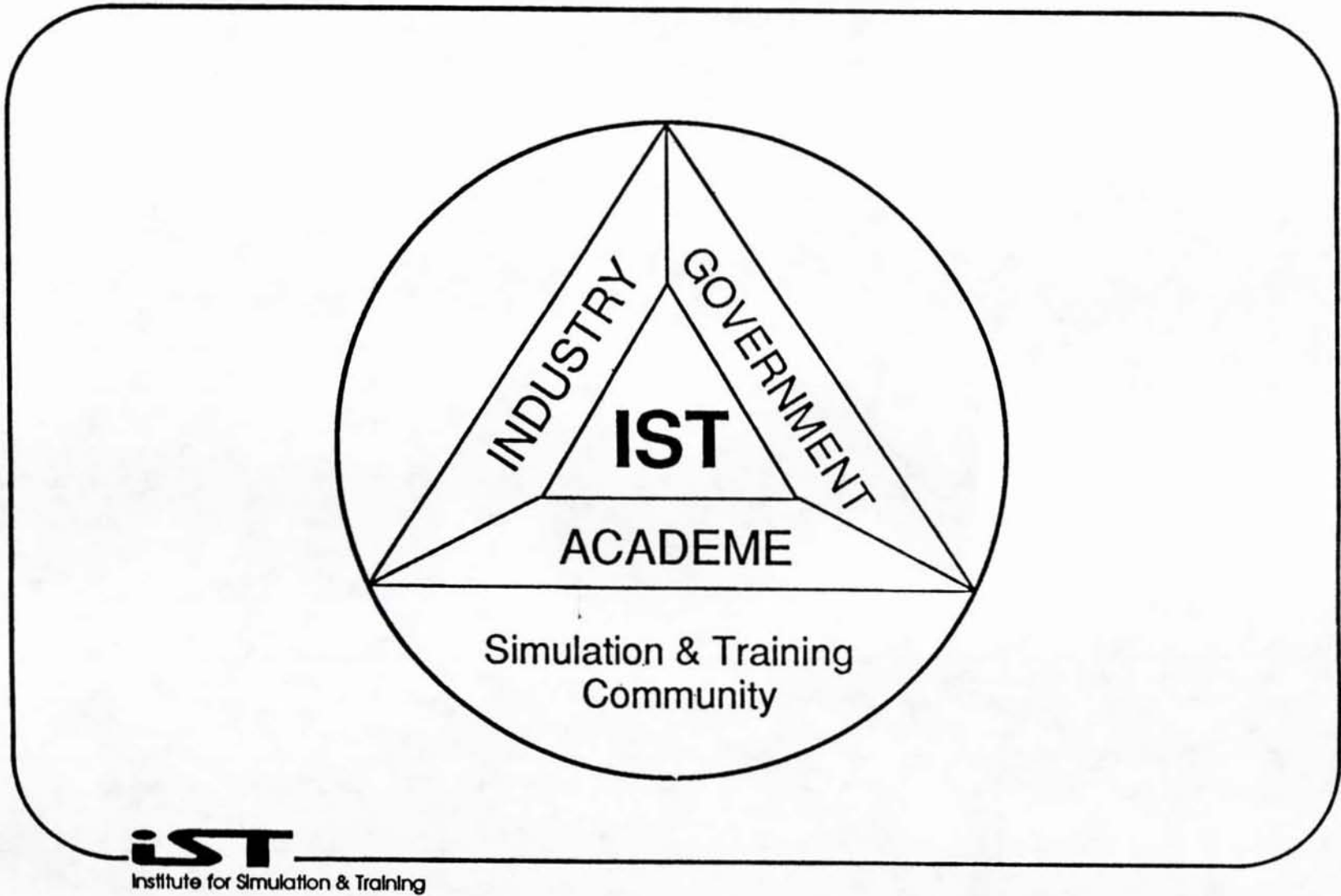
FIGURE 1

NETWORKING BETWEEN IST, GOVERNMENT, ACADEME AND INDUSTRY

1.2.1 Simulation and Training Technologies

IST is currently conducting a continuing surveillance and assessment of simulation and training technologies under contract to PM TRADE. This effort is in coordination with industry, other universities and government laboratories. We have gathered a large number of technical documents in the Fields of Endeavor below:

- Real-time Man-in-the-Loop Simulation Technology
- Low Cost/Complexity Training Simulation Technology
- Engagement Simulation and Instrumentation Technology
- Artificial Intelligence and Interactive Informational Processes

Scientists and engineers at IST are reviewing these documents and assessing their impact on the above Fields of Endeavor in the near and long term future.

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

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

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

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

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- 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 laboratories:

- PM TRADE

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- USA HEL
- NTSC
- Naval Air Test Center
- NASA Ames
- ARI Ft. Rucker
- Naval Oceans Systems Center
- SIMNET D Site Ft. Knox
- USA CECOM
- USA ETL
- USA DCA

1.2.2 Interdisciplinary Research

IST is currently conducting interdisciplinary simulation and training research involving the physical, engineering, behavioral and computer sciences. Table I lists IST personnel and their academic training. Note that IST has personnel with training in all four of the sciences listed above. In addition, IST has access to personnel in other institutes and academic departments at UCF as well as other universities. Table II lists IST current and past projects and which of the above sciences were involved in their execution.

1.2.3 Areas of Research

In addition to conducting an assessment of the simulation and training technologies listed in 1.2.1, IST is currently performing research in these areas. Table III contains a list of current and recently completed IST projects and an indication of where in this document the reader will find a description of the project. Table IV lists the PM TRADE Fields of Endeavor and indicates which projects impact that particular field. Table V lists the Fields of Endeavor and indicates which IST personnel have experience and training in each of these fields. Table VI lists the Fields of Endeavor and indicates which IST laboratories are equipped to do research in each field. Detailed descriptions of each of these laboratories are located in the document as indicated below:

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UCF/IST's research is further supported by the Center for Research in Electro-Optics and Lasers (CREOL) and our newly founded Center for Applied Human Factors in Aviation (CAHFA).

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Table I

IST RESEARCHERS AND TECHNICAL EXPERTISE

NAME	DEGREE	AREA OF HIGHEST DEGREE	SCIENCE			
			Physical	Engineering	Behavioral	Computer
Patsy Anglin	M.S.	Computer Science				●
Bill Bramble	Ph.D.	Educational Research			●	
Thomas Carolan	M.A.	Experimental Psychology			●	
Thomas Clarke	Ph.D	Applied Mathematics	●			
Michael Companion	Ph.D	Engineering Psychology			●	
James Cossin	B.S.	Statistics	●			
Richard Dunn-Roberts	B.S.	Computer Science				●
R. E. Fairfield	M.A.	Military Art & Science			●	
Robert Glasgow	B.S.	Industrial Engineering		●		
Brian Goldiez	M.S.	Eng. Math/Computer Sci.		●		
Gilbert Gonzalez	B.S.	Computer Engineering				●
Lucille Haddad	B.S.	Computer Science				●
Amy Vanzant-Hodge	M.S.	Computer Science				●
David Hosley	Ed.D.	Educational Admin.			●	
Kevin Kearns	B.S.	Computer Science				●
Peter Kincaid	Ph.D.	Industrial Engineering			●	
Ronald Klasky	M.S.	Computer Science				●
Janice Kuehne	B.S.	Experimental Psychology				●
Kuo-Chi Lin	Ph.D.	Computer & Info. Science		●		
Michael LoMurro	B.S.	Computer Science	●			
Margaret Loper	B.S.	Aerospace Engineering		●		
Marie Martling	B.S.	Physics				●
Bruce McDonald	Ph.D.	Electrical Engineering		●		
Michael Moshell	Ph.D.	Computer Science				●
Patrick Moskal	Ph.D.	Experimental Psychology			●	
Daniel Mullally	M.A.	Human Resource Mgmt.			●	
Ruey Ouyang	M.S.	Computer Science				●
Chris Pinon	M.S.	Mathematics	●			
Duane Schultz	B.S.	Political Science			●	
William Shaffer	M.A.	Business Mangement			●	
David T. Shen	M.S.	Computer Engineering				●
Ernest Smart	B.S.	Education			●	
Scott Smith	M.S.	Computer Science				●
Larry Springer	M.A.	Human Resource Mgmt.			●	
Jack Thompson	B.S.	Electrical Engineering		●		
Kevin Uliano	M.S.	Industrial Psychology			●	
David Van Brackle	M.S.	Computer Science				●
Les Vaughan	B.S.	Electrical Engineering		●		
Kent Williams	Ph.D.	Cognitive Psychology			●	
Douglas Wood	B.S.	Computer Science				●
CREOL			●	●		●
CAHFA					●	
Other UCF			●	●	●	●
Other Universities			●	●	●	●

Table II
IST Projects and Sciences Involved

Project	Science			
	Physical	Engineering	Behavioral	Computer
Simulation Networking - Modeling & Monitoring		●		●
Networking Protocol Alternatives		●		●
Modeling and Performance Evaluation of Simulation Networks Using Petri Nets		●		●
Interoperability of Network Standards		●	●	●
Training Technologies Integration	●	●	●	●
Unit Performance Assessment System Test Bed		●	●	●
Tactical Electronics Simulation Test System	●	●		●
MANPRINT Decision Options			●	
Team Training Test Bed			●	●
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 Animated Technology to the Training of Multidimensional Concepts			●	●
Application of RISC Processor Technology to Training Simulators		●		●
Terrain Data Bases for Simulation		●		●
Classroom of the Future		●	●	●
Visual Display Technology - Terrain Display				●
Computer Animated Films for Training and Simulation			●	●
Visual Database Technology - Databases				●
Action Graphics: Constraint-Based Declarative Programming for Modeling Complex Motions				●

0099-1244

Table III

IST Project Descriptions

Table IV
Fields of Endeavor Impacted by Projects

Projects (See Table III)

Fields of Endeavor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	22	23
(Fields of Endeavor)	●	●	●	●	●	●	●		●					●	●	●	●	●	●	●	●	●	●	●
Real Time Man-in-the-Loop Simulation Technology																								
Simulation Networking	●	●	●	●	●	●																		
Battlefield Simulations	●			●	●	●								●						●				
Modular Design Standards				●	●									●			●							
Std. Reuseable, Rapidly Reconfigurable Data Base				●	●										●			●		●		●		
Visual Simulation Technology					●										●	●	●	●	●	●	●	●	●	●
Visual Presentation Technology				●	●											●	●	●		●	●	●	●	●
Visual Performance and Cost					●										●	●		●	●	●		●	●	
Mission Rehearsal					●										●					●		●		
Team Training				●	●				●															
Standardization				●	●																			
Software Development Technology					●									●							●	●	●	●
Advanced Distributed Simulation	●	●	●	●	●	●														●				
Embedded Training					●																			
Low Cost, Complexity Training Simulation Technology					●				●	●	●		●					●	●	●	●			
Test Bed for Cost/Training Effectiveness Evaluation					●					●	●							●	●	●	●			

0999-1237

Table IV (Cont'd)
Fields of Endeavor Impacted by Projects

Projects (See Table III)

Fields of Endeavor	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	22
Man-System Interface Representation and Simulation					●			●	●	●	●	●	●		●				●	●	●		
Generic, Reconfigurable Designs					●																		
Novel Techniques for Low Fidelity Training Devices					●			●		●	●	●	●		●				●	●	●		
Table Top/Part-Task Trainers					●				●	●									●				
Engagement Simulation and Instrumentation Technology					●		●																
Pairing Systems					●																		
Range Instrumentation					●		●																
Targets					●																		
Robotics (OPFOR)					●																		
Artificial Intelligence and Interactive Informational Processes					●	●	●				●	●	●		●				●		●		
Automated Instructional Process					●							●	●						●				
Job Aiding					●		●				●								●				
Natural Language Interfaces					●																		
Voice Technology					●							●									●		
Instructor Support Systems					●	●							●						●				
Simulated Forces					●																		
Neural Network Technology					●										●								
Distributed Training					●	●																	
Experimental Classroom					●							●	●		●				●				

0099-1238

Table V
Fields of Endeavor Experience of IST Personnel

Fields of Endeavor	Patsy Anglin	Bill Bramble	Thomas Carolan	Thomas Clarke	Michael Companion	James Cossin	Richard Dunn-Roberts	R.E. Fairfield	Robert Glasgow	Brian Goldiez	Gilbert Gonzalez	Lucille Haddad	Amy Vanzant-Hodge	David Hosley	Kevin Kearns	Peter Kincaid	Ronald Klasky	Janice Kuehne	Kuo-Chi Lin	Michael LoMurro	Margaret Loper	Marie Martling	Bruce McDonald	Michael Moshell	Patrick Moskal	Daniel Mullally	Ruey Ouyang	Chris Pinon	Duane Schultz	William Shaffer	David T. Shen	Ernest Smart	Scott Smith	Larry Springer	Jack Thompson	Kevin Uliano	David Van Brackle	Les Vaughan	Kent Williams	Douglas Wood	Other Resources	CREOL	CAHFA	UCF	Other Fla. Univ.
Real Time Man-in-the-Loop Sim. Tech.	•		•		•		•	•	•	•				•			•				•		•	•	•	•	•	•	•				•	•	•	•			•	•				•	•
Simulation Networking					•	•															•		•			•	•						•		•					•				•	•
Battlefield Simulations																																					•							•	•
Modular Design Standards							•										•																•											•	•
Std. Reuseable, Rapidly Reconfig. D. B.							•										•							•																				•	•
Visual Simulation Technology — Visual Pres. Tech.							•										•							•																				•	•
Visual Perf. and Cost							•										•							•																				•	•
Mission Rehearsal							•										•							•																				•	•
Team Training					•			•						•												•			•				•		•									•	•
Standardization							•		•	•							•				•		•	•			•						•		•					•				•	•
Software Devel. Technology	•																							•																				•	•
Advanced Distrib. Simulation							•		•	•							•				•		•	•		•	•						•		•					•				•	•
Embedded Training	•	•																						•															•					•	•

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Table V (Cont'd)
Fields of Endeavor Experience of IST Personnel

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Fields of Endeavor	Patsy Anglin	Bill Bramble	Thomas Carolan	Thomas Clarke	Michael Companion	James Cossin	Richard Dunn-Roberts	R. E. Fairfield	Robert Glasgow	Brian Goldiez	Gilbert Gonzalez	Lucille Haddad	Amy Vanzant-Hodge	David Hosley	Kevin Kearns	Peter Kincaid	Ronald Klasky	Janice Kuehne	Kuo-Chi Lin	Michael LoMurro	Margaret Loper	Marie Martling	Bruce McDonald	Michael Moshell	Patrick Moskal	Daniel Mullally	Ruey Ouyang	Chris Pinon	Duane Schultz	William Shaffer	David T. Shen	Ernest Smart	Scott Smith	Larry Springer	Jack Thompson	Kevin Uliano	David Van Brackle	Les Vaughan	Kent Williams	Douglas Wood	Other Resources	CREOL	CAHFA	UCF	Other Fla. Univ.
Low Cost, Complexity Trng. Sim. Tech.	•	•	•	•	•		•			•	•		•	•		•	•		•				•	•	•	•							•		•	•		•	•	•		•	•	•	•
Test Bed for Cost/Trng Effect. Eval.	•	•	•	•			•			•							•		•				•	•	•								•		•	•		•	•	•				•	•
Man-System Interface Rep. and Sim.	•		•		•												•		•				•	•	•												•	•	•				•	•	•
Generic, Reconfigurable Designs							•			•														•									•					•						•	•
Novel Techniques for Low Fid. Trng Dev.	•		•	•	•		•			•							•		•				•	•	•	•							•		•	•		•	•				•	•	•
Table Top/Part-Task Trainers	•		•	•	•		•										•		•				•	•	•	•										•		•						•	•
Engagement Sim. and Instrumentation Tech.											•		•											•									•						•				•	•	•
Pairing Systems																																										•		•	•
Range Instrumentation																																										•		•	•
Targets																																										•		•	•
Robotics (OPFOR)											•		•											•									•							•				•	•

0099-1234

Table V (Cont'd)
Fields of Endeavor Experience of IST Personnel

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Fields of Endeavor	Patsy Anglin	Bill Bramble	Thomas Carolan	Thomas Clarke	Michael Companion	James Cossin	Richard Dunn-Roberts	R. E. Fairfield	Robert Glasgow	Brian Goldiez	Gilbert Gonzalez	Lucille Haddad	Amy Vanzant-Hodge	David Hosley	Kevin Kearns	Peter Kincaid	Ronald Klasky	Janice Kuehne	Kuo-Chi Lin	Michael LoMurro	Margaret Loper	Marie Martling	Bruce McDonald	Michael Moshell	Patrick Moskal	Daniel Mullally	Ruey Ouyang	Chris Pinon	Duane Schultz	William Shaffer	David T. Shen	Ernest Smart	Scott Smith	Larry Springer	Jack Thompson	Kevin Uliano	David Van Brackle	Les Vaughan	Kent Williams	Douglas Wood	Other Resources	CREOL	CAHFA	UCF	Other Fla. Univ.
Artif. Intell. and Interactive Inform. Proc.	•	•	•	•	•		•	•	•	•	•		•			•	•				•		•		•	•	•	•	•				•		•	•		•	•	•			•	•	•
Automated Instructional Process	•		•		•											•							•		•											•		•	•					•	•
Job Aiding				•												•							•													•			•				•	•	•
Natural Language Interfaces				•	•											•																											•	•	•
Voice Technology					•											•																											•	•	
Instructor Support Systems	•		•		•		•									•							•		•											•		•	•				•	•	•
Simulated Forces										•			•													•							•							•				•	•
Neural Network Technology				•	•																																							•	•
Distributed Training		•					•			•	•							•					•	•		•	•	•					•	•						•				•	•
Experimental Classroom	•		•		•											•							•		•													•	•					•	•

0099-1235

Table VI (Cont'd)
Fields of Endeavor Impacted by Laboratories

Fields of Endeavor	Networking	Intelligent Simulated Forces	Low Cost Aviation Trainer	Visual Systems	Low Cost Simulator Test Bed	Team Training	Language Technology	Mathematical Simulation	Experimental Classroom	Human Performance Modeling	Classroom Educational Technology	Other UCF	Other Florida Universities
Man-System Interface Representation and Simulation			●	●	●					●	●	●	●
Generic, Reconfigurable Designs	●				●					●	●	●	●
Novel Techniques for Low Fidelity Training Devices			●	●	●					●	●	●	●
Table Top/Part-Task Trainers											●	●	●
Engagement Simulation and Instrumentation Technology		●										●	●
Pairing Systems												●	●
Range Instrumentation												●	●
Targets												●	●
Robotics (OPFOR)		●										●	●
Artificial Intelligence and Interactive Informational Processes	●	●	●	●	●	●	●	●	●	●	●	●	●
Automated Instructional Process							●	●	●	●		●	●
Job Aiding							●			●	●	●	●
Natural Language Interfaces							●		●	●	●	●	●
Voice Technology							●					●	●
Instructor Support Systems							●		●		●	●	●
Simulated Forces		●										●	●
Neural Network Technology								●	●			●	●
Distributed Training	●	●	●	●	●	●	●					●	●
Experimental Classroom									●		●		

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1.2.4 Points of Contact

Table VII contains a list of IST projects and points of contact.

1.2.5 Financial Capabilities

IST financial capabilities appear in Section 6.0 of this document.

Table VII

Persons to Contact

Project(s)	Agency	Name	Phone No.
Networking	DARPA	Major J. Wargo	(703) 528-5906
	PM TRADE	Mr. G. Wiehagan	(407) 380-4357
Visual Systems	PM TRADE	Mr. R. Green	(407) 380-4354
	ETL	Mr. G. Lukes	(202) 355-2818
	DARPA	Lt.Cmdr. D. McBride	(703) 528-5906
Low Cost Aviation	DARPA	Lt. Cmdr. D. McBride	(703) 528-5906
	PM TRADE	Mr. R. Green	(407) 380-4354
Intelligent Simulated Forces	DARPA	Lt. Cmdr. D. McBride	(703) 528-5906
	PM TRADE	Mr. R. Paulson	(407) 380-4362
Interoperability of Network Standards	DARPA	Major J. Wargo	(703) 528-5906
	PM TRADE	Mr. G. Wiehagen	(407) 380-4357
Technology Integration	PM TRADE	Mrs. C. Fisher	(407) 380-4348
Distributed Laboratories	PM TRADE	Mr. R. Green	(407) 380-4354
In House and FHTIC	IST	Dr. Bruce McDonald Mr. Ernie Smart	(407) 658-5014
UPAS	ARI	Dr. L. Meliza	(407) 380-4374
Tactical Electronic Simulation Test System	NAVAIR	Cmdr. G. Mikolai	(301) 863-3167
	NTSC	Mr. M. Smith	(407) 380-8590
MANPRINT Decision Option	HEL	Dr. A. Galbavy	(407) 380-4325
Team Training	NTSC	Dr. E. Salas	(407) 380-4651
Training Transfer in Tank Gunnery	ARI	Dr. J. Boldvici	(407) 380-4196
Cost & Training Effectiveness	ARI	Dr. M. Singer	(407) 380-4387
Intelligent Tutoring	NTSC	Dr. R. Reynolds	(407) 380-4739

2.0   Description of Organization

Since the Institute became a reality, the Institute 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 Research Park represents the largest concentration of simulation and training technology in the country.

2.1   Mission

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

2.2   Objectives

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

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

2.3   Goals

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

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

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- 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.

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The following IST policies illustrate this philosophy:

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
- On-site ADP capability for electronic communications with PM TRADE data sources and contract performance
- 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
- Frequent interface with PM TRADE COTR to assure effective coordination and performance
- Quality control in accordance with sound research practices

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                              ┌─────────────────┐
                              │  Vice President │
                              │       for       │
                              │    Research     │
                              │                 │
                              │    M. Bass      │
                              └────────┬────────┘
                                       │
                              ┌────────┴────────┐
                              │       IST       │
                              │    Executive    │
                              │    Director     │
                              │                 │
                              │   A. L. Medin   │
                              └────────┬────────┘
   ┌──────────────────┐                │
   │ Industrial Advisory│- - - - - - - -│
   │       Board       │                │
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Director Research & Development	Director Operations	Program Manager TPDC Projects	Manager Advanced Applications	Manager Special Programs
B. Goldiez	D. Beistel	D. Schultz	E. Smart	S. Fairfield

Director Research & Development
- General Research
- Engineering Research
- Cognitive Research
- Hi Tech Research

Director Operations
- Contracts Management
- Fiscal Management
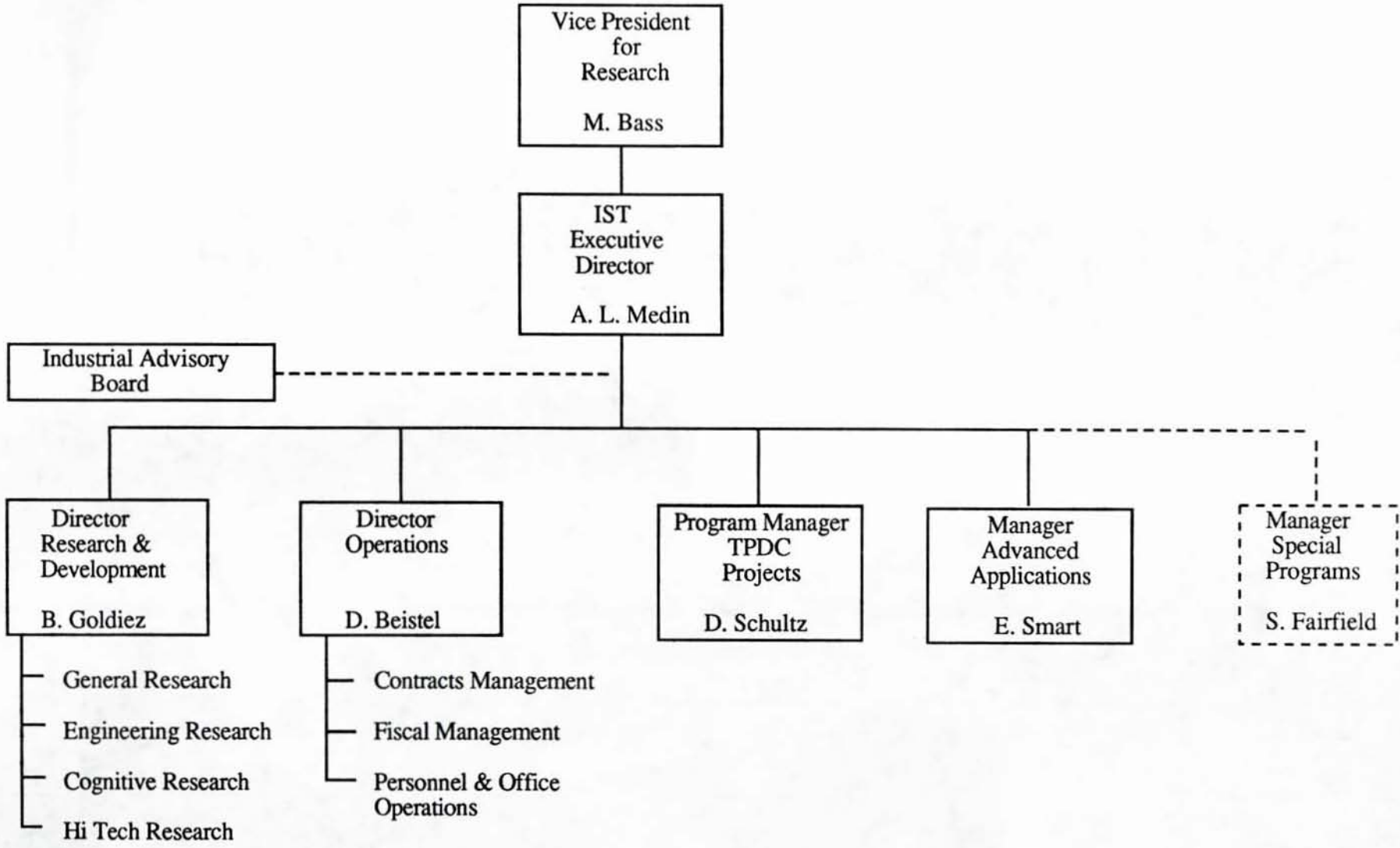- Personnel & Office Operations

FIGURE 2

IST ORGANIZATION

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 PM TRADE's simulation and training research. The following benefits provide "value added" to the 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 two-fold 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,

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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. A brief summary for each of the projects is located in Section 5.0.

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 seventeen research grants in the following areas:

- Parallel Computation in Simulation: Architecture and Algorithms
- Human Factors Designs Utilizing Advanced Simulation
- Application of Statistical Techniques to Improved Automated Keywording Systems
- Training Systems for Mechanical Engineering Design
- Use of Surrogate Measurements for the Prediction of Flight Training Performance
- Cognitive Processing of Synthetic Speech
- Implementation of Computer Graphics for Flight-Training Simulators Using Systolic Arrays
- Studies of Team Training: Identifying Targets for Team Skills Training
- Analytical and Simulation Models of Distributed and Local Area Networks
- Spectral Simulation of Infrared Scenes
- Advanced Training Algorithms for Neural Networks
- Interfacing and Using Small AI Expert systems with Interactive Laser-Optical Technology
- Quantitative Analysis of Manprint Decision Options

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3.3 Donated Hardware and Software

- IST has substantial donated resources that are being used in support of military contracts. These resources are described in Section 4.0.
- Hardware - approximately $2.5 million in Image Generators, Simulation Computers, and Workstations.
- Software - approximately $300,000 in latest software, most of it in the Visual Lab and Experimental Classroom.

3.4 Location

Being co-located with PM TRADE in the Central Florida Research Park has several advantages.

- Communications:

    - Frequent (sometimes daily) interface and exchange of information with key personnel, either at IST's or PM TRADE's location.
    - Frequent interaction with local simulation and training activities, UCF faculty, students, and IST researchers.

- Availability of laboratories for use by PM TRADE engineers and ARI behavioral scientists.

- A showplace for PM TRADE to bring distinguished, military (US and Allies) and non military visitors at the national and state levels. Visitors in the past three years have included:
    - 4 Representatives
    - Several Congressional Staffers;
    - Military officers:
        - 3 four star
        - 5 three star
        - 6 two star
        - 3 one star
    - Representatives from:
        - the UK MOD (United Kingdom Ministry of Defense)

- Australian Army
- German Army
- Swiss Army
- Brazil
- Sweden
- France

• Visiting Research Scholar's Program where each service will have a research scholar located at the Institute. These scholars are conducting research, teaching, and providing a joint military thrust to the simulation and training technologies to be researched.

3.5 Technology Transfer

Information derived from studies and experimental research will further the technology state-of-the-art for the military and industry alike. It is anticipated that a free flow exchange of information could take place to the mutual benefit of industry and the military. Figure 3 shows schematically how this would take place. UCF/IST would ensure the safeguarding of any proprietary data coming under its purview.

3.6 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.

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.
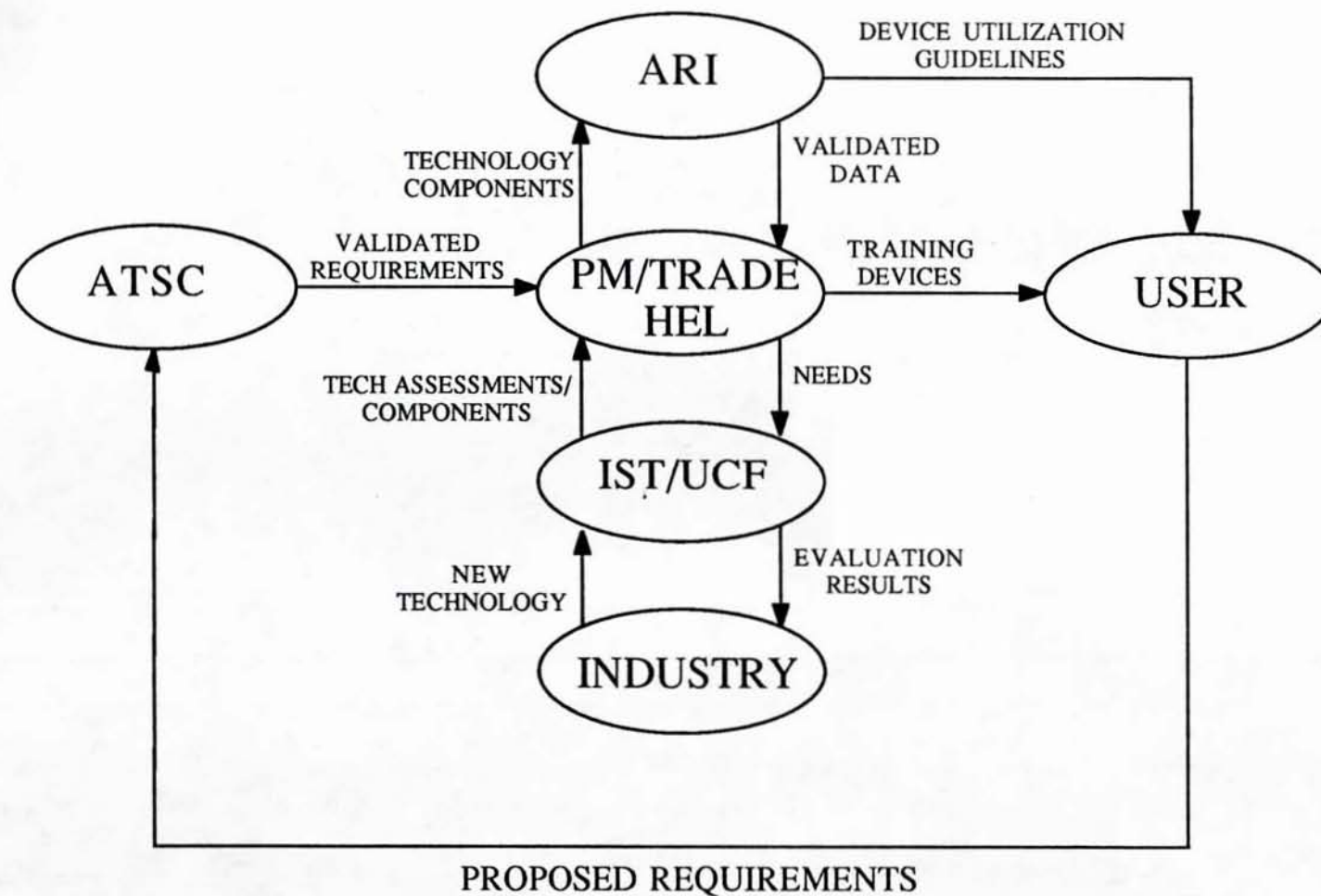
TECHNOLOGY TRANSFER

FIGURE 3
Information Flow Between IST, Government and Industry

IST's research staff consists of over 200 research scientists, faculty, and students, in addition to support personnel (See Figure 4). Their diverse backgrounds provide the necessary technical expertise to work on projects in key technologies that are the basis of simulation and training research.

3.7 National and Industrial Relationships

In new technologies to support simulation and training, UCF/IST has formed research and development partnerships with some of the leading researchers in academia and industry. These symbiotic relationships are critical if technology is to transfer from experimental and prototype form into operational use. Some of the institutions and corporations involved with UCF/IST include:

- Georgia Tech Research Institute (GTRI)
- Evans & Sutherland
- Harris
- Perceptronics
- BDM Corporation
- Martin Marietta
- University of Iowa
- University of South Florida
- Carnegie-Mellon University
- IBM
- General Electric
- Westinghouse
- BBN

IST has collaborative agreements existing or in process with the USAF Human Resources Laboratory at Williams AFB, NTSC, HEL, GTRI, University of Iowa, CMI, Martin Marietta and McDonnell Douglas Helicopter (MDH) at Mesa, Arizona. In addition, IST is in the final preparation of establishing a long haul networking capability with MDH and Navy NOSC.
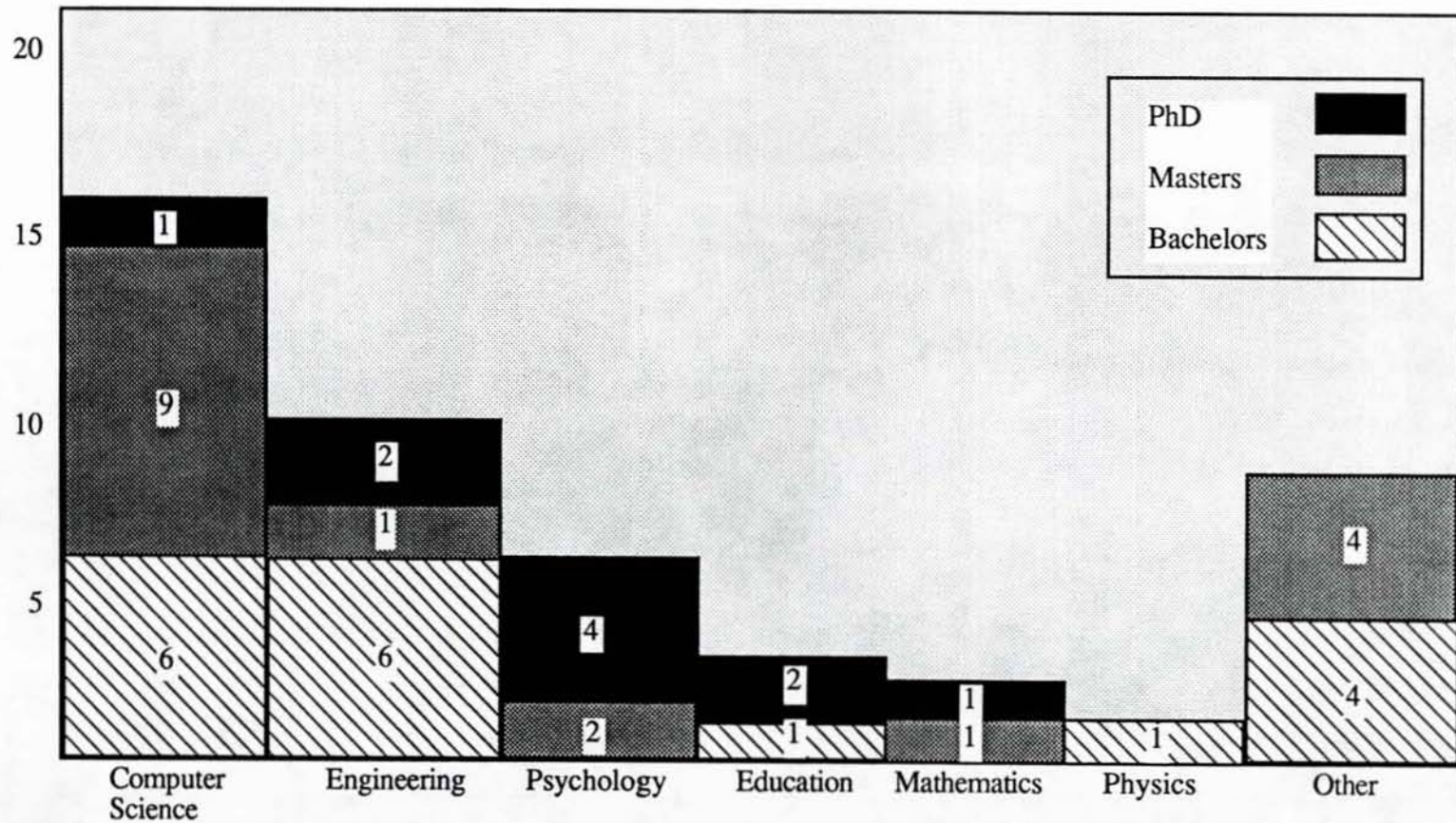
FIGURE 4

IST PROFESSIONAL STAFF BY DISCIPLINES

4.0 IST General Facilities

The University of Central Florida, Institute for Simulation and Training (IST) is situated in the Central Florida Research Park in Orlando, Florida. The Research Park is located adjacent to the University of Central Florida campus. IST is located in the Research Pavilion, adjacent to PM TRADE and the Naval Training Systems Center. IST's facilities include over 19,000 square feet of office space and approximately 8,000 square feet of research laboratory space.

IST's facilities contain modern telecommunications capabilities for voice and data. In addition, meeting facilities are available at IST or at UCF which can accommodate various size groups. IST has a self contained capability for the generation of graphics using various media and has the ability to generate small quantities of documents. Larger documentation requirements are easily accommodated at UCF.

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 internally or externally so that data and results can be shared. Each of IST's laboratories are networked by Ethernet and have been designed to be modular and easily reconfigurable. This feature allows IST to configure its laboratories quickly to meet varied customer needs. This capability has been demonstrated on several occasions when specific demonstrations or classes have used the laboratories. In addition, the laboratories have the ability to link remotely to other laboratories. Linkage can be accomplished through several means: by use of the UCF Mainframe, by modem connection, through an 800 number modem connection, by a BBN Butterfly Gateway, and through a commercial gateway currently being procured by IST.

The research facilities of IST currently consist of eleven separate laboratories:

- Networking and Communications Technology Laboratory
- Intelligent Simulated Forces Laboratory
- Visual Systems Laboratory
- Low Cost Aviation Trainer Laboratory

- Team Training Laboratory
- Low Cost Simulator Testbed Laboratory
- Language Technology
- Human Performance Modeling Laboratory
- Experimental Classroom of the Future
- Classroom Educational Laboratory
- Mathematical Simulation Laboratory

The hardware, software, and equipment in the laboratories have been funded by UCF, IST, PM TRADE, DARPA, NTSC, grants, and industry. All of it is the latest state-of-the-art.

IST has several major pieces of hardware which are shared by more that one laboratory. These include, a suite of hardware from DEC, the SIMNET hardware, the Evans and Sutherland ESIG 500 HTL, and the Harris Night Hawk Computer System. These major pieces of equipment are accessed through appropriate software or hardware interfaces to support specific laboratory needs.

The ESIG 500 HTL, Harris Night Hawk Computer System, and DEC Computer Network also provide facilities for general purpose research and specific research projects. The ESIG 500 HTL is being used to study methods to enhance data base generation methods, to study correlation, and as a classroom tool in computer graphics. The Harris Night Hawk, a recent donation to IST, provides IST with state-of-the-art, real-time computing power. The system will be used to rehost existing software at IST and to address real-time computing research pertinent to the simulation and training community. The DEC computer system is the key part of IST's Classroom Educational Laboratory. This system will host advanced educational software under development at IST. The DEC system is also being used in a classroom environment.

IST's laboratories serve several purposes. General purpose equipment is available for basic research. New systems, ideas, or theories can be prototyped and evaluated in IST's laboratories. Test beds are available for various purposes. Detailed examples of IST laboratory activities can be found in subsequent sections of this capabilities document.

Hardware basic research is IST's smallest laboratory activity. Because simulation and training is primarily an importer of hardware technology. An example of equipment to support basic

research, the Classroom of the Future contains DEC and Data general computing resources. These general purpose computing systems support basic research in learning theory and teaching methods. Likewise, the NeXT computer support basic research in mathematics research related to simulation and language research.

Prototyping new concepts consumes the largest part of IST's laboratory assets. Examples include using the SIMNETs to evaluate various network topologies, prototyping various components of an automated force for evaluation purposes, and developing of methods to create dynamic terrain for computer image generation systems.

Test beds are an ever expanding part of IST's laboratories. Current test beds support evaluation of low cost flight simulation, evaluation of the networking standard for interoperability of simulations, and a set of test beds to support research on interactive simulated forces. SIMNET is also used as a testbed to generate data and evaluate concepts in networking and visual systems technology.

Several IST laboratories make use of SIMNET hardware on loan from PM TRADE . The focus of SIMNET research is on developing the technology to allow combat teams to practice critical combat skills that are more expensive, or too dangerous, or even impossible to practice in peacetime. A major part of the research carried on at IST is associated with the networking of simulators. This research is focused on development of the technology and procedures that will allow dissimilar simulators to interact on the same electronic battlefield regardless of their location or type. The SIMNET hardware at IST is also used in research related to representation of simulated forces produced directly from SIMNET or from an IST-developed automated opposing force. IST's laboratories are networked together by Ethernet as shown in Figure 5.

Ultimately this research will be directed toward four areas:

1. A testbed for establishing or validating - bench marks, protocols, advanced networks/concepts (such as FDDI), computer generated forces, interoperability standards for dissimilar simulators; and for providing a neutral node for industry, academia, and government laboratories to use for evaluating or validating their prototypes, concepts.

Experimental Classroom	13 - VaxStation 3100

Mathematical Simulation Lab	2 - NeXT 3 - IPM PC

Visual Systems Laboratory	2 - Sun SparcStations 4 - Silicon Graphics Irises 1 - VaxStation 3100 1 - NeXT 1 - E&S ESIG-500, 2 channels

Network Communications Laboratory	7 - HP PCs 2 - SparcStations 2 - Motorola VME systems

Intelligent Simulated Forces Lab	5 - HP PCs 1 - Symbolics 3650 2 - MassComps 1 - Mips M/2000

Trainer & Cockpit Laboratory	2 - Perceptronics ASATs

UCF Campus

16-node Butterfly
Harris HCX-9
... etc ...

Internet

Realtime
Ethernet

LHN Gateway

MCC (MassComp)

M1A1 SIMNET

M1A1 SIMNET

.... Serial ASCII
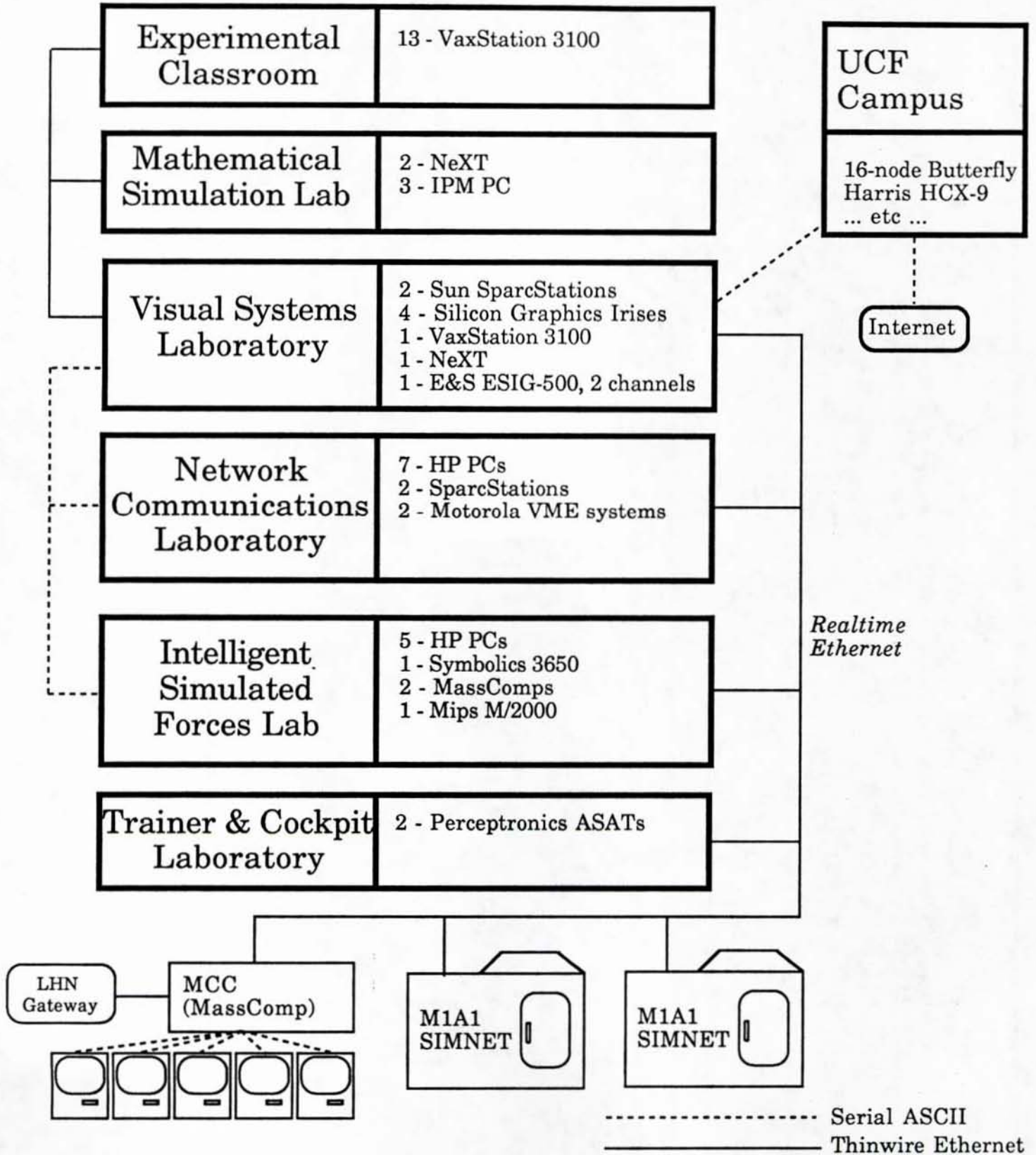
———— Thinwire Ethernet

FIGURE 5

IST's Networked Laboratories

2. A "simulate before you build" capability in the weapons system acquisition process.

3. A testbed for pre-field testing for Government acquisitions of training systems.

4. Developing interoperability standards for networks.

4.1.1 Networking Communications Laboratory

The purpose of the Networking and Communications Laboratory is to develop affordable and effective technology for networking large numbers of training devices in separate locations so that students can interact and train together as if they were in the same room. A diagram of the Networking Laboratory communications system appears in Figure 6.

Research in this laboratory concentrates on the following areas:

- Procurement of high speed networks (e.g. fiber distributed digital interface) and development of various protocols to study the impact of integrating voice data on local networks.

- Development of efficient techniques for comprising real-time digital voice data for transmission.

- Extensions to existing protocols to increase network performance using priority mechanisms and other software controls are being modeled in Ada.

- Open systems interconnection (OSI) is being implemented to evaluate performance in the real-time simulation environment by using an OSI development environment in IST's laboratory.

- A Fiber Distributed Data interface (FDDI) network running express transfer protocol is being modeled in Ada.

NCL's Internal
Developmental Ethernet

Realtime (SIMNET) Ethernet

HP PC

HP PC

HP PC

HP PC

HP PC

HP PC

HP PC

SparcStation

To IST/VSL
Ethernet &
Internet
(UUCP)

SparcStation

VME System

VME System

To SIMNET units

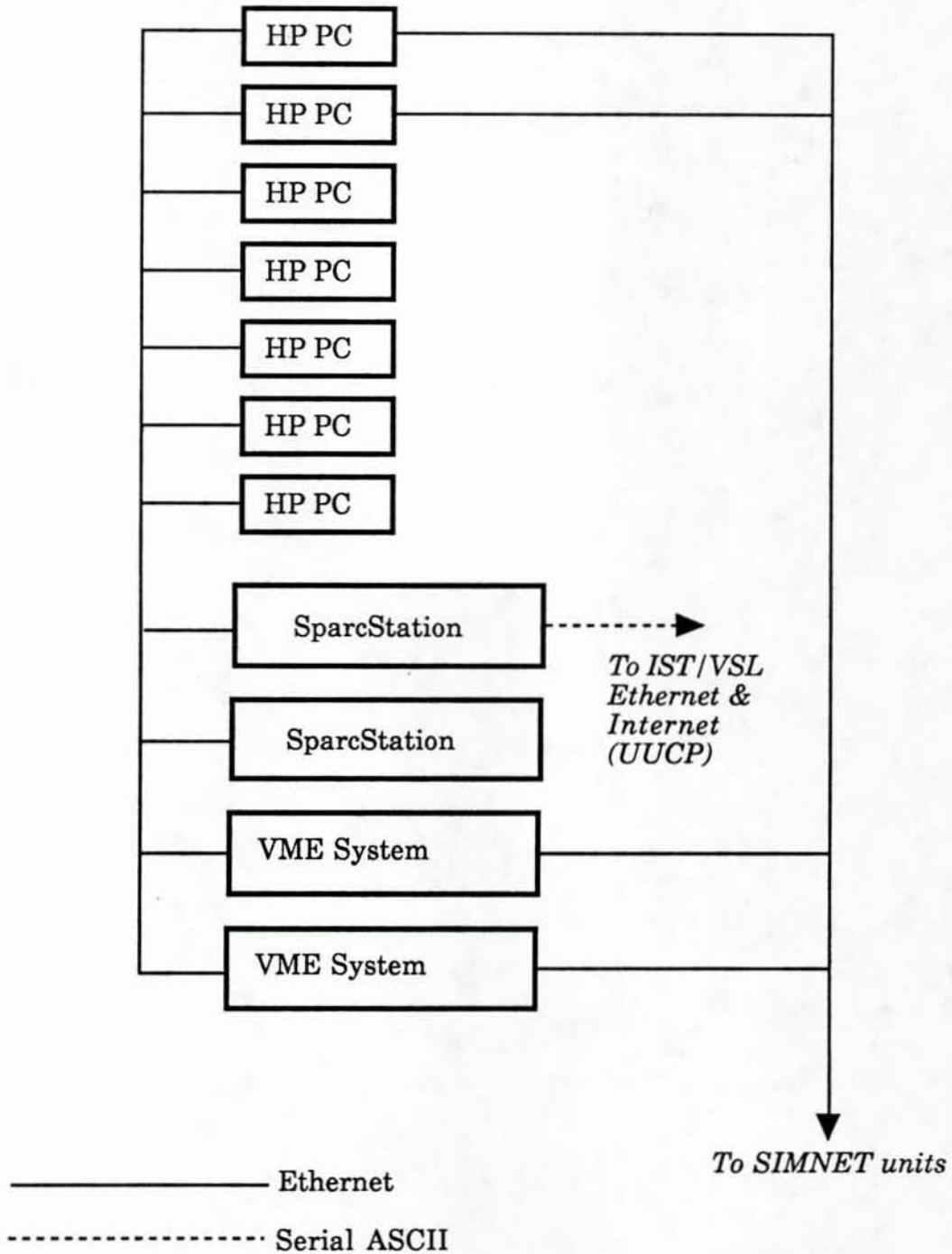——————— Ethernet

- - - - - - - - - - - - Serial ASCII

FIGURE 6

Network Communications Laboratory

- Methods to benchmark network performance are being developed and tested through a joint effort with the Software Engineering Institute at Carnegie-Mellon University.

- Test and evaluation facilities are being developed for simulation network standards.

- Conformance testing strategies are being developed for simulation network standards.

Laboratory resources:

- 2 SIMNET tank trainers
- Vax 3100 system networked to multiple users
- Hewlett Packard network analyzer
- Ethernet, Token Ring and FDDI networks
- Flexible interfaces for connectivity
- Four Hewlett Packard Vectra RS20C workstations
- Electronic bulletin board
- Access to IBM 4341
- Access to Gould MultSEL 9800

Research applications:

- Tactical Engagement Simulation
- Command, Control, Communications and Intelligence (C31)
- Embedded Training
- Combined Arms Warfighting Training
- Mission Rehearsal

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. A diagram of laboratory communications appears in Figure 7.

Stealth Display

Graphics Display | Graphics Display | Graphics Display

Realtime (SIMNET) Ethernet

Masscomp — Graphics Display

Plan View Display

HP PC | HP PC
HP PC | HP PC
HP PC

IST's SAF Devel. System | **Baud Wars**

Symbolics 3650
Mips M/2000 — Graphics Display

BBN SAF System

Masscomp 300 MB Hard Drive — VT100 Display

Data Logger

Masscomp — SIMNET Image generator

To SIMNET units

———— Ethernet
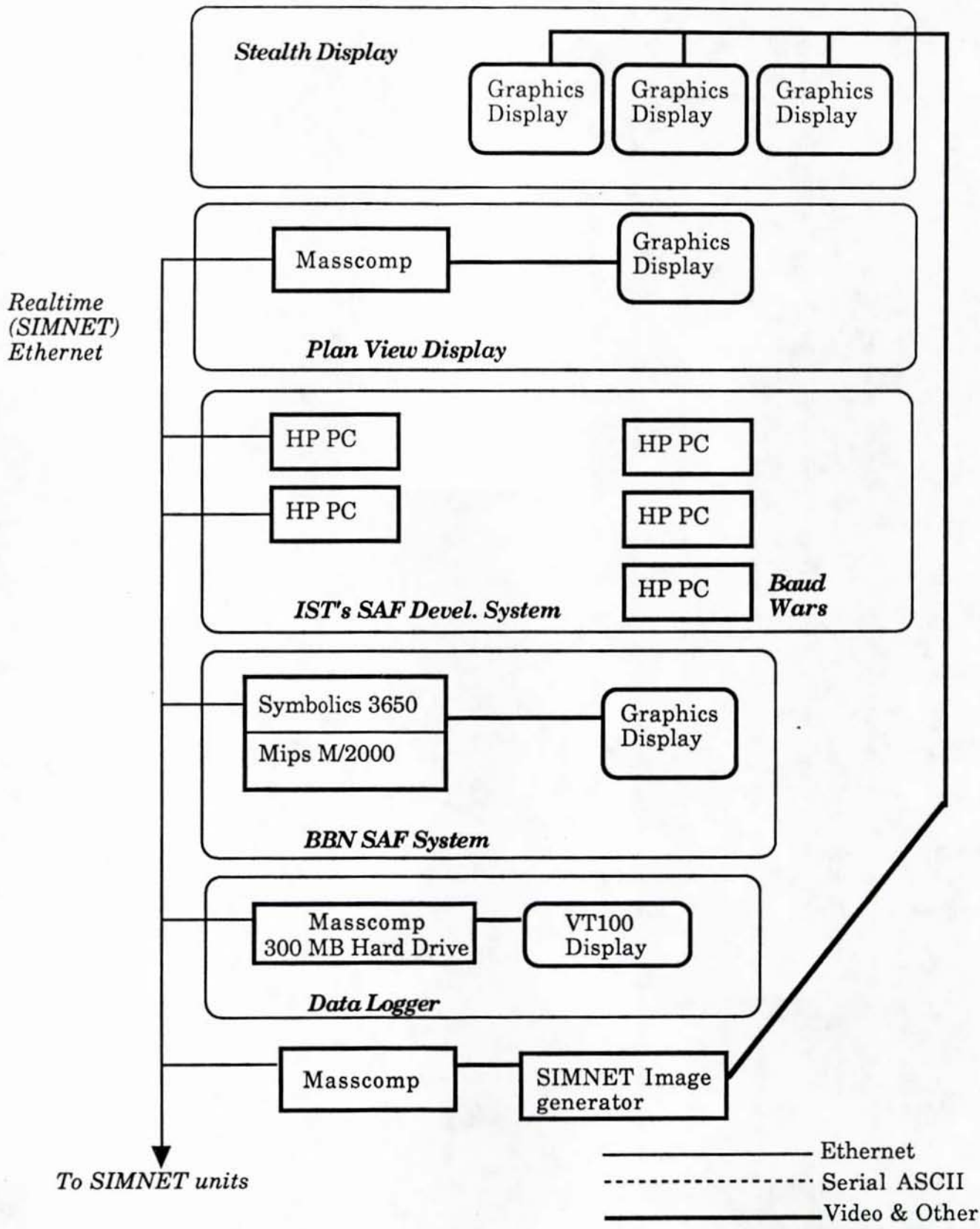----------- Serial ASCII
———— Video & Other

FIGURE 7

Intelligent Simulated Forces Laboratory

4.1.3 Low Cost Aviation Trainer Laboratory

The Low Cost Aviation Trainer Laboratory was created to develop low cost, training-effective flight trainers and to evaluate their effectiveness. The primary objective of this laboratory is to determine how much fidelity is required to meet the training objectives. Results of this research will be used to reduce training hours in higher fidelity, more costly flight trainers as well as in actual aircraft. Figure 8 contains a diagram of the laboratory communications system.

This research will demonstrate the feasibility of developing low cost aviation units oriented to tactical team training. The following investigations are ongoing in this laboratory:

- A simulator validation prototype system using video tape and a computer-based data acquisition system is being developed.

- Techniques to validate simulation mathematical model performance are being developed using parameter identification methods for comparison to actual aircraft performance.

- Human performance is being assessed in various flight simulator environments.

- A method is being developed for relating simulator performance to operator/simulation performance using objective and subjective measurement techniques.

- Methods are being developed to provide validated simulation models which can be used for vehicle design. This effort requires the assessment of operator/simulator performance over a wide range of simulators to obtain reliable and valid quantitative measures.

Laboratory resources:

- 2 F-16 avionics situational awareness trainers
- 1 low cost helicopter control set
- 3 Hewlett Packard Vectra RS/20/C Workstations
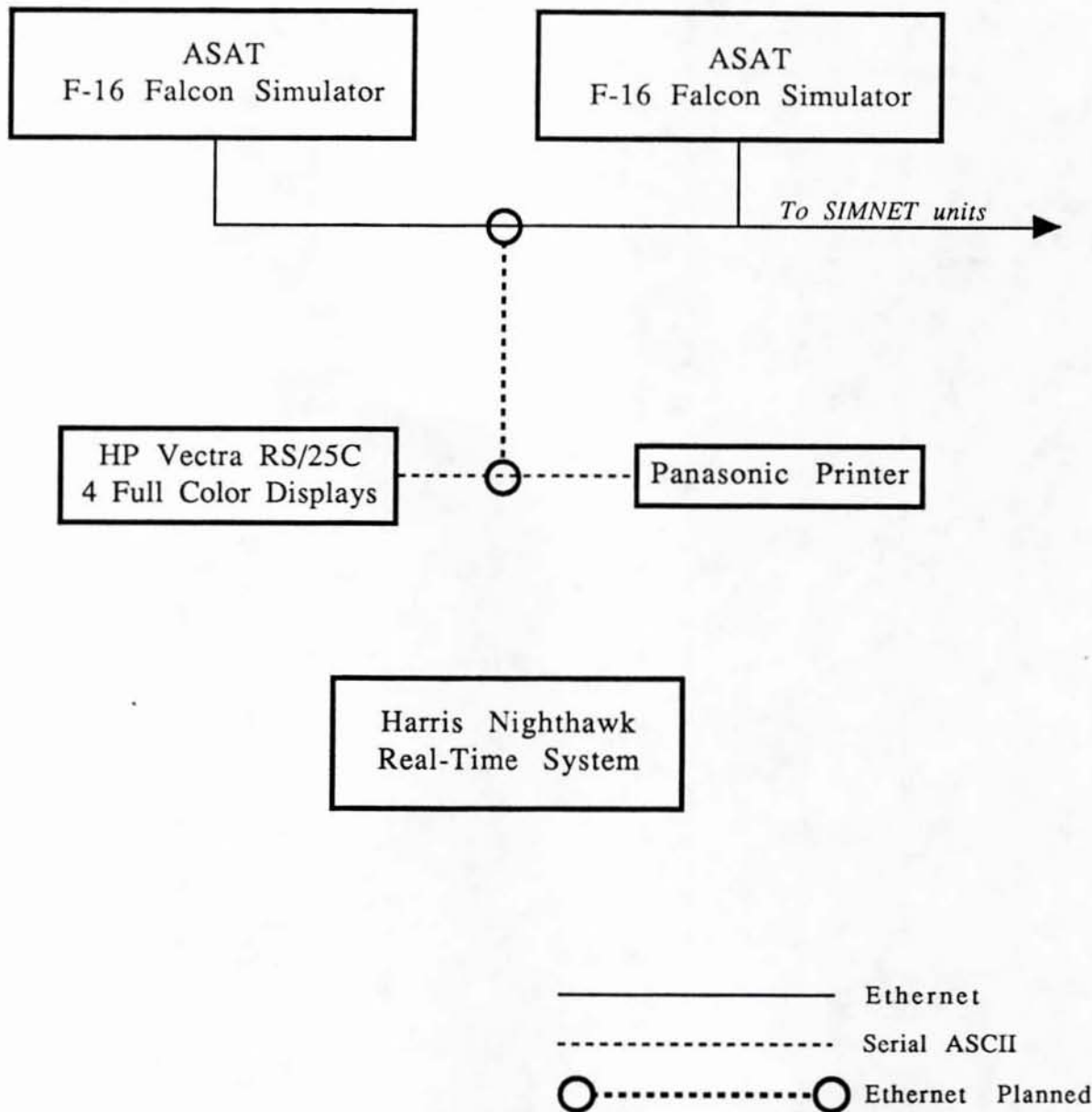- Harris Night Hawk 3800 computer

FIGURE 8

Aviation Trainer and Cockpit Laboratory

Research in this laboratory is applicable to:

- Training at Operational Sites
- Refresher Training
- Commercial Pilot Training
- Combined Arms Warfighting Training
- Mission Rehearsal

4.1.4 Visual Systems Laboratory

The purpose of the Visual Systems Laboratory is to develop more rapid and less costly means of creating and modifying visual images for simulation and training. Research in this area is applicable to low cost visual systems for training equipment, instructor support systems, and rapid development/reconfiguration of visual system data bases. Figure 9 illustrates the communications between hardware components in the Visual Systems Laboratory.

Research in the Visual Systems Laboratory (VSL) concentrates on the following areas:

4.1.4.1 Visual Databases

- **Terrain for Simulation**

Processing information from remote sensing and cartographic sources to build realistic visual models of the land, waterways, and surface features efficiently and rapidly.

- **Art and Film Animation**

Assisting the film industry in taking advantage of military-derived technology to build better computer-animated training materials.

- **Computer Aided Design (CAD)**

Transferring workstation-based technology between various CAD-using groups including simulation database builders, artistic users, engineering designers, and scientific visualization projects.

IRIS 4D/70GT

IRIS 4D/25G

IRIS 4D/25G

Sun SparcStation

**Simulation
Databases**

Sun 4/330

Kurta Graphics
Tablet

Tektronix Color
Plotter

Geospecific Data

Sun 386i

9 T-800 Transputers

NeXT

256 meg
Optical
Disk

Laser
Printer

Physical Modeling

PC-386+Targa32

Sony
VO9850
U-Matic
VCR

Video Recording Suite

VaxStation 3100

Evans & Sutherland
ESIG-500
Image Generator

Image Generators

To other IST Laboratories

To UCF Campus (SLIP)

PC/AT

PC/AT

Head Tracking Display

Helmet Mounted Display

GOSS(Generic Operator-
Student Station)

Joysticks, etc.

Displays and Interactive Devices

———————— Ethernet

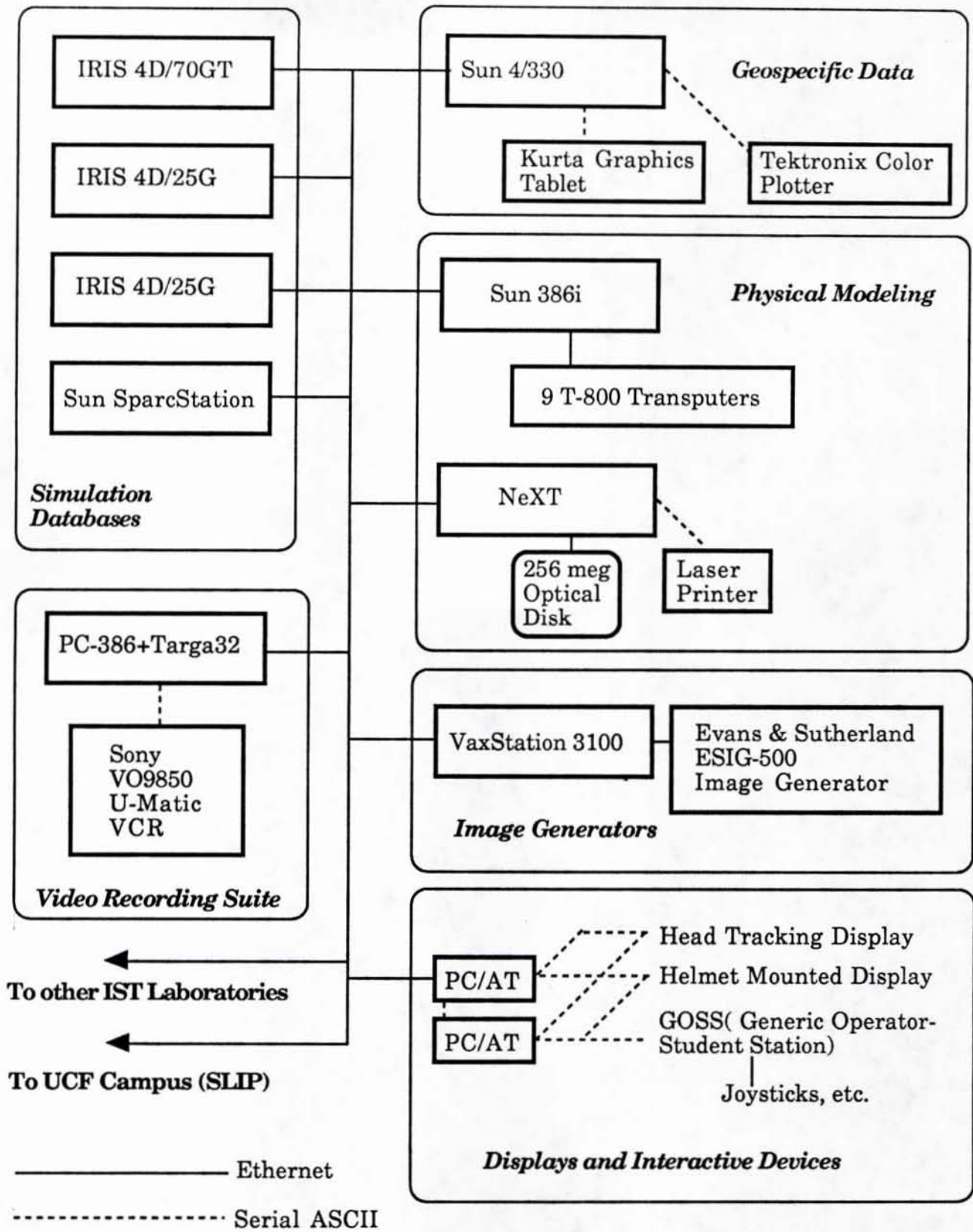------------------ Serial ASCII

FIGURE 9

Visual Systems Laboratory

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4.1.4.2 Display Systems

- **Head Tracking Displays (Panoramic)**

Designing multi-screen display systems which sense the viewer's head position to provide the appropriate imagery in front of the user - simulating a panoramic scene.

- **Helmet Mounted Displays ("EyePhones™")**

Interfacing new, lightweight *electronic eyeglasses*, that use one video monitor per eye, with state-of-the-art simulation and imaging systems, so as to study their training effectiveness.

- **Virtual Reality (Interactive Physics)**

Providing, via software, a simulated world with realistic interactions between visual entities. For example, *Dynamic Terrain* has bulldozers digging holes, and explosives making realistic craters during a real-time interactive simulation.

Laboratory resources:

- Evans & Sutherland ESIG-500 image generator (2 channels)
- Silicon Graphics Iris 4D70GT & 4D25G workstations
- Sun 4/330 & SparcStation workstations
- Sun 386i workstation
- NeXT workstation
- Macintosh IIx workstation
- PC/AT with nine T-800 transputers
- PC/AT with Vista Board and digital recorder controller
- Ethernet, linking all lab computing resources

Research in the laboratory is applicable to:

- Generic helicopter cockpit testbed
- Generic Operator/Student Station (GOSS) instrument system
- Kurtaq 48" x 60" digitizing tablet

- Tektronix color plotter
- Sony video projector
- 2 - IBM 5080 100 mHz 19" displays
- 2 - Evans & Sutherland 27" calligraphic/raster displays
- U-Matic & VHS video tape equipment for image capture and animation

4.1.5 Low Cost Simulator Testbed/Distributed Laboratories

The purpose of this concept is to develop simulation testbed facilities at UCF/IST wherein a research capability resides, either alone or with the shared capability of companion laboratories. IST will establish a joint working relationship between UCF/IST and other outside government laboratories wherein sharing of hardware/software capabilities can be realized. Simulation capabilities will be developed to support interactive combined arms training of armor, air, and ground forces. The testbed will be comprised of simulation tools suited for rapid prototyping, evaluation of man-machine interactions, and data base development.

4.1.6 Team Training Laboratory

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

Laboratory resources:

- Five IBM 386 units
- Ethernet connections

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

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                                              │
                                     ┌────────┴──────────┐
                                     │                   │   ┌──────────────────────────┐
                                     │                   ├───│  ACER 386 SX 16 MHz      │
                                     │                   │   │  20 MB  Hard Drive       │
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  │  Zenith 286 10 MHz      │────────┤                   ├───│  ACER 386 SX 16 MHz      │
  │  20 MB  Hard Drive      │        │                   │   │  20 MB  Hard Drive       │
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                                     │                   │   │  20 MB  Hard Drive       │
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  │  1/4" Tape Drive        │────────┘                   │   ┌──────────────────────────┐
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                                                         │   │  20 MB  Hard Drive       │
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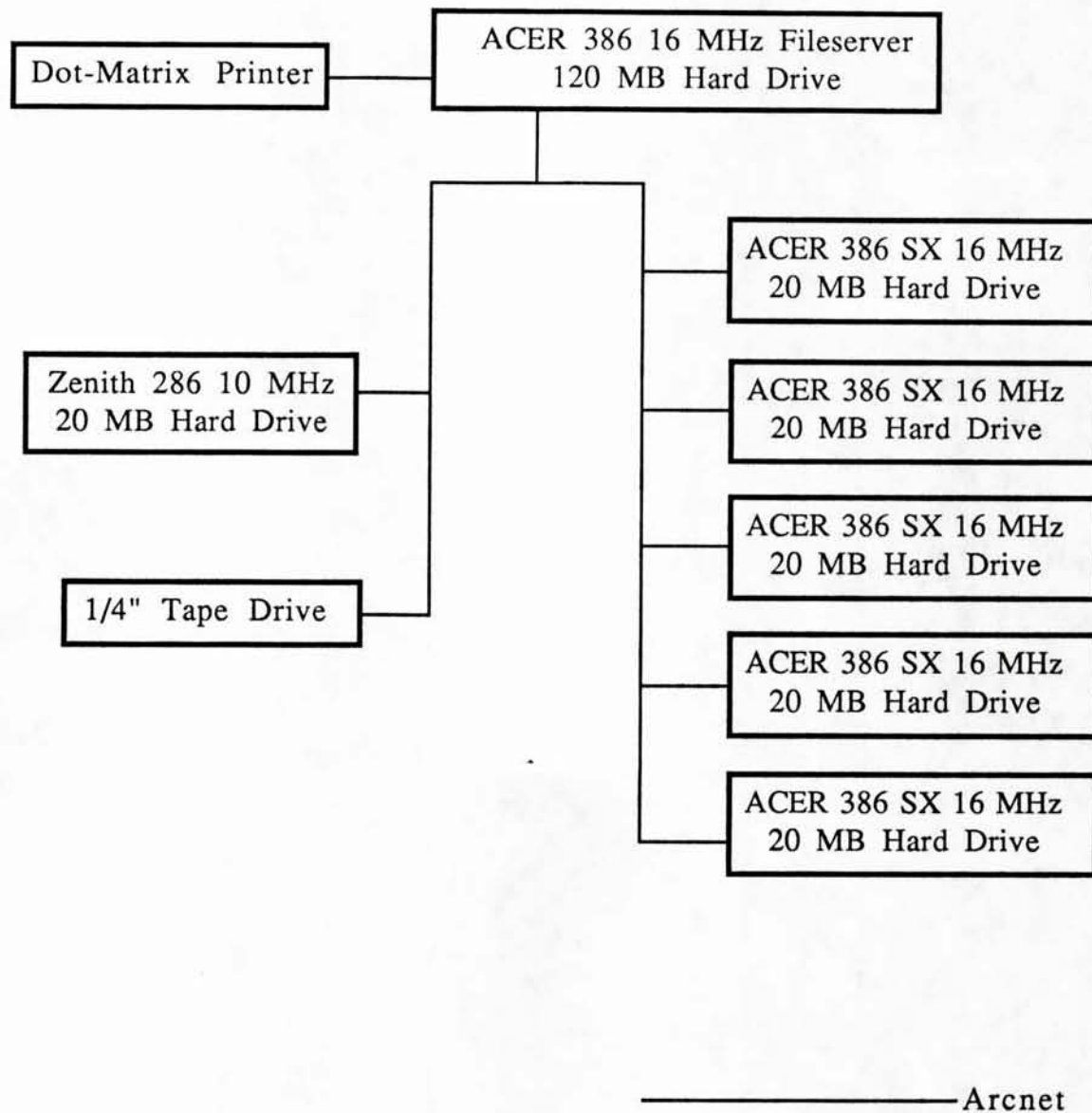─────────────────── Arcnet

FIGURE 10

Team Training Laboratory

Research in this laboratory is applicable to:

- Command, Control, Communications and Intelligence (C31)
- Anti-Submarine Warfare
- Air Traffic Control
- Manufacturing Plant Operations
- Emergency Team Operations

4.1.7 Language Technology Laboratory

IST's Language Technology Laboratory has several externally funded research projects which apply instructional technology to the teaching of languages (primarily through IST's Language Technology Project). Funding sources include the Florida High Technology and Industry Council, the Florida Technological Research and Development Authority, the U.S. Marine Corps. (Pending), and the U.S. Customs Service (pending). In addition, a contract for development of an English as a second language (ESL) series with a major publisher is in the final stages of negotiation. A prototype of this courseware, "Picture This . . ." is currently being tested within the Orange County Public School System.

The Language Technology Laboratory contains the following equipment:

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

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

- Macnitosh IIcx PC, 21" high resolution manochrome monitor, 80 megabyte hard drive (voice interface is the MacRecorder). Special software includes SuperCard and software for the MacRecorder.

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

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

4.1.8 Mathematical Simulation Laboratory (IST)

The Mathematics Simulation Laboratory contains equipment used to support research into the applications of advanced mathematics to simulation. Current research includes the application of abstract geometrical methods such as differentiable manifolds, Lie groups, and fiber bundles to problems of generating terrain data and simulating vision. Available equipment includes two NeXT workstations and three 386-class PC machines; all of these computers are connected to the IST workstation Ethernet. The NeXTs run mathematics and other applications supporting mathematical analysis and simulation. The PCs provide connectivity and communication with the IBM standard and also allow interface with scanners and other hardware input/output devices. The networking of hardware in the Mathematical Simulation Laboratory is depicted in Figure 11.

4.1.9 Experimental Classroom

The objective of the Experimental Classroom is to integrate the teacher with technology by providing advisories concerning the instructional activities which are most appropriate for the teacher to engage in as a result of computer diagnosis of student performance. The Classroom of the Future is comprised of a lesson development center, student stations, and an instructor station. Intelligent software processes customize the sequencing of exercises based on the system's diagnosis of individual student strengths and weaknesses. These processes also monitor overall student and class performance, and make decisions about which type of instructional activities are best for learning a particular subject or concepts. These decisions are sent as advisories to the instructor who can select cases for display on a large video projection screen for the entire class. These methods, when fully developed, will accelerate the learning process, reduce individual
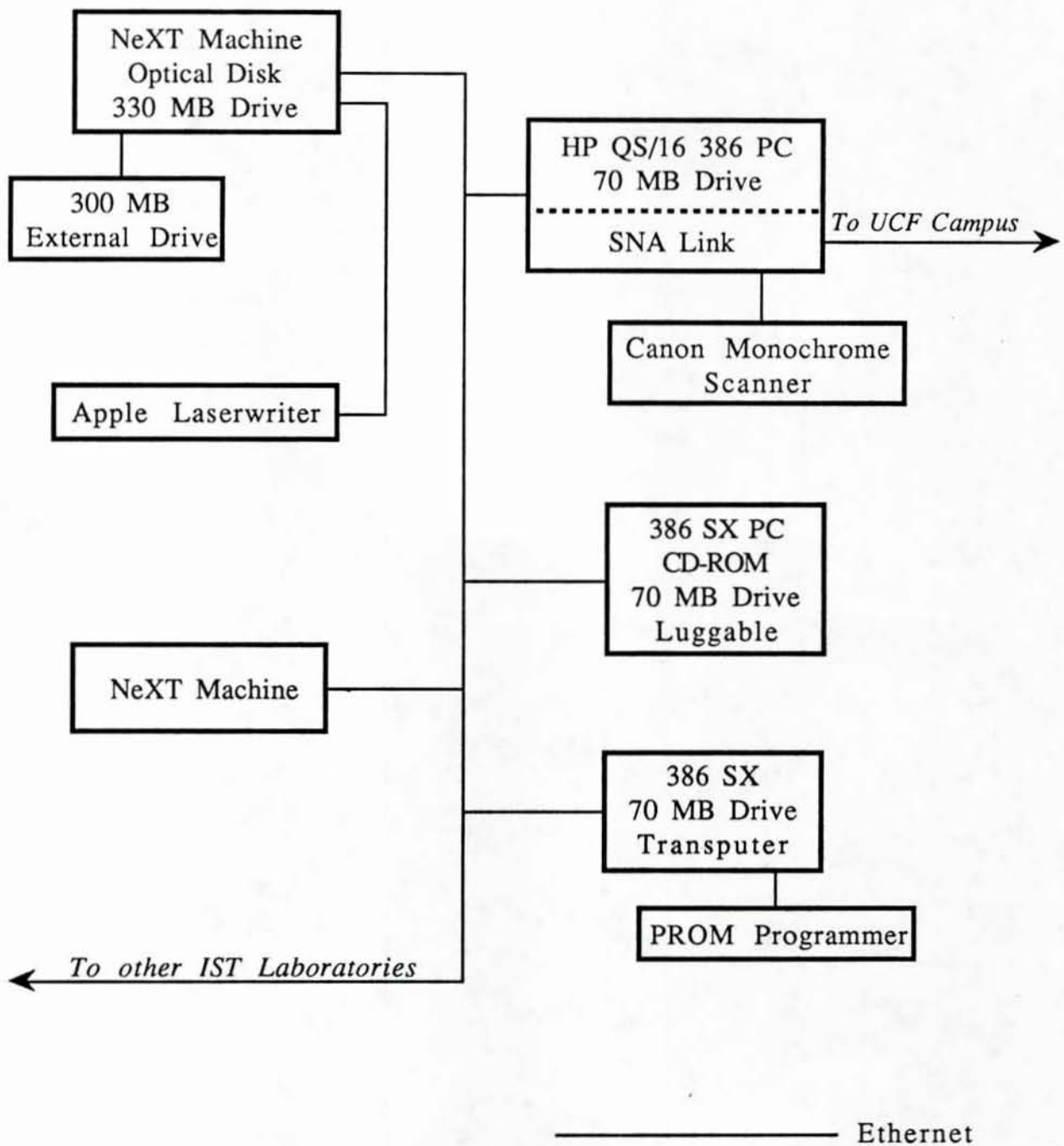
47

NeXT Machine
Optical Disk
330 MB Drive

300 MB
External Drive

Apple Laserwriter

HP QS/16 386 PC
70 MB Drive

SNA Link

To UCF Campus

Canon Monochrome
Scanner

386 SX PC
CD-ROM
70 MB Drive
Luggable

NeXT Machine

386 SX
70 MB Drive
Transputer

PROM Programmer

To other IST Laboratories

——————— Ethernet

FIGURE 11

Mathematical Simulation Laboratory

errors, and allow for more one-on-one student/teacher interaction by reducing the administrative workload that takes up so much of a teacher's time. When developed, the prototype instructional system will:

- Customize the sequence of presentation of instructional materials depending upon student strengths and weaknesses - what to teach.
- Dynamically plan instructional activities for the teacher employing intelligent planning software - how to teach.
- Design instructional activities around interactive animated simulations which are presented on a large screen display with which the teacher can interact. Through animated simulations the teacher can provide concrete representations of principles, laws, scientific systems, and theories.(making the abstract concrete)
- A demonstration prototype will be operational in January 1991.
- A satellite link for long distance education is provided for in the design.
- The Classroom may also serve as a Management Support facility to apply intelligent software processes to assist management in gaining access to information resources for use in decision making, brainstorming, planning, problem solving and problem definition.

Figure 12 depicts the networking of hardware in the Experimental Classroom of the Future.

4.1.10 Human Performance Modeling Laboratory (IST)

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.
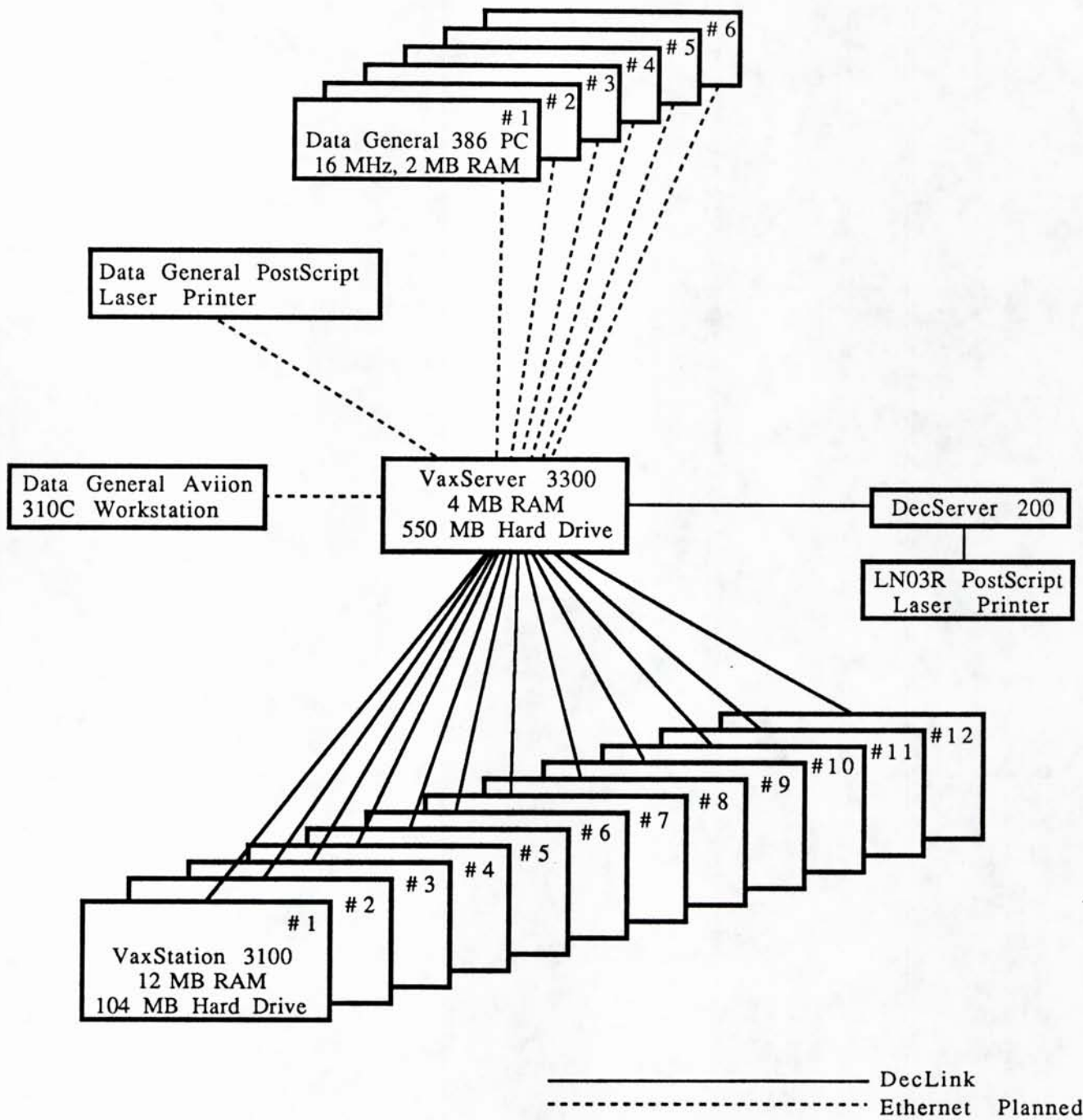
49

Data General 386 PC
16 MHz, 2 MB RAM
#1 #2 #3 #4 #5 #6

Data General PostScript
Laser Printer

Data General Aviion
310C Workstation

VaxServer 3300
4 MB RAM
550 MB Hard Drive

DecServer 200

LN03R PostScript
Laser Printer

VaxStation 3100
12 MB RAM
104 MB Hard Drive
#1 #2 #3 #4 #5 #6 #7 #8 #9 #10 #11 #12

—————— DecLink
- - - - - - - - - Ethernet Planned

FIGURE 12

Experimental Classroom

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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 multi-tasking 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.

4.1.11 Classroom Educational Technology Laboratory

The purpose of the Classroom Educational Technology Laboratory is to develop and demonstrate affordable techniques whereby microcomputers and other advanced technology can be used to improve classroom instruction. Results of the research will be used to increase the effectiveness of classroom instruction and to lessen the administrative workload that takes away from instructor contact time with the student.

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

Laboratory resources:

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

Research applications:

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

4.2 Other UCF Research Centers

The University of Central Florida has several research centers that directly support PM TRADE's research needs. These centers allow IST to draw upon their expertise and research resources, or

have them conduct the research under a collaborative agreement. The two key centers are the center for Research in Electro-optics and Lasers and the center for Applied Human Factors in Aviation.

4.2.1 Center for Research in Electro-Optics and Lasers (CREOL)

The Center for Research in Electro-Optics and Lasers (CREOL) is part of the University of Central Florida (UCF) and is the State University System of Florida's Center of Excellence for research and education in optical and laser sciences and engineering.

4.2.1.1 Mission/Scope

CREOL currently is housed in the Central Florida Research Park adjacent to the UCF main campus in Orlando, Florida. The Florida Legislature formally established CREOL in the Spring of 1986, to bring together diverse disciplines into a cohesive program in optics and lasers. Research activities at the Center are integrated with instructional programs to ensure involvement of both students and faculty. Substantial funds have been appropriated to support these activities, and to provide for additional faculty lines in optics, lasers and support positions, which are rapidly being filled by top scholars from around the world.

4.2.1.2 Research Areas

CREOL research projects reflect the interdisciplinary nature of the faculty and the faculty's diverse interests. Research within the Center is supported by federal, state and private research grants in excess of $6 million for the current year. Faculty and students pursue joint research projects with industry, other Florida universities and government laboratories. Present research areas include laser propagation; laser/materials interaction; non-linear and fiber optics; optical processing; laser development; detector technology; ultra-fast phenomena (femtosecond laser interactions); stimulated scattering; non-linear optical spectroscopy; diffractive and thin film optics; optical wave guides; metal-vapor, diode-pumped, tunable, and free-electron lasers; opto-electronics; growth of non-linear and lasers host materials; superconductivity; and many more.

4.2.1.3 Research Laboratories

- Femtosecond Lab
- Four Wave Mixing/Phase Conjugation Lab
- Nanosecond YAG Lab
- Picosecond YAG Lab
- Single Mode, Nanosecond CO_2, and Picosecond CO_2 Lab
- Analysis Lab
- Infrared Systems Lab
- Experimental Mechanics Lab
- New Laser Lab
- Turbulence Lab
- Diffractive Optics Lab
- Solid-State Laser Lab
- Spectroscopy Lab
- Propagation Lab
- Thin Film Lab
- Free-Electron Laser Lab
- Crystal Growth Lab
- Metal-Vapor Laser Lab
- Laser Spectroscopy Lab
- Miniature Laser Lab

4.2.2 Center for Applied Human Factors in Aviation (CAHFA)

The University of Central Florida (UCF) and Embry-Riddle Aeronautical University (ERAU) have marshalled their extensive resources to establish, in March 1990, the Center for Applied Human Factors in Aviation (CAHFA). CAHFA's chartered mission is to enhance safety in the nation's airspace system through human factors research, design, and training applied to the rapidly-growing field of aviation technology. Pooling the complementary strengths of the two universities establishes a research resource that is without peer for solving a vast assortment of aeronautical human factors problems.

As an organizational entity, CAHFA's administrative headquarters resides at University of Central Florida in Orlando. The Center's charter partner is Embry-Riddle Aeronautical University, located on the airport at Daytona Beach, Florida, with a second campus at Prescott, Arizona. CAHFA has received seed money financial support from the State University System of Florida in the amount of $150,000 for the 1990-91 State Fiscal Year (commencing July 1, 1990).

4.3 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.

4.3.1 Psychology

Research in the Department of Psychology has included visual simulation training, effects of biofeedback upon performance, cognitive learning theory applications, simulation and training subsystem requirements, user interfaces for computer aided instruction, operations research employing simulation, expert systems applications to training systems, cognitive modeling, decision-making in the tactical environments, team training, workload assessment, performance measurement, skill development, and human information processing. A new doctoral program in Human Factors has been developed as a result of Central Florida's growing needs in simulation and training.

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

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

4.3.2 Computer Science

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

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

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

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

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

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

4.3.3 Computer Engineering

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

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

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

4.3.4 Electrical Engineering and Communication Sciences

The EE Department has established laboratories to support research in image and digital speech processing. The Department also has laboratory capability in neural network modeling under development to support research on the application of neural networks to simulation and training.

4.3.5 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.

4.3.6 College of Education

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

4.3.7 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 on-going cost/benefit analysis programs and systems.

4.3.8 Health

Faculty in the Department of Health are involved in a study on the health-related effects of simulators on persons whose jobs require extensive training in a simulator environment, for example, airline pilots. They are also studying the use of simulators to enhance the driving skills of the elderly and handicapped.

4.3.9 Mathematics Department

The Department of Mathematics is devoted to the expansion of mathematical knowledge and techniques with applications in science and engineering. The Department is oriented toward faculty interaction with researchers in computer science, statistics, engineering, the behavioral sciences, the physical sciences, and at IST, in the search for new applications. Relevant faculty research for training and simulation include signal processing, nonlinear regression modeling, mathematical statistics, graph theory, and applied mathematics.

4.4 Additional University Support

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

4.4.1 Florida State University

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

Florida State also hosts the Supercomputing Computations Research Institute developed in conjunction with the Department of Energy (DOE). This facility provides access to state-of-the-art supercomputing capability to support advanced simulation studies.

4.4.2   University of Florida

The University of Florida has several programs and facilities related to simulation and training. These include:

4.4.2.1   Center of Intelligent Machines and Robotics

Research in this center is focused on robotics, artificial intelligence, and interactive animated displays of human-controlled and autonomous robots.

4.4.2.2   Computer Graphics Laboratory

Work in this laboratory involves the development and application of advanced graphics technology in the area of Computer-Aided Design (CAD). IBM is the major sponsor.

4.4.2.3   Mind-Machine Interaction Research Center

This center is comprised of the Cognitive Electrophysiology, Applied Artificial Intelligence, Signal Processing, and Laryngeal Physiology Laboratories. Current research programs are focused on a wide variety of research issues related to speech, speech synthesis, and voice recognition. Research topics include both basic research and applications of speech technology.

4.4.2.4   Software Engineering Research Center

In conjunction with Purdue University, the Computer Science Department of the University of Florida operates the NSF-funded Software Engineering Research Center. Ten industrial partner firms contribute annual support, which is matched by the National Science foundation. Faculty members at the two host institutions and at other selected colleges conduct basic research into software development methodologies.

4.4.3 University of South Florida

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

4.4.3.1 Center for Interactive Technologies, Applications, and Research

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

4.4.3.2 Department of Psychology

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

4.4.3.3 Department of Industrial and Management Systems Engineering

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

4.4.4 Other Florida Universities

IST also pursues and encourages cooperative projects with other Florida universities outside the SUS to (non-state university system universities) to foster technology transfer and to broaden its available technology and expertise base. Among these is Embry-Riddle Aeronautical University.

Embry-Riddle is one of the leading institutions in the nation for undergraduate pilot training. The university has extensive flight simulation capabilities and experience, and is involved in research programs in pilot training and air traffic control.

5.0 Pertinent Active and Completed Projects at IST

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

5.1 Simulation Networking - Modeling and Monitoring (DARPA/PM TRADE)

The purpose of this project is to model distributed simulation networks (for example, SIMNET), monitor their performance, and evaluate different networking alternatives. Presently, SIMNET uses a bus-based local area network (LAN) with contention access. Project personnel are examining the performance of SIMNET under various peak load conditions; and are investigating different ways to improve its networking scheme and capability to support a large number of ground and air vehicles without degrading real-time performance.

Token-ring LANs are being considered for enhancing SIMNET performance and for alleviating some of the problems facing the current networking scheme. Another important outcome of the project is the development of monitoring capability (data logging analysis) to provide real-time surveillance and control of an operational network.

5.2 Networking Protocol Alternatives (DARPA/PM TRADE)

Researchers on this project are developing a Simulator Network Software Model, which simulates the operation of the SIMNET network for different accessing protocols (i.e., Ethernet or GBRAM). The object is to show which multiplexing technique performs the best. Steps in the study include: (1) the examination of interconnecting two SIMNET devices to characterize the inter-network traffic arriving at each link node; and (2) the determination of the number of simulators (SIMNETs) that each local area simulator supports when frequency division multiplexing, or contention multiplexing of intra or inter-network traffic is used. The study is expected to reveal whether the 10 Mbps bandwidth cable which is currently being used in the SIMNET system has sufficient bandwidth to support both the intra and inter-network traffic which could be generated under worst case conditions.

5.3 Modeling and Performance Evaluation of Simulation Networks Using Petri Nets (PM TRADE)

In a related project, researchers are investigating the performance of SIMNET using Petri Nets under various loading conditions, and are developing techniques for evaluating network performance. SIMNET currently uses Ethernet, which may not optimally handle very heavy network loading. Continued improvement of very large simulation networks for training depends upon accurate performance evaluation, which this project should provide.

5.4 Interoperability of Network Standards (DARPA/PM TRADE)

IST has been tasked by DARPA and PM TRADE to develop standards for the interoperability of defense simulations. Using these communications protocol standards, training device simulators, war game simulations, and engineering development simulators will be able to communicate with one another in real-time interactive exercises. These exercises will be used in large scale combined arms training, equipment development studies, and equipment testing.

IST formed a steering committee of government and industry representatives and hosted three workshops on standards with an average of three hundred participants. Representatives of Industry and Government submitted recommendations on the protocols and IST summarized these recommendations in a Rationale Document. IST completed analyses and performed laboratory experiments to test many of the recommendations and incorporated the results into a Draft Military Standard. Future plans are to produce an international standard to allow interoperation of defense simulations between all U.S. Allies.

5.5 Training Technologies Integration (PM TRADE)

This effort involves collecting, developing, and analyzing simulation and training technologies for developing a technology investment strategy for training systems and devices. The strategy will be based on data processed at three levels. Level 1 data will address the architecture and methodology to provide top level trends and forecasts. Level 2 will assess the impact of ongoing tasks on the

development of technology for more effective and affordable simulation and training. Level 3 data will consist of actual, planned, executable research programs, and will be for Government access only.

5.6 Unit Performance Assessment System (UPAS) Testbed (ARI)

UPAS is a prototype, PC-based computer program and database designed in response to the need to collect, manage, and study effective performance measures in networked combined arms simulators. IST is presently enhancing the usefulness of UPAS as well as improving upon several UPAS current limitations. Four of the major improvements that will be made to UPAS include upgrading UPAS to be compatible with SIMNET Version 6, making refinements and enhancements that will allow UPAS to be a more effective tool for After Action Reviews (AAR), studying techniques for integrating SIMNET terrain database information into UPAS, and increasing the general data collection methodology of UPAS.

5.7 Tactical Electronics Simulation Test System, NATC, Patuxent MD (Navy)

An initial inquiry by the Naval Air Test Center at Patuxent River Maryland has led to a contract to explore the feasibility of developing a prototype test tool which could be used to test installed electronic equipment. The Tactical Electronics Test Simulation System (TESTS), if the initial study proves feasibility, will be developed and utilized to test Navy specific objectives during developmental testing of the MK XV IFF. TESTS will also provide a tool to supplement development and operational testing for other electronics equipment installed aboard aircraft, ships, and land vehicles as appropriate. Some hardware and software components for such testing already exist. The challenge of the TESTS project is to identify usable components and to plan a technical approach to development of the prototype test tool which is cost effective and which minimizes technical risk.

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5.8 MANPRINT Decision Options (HEL)

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

5.9 Team Training Testbed (NTSC)

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

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

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

5.10 Training Transfer in Tank Gunnery Training Program (PM TRADE/ARI)

Work in this area concentrated on evaluating the optimal sequence and duration of training on two part-task tank gunnery trainers: the Videodisc Gunnery Simulator (VIGS), which uses videodisc imagery, and the TopGun device, a computer driven arcade-type trainer. This program was completed in September, 1989. Follow-on work is being accomplished at the IST by ARI personnel and graduate students. Although IST is not conducting this research, it demonstrates the collaborative efforts between IST and the Government.

5.11 Cost and Training Effectiveness Research in Support of Simulation and Training Technology (ARI/PM TRADE)

The development/modification and validation of cost and training effectiveness measures was the focus of this research. The objective was to study tools useful to training designers. The two tools studied were Optimization of Simulation-Based Training Systems (OSBATS) and the Automated Simulator Test and Assessment Routine (ASTAR), developed by the Army and the Navy respectively.

5.12 A Cognitive Model of Instruction (NTSC/Battelle)

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

5.13 Intelligent Tutoring System (ONR/NTSC)

This project focuses primarily upon tactical decision making. A variety of techniques and methods developed from basic research are being implemented in a tactical training testbed for multi-threat warfare. These techniques, developed from research in cognitive science, involve embedding and

developed from basic research are being implemented in a tactical training testbed for multi-threat warfare. These techniques, developed from research in cognitive science, involve embedding and automating numerous instructor functions.

Research areas include the development of (1) intelligent instructional strategies for customizing exercise sequences, (2) intelligent feedback techniques (which provide direction and correction in case of errors of omission and commission), (3) simulations of other team members in the training environment, (4) intelligent adversaries as targets in a simulated scenario. Scenarios demonstrate coordinated and non-coordinated tactics among targets.

In brief, given very little information about the student, the system will learn to abstract information concerning student performance. With this knowledge, scenario events can be modified to adjust the level of play for any trainee. This capability reduces the current costs of developing knowledge-rich systems which compare student responses to knowledge-rich bases describing student behaviors in order to determine student capabilities. The system will be used to automatically abstract knowledge from experts interacting with the trainer, and to use this expert knowledge as a template against which student performance can be compared.

5.14 CAD Tools in Battle Simulation (PM TRADE)

The goal of this project is to re-specify and modify an Ada-coded behavioral level simulator developed at UCF for the FIRST silicon compiler for Digital Signal Processing (DSP) systems. The FIRST silicon compiler and the UCF simulator accept a block-diagram description (coded) as input. This description can be viewed as a synchronous large grain data flow graph. Previously processed graphics can be used in the description, leading to structured functional simulation.

The UCF simulator will be modified to include primitives (to be determined) of Battle Simulation Systems. Additional primitive and control strategies will be specified for the simulator.

An additional important outcome of this investigation is an assessment of the value of DSP design systems techniques and tools in simulation technology.

5.15 Neural Network Data Base Generator (IST)

The purpose of this research is to develop techniques to convert aerial photographs of cities to formats that are suitable for simulators and mission trainers. This technique requires using the novel learning properties of a neural network.

The researchers are developing models and simulation studies using simple computer-generated geometric models as training images. The plan is to use complex images to compare alternative training techniques. Scanned photographic images will be used as training examples. The researchers will correlate empirical results with those from the computer models and try to identify and account for any discrepancies.

5.16 Application of Animated Technology to the Training of Multidimensional Concepts (FHTIC)

Computer-generated animation is an alternative to current ineffective training methods for multidimensional tasks. These tasks often require decisions that depend upon comprehensive knowledge of relations and interactions among multiple variables. These multidimensional concepts have been found to be quite difficult to learn. Properly developed, the learning and motivational characteristics of animation could revolutionize the training of complex technical concepts, thereby broadening the base of Florida's animation and educational software industries.

5.17 Application of RISC Processor Technology to Training Simulators (FHTIC)

The realism and fidelity requirements of training devices place greater demands on embedded computers. The Reduced Instruction Set Computer (RISC) gives more computing power at lower cost. As RISC designs near the stage of commercialization required for use in simulators, it is important to evaluate their utility in real-time simulation. This research uses Naval Training Systems Center (NTSC) hardware and software. Gould, Harris and other Florida simulator companies are participating in the project.

5.18 Terrain Data Bases for Simulation (FHTIC)

Terrain Data Bases are the basis of computer-generated imagery for training simulators. This research project integrates terrain data bases with visual imagery, such as reconnaissance photography. Advances in technology make such automated integration of textural detail practical and cost effective. The integration of imagery with terrain data has commercial potential, not only in Florida's simulation industry, but in other fields such as land-use planning and resource assessment.

5.19 Classroom of the Future (FHTIC)

The programs under development for the Classroom of the Future have their roots in military training systems research and development, and make use of recent advances in computer and software technology. This research is readily adaptable to public school curriculum design and can effectively address today's critical education needs.

Much of the current work in the facility involves the development of artificial intelligence software that will eventually be able to "learn" in much the same way humans learn. Other areas that will be studied in the classroom include instructor support features, visual representation of complex concepts in math and science, embedded training, learning retention, and refresher training.

5.20 Visual Display Technology - Terrain Display (PM TRADE)

This project consists of two tasks:

1. Development of Low-Cost Head Tracking and Helmet Displays
2. Time Varying Visual Features in Real-Time Simulation

TASK 1: This effort involves two sub-tasks, both concerning innovative display devices for low cost networked part task trainers - specifically the SIMNET system.

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Part 1: Head Tracking Panoramic Display. Six monitors are arranged to simulate the six vision blocks of the M1 tank. The tank commander's helmet has a magnetic sensor. Three imagery channels from the SIMNET system are switched to the three monitors currently before the tank commander.

Part 2: A low cost helmet mounted display is attached to two channels of SIMNET imagery and controlled with a magnetic position sensor.

In both cases, experiments will be conducted with the original SIMNET commander's turret as a control, to see if cross country navigational skill training is improved with the new displays.

TASK 2: Time Varying Visual Features. This task involves developing the technology to display in real-time changes that are made to the terrain database - such as the construction of earthworks, cratering, and the repair of damage to the land. Issues raised include problems in physical modeling and in networking of simulation and database architectures for terrain.

5.21 Computer Animated Films for Training and Simulation (IST)

IST and UCF, in collaboration with the SAS Institute, Inc., Automated Images Inc., and Harcourt Brace Jovanovich, Inc., are developing a research and technology transfer project based on the production of computer-animated films for training and education. The Film and Art Departments and industrial partners are offering a course in computer based animation, and will be producing a short film to demonstrate computer animation's potential in the training industry. The IST Visual Systems Laboratory and UCF's Computer Science Department are exploring the application of high-speed image generation systems to the "rough drafting" of animated films.

5.22 Visual Database Technology - Databases (PM TRADE)

This project consists of two tasks:

1.   Rapid Production of Geospecific Databases

2.   Production of Standard Simulation Databases for Multiple Image Generators

TASK 1: Critical to the successful automation of database production is the ability to recognize buildings in imagery and to extract polygonal descriptions of the buildings.

IST staff are studying stereoscopic and shadow-based methods of recognizing and modeling buildings from remote sensing data. They are also developing CAD tools and demonstrations based on the research, so as to apply the results to research at IST in other aspects of database preparation.

TASK 2: IST researchers are building a family of formatting tools, to work from a common database and produce correlated databases on two image generators: SIMNET and Evans & Sutherland ESIG-500. These databases' degree of visual similarity will be measured and the disparity used as feedback to the construction process, with the goal of discovering minimal-cost strategies for producing correlated databases.

5.23   Action Graphics: Constraint-Based Declarative Programming for Modeling Complex Motions (IST)

The Action graphics project is merging the technologies of object-oriented programming and constraint programming to create new tools and methodologies for the development of graphical simulations. Our goal is to reduce the cost of software production and maintenance while simultaneously producing software that is more adaptable to changing requirements. This effort is enhanced by collaboration with several high technology firms (Software Productivity Solutions of Melbourne, FL and Datawise Corporation of Orlando, FL) and the Army's Project Manager for Training Devices.

6.0   Financial Status

IST has experienced steady growth over the last four years, primarily through increased work for
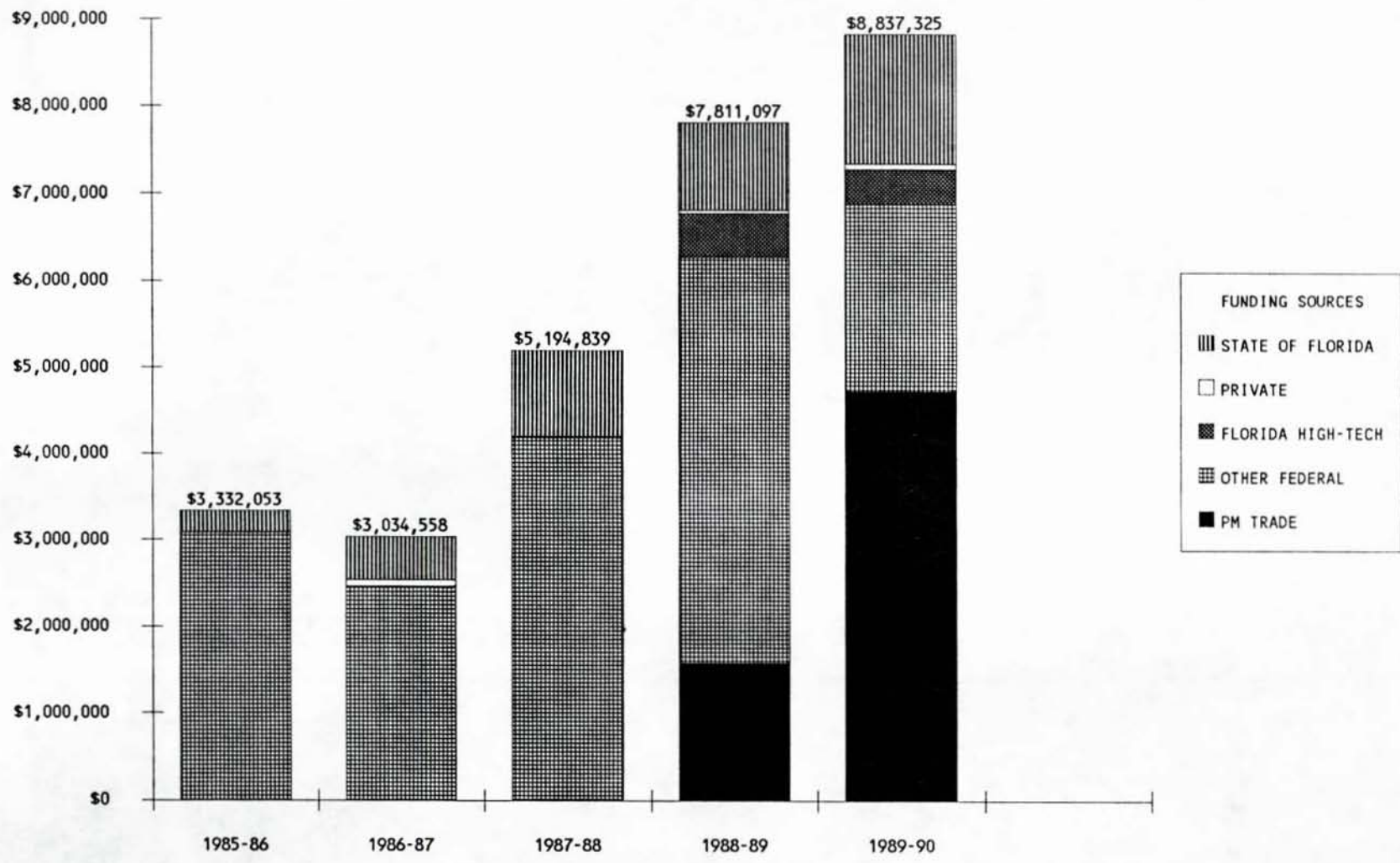PM TRADE. IST funding sources and quantities appear in Table VIII and Figure 13.

FIGURE 13

IST FUNDING
FEDERAL, PRIVATE, AND STATE OF FLORIDA

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Table VIII

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