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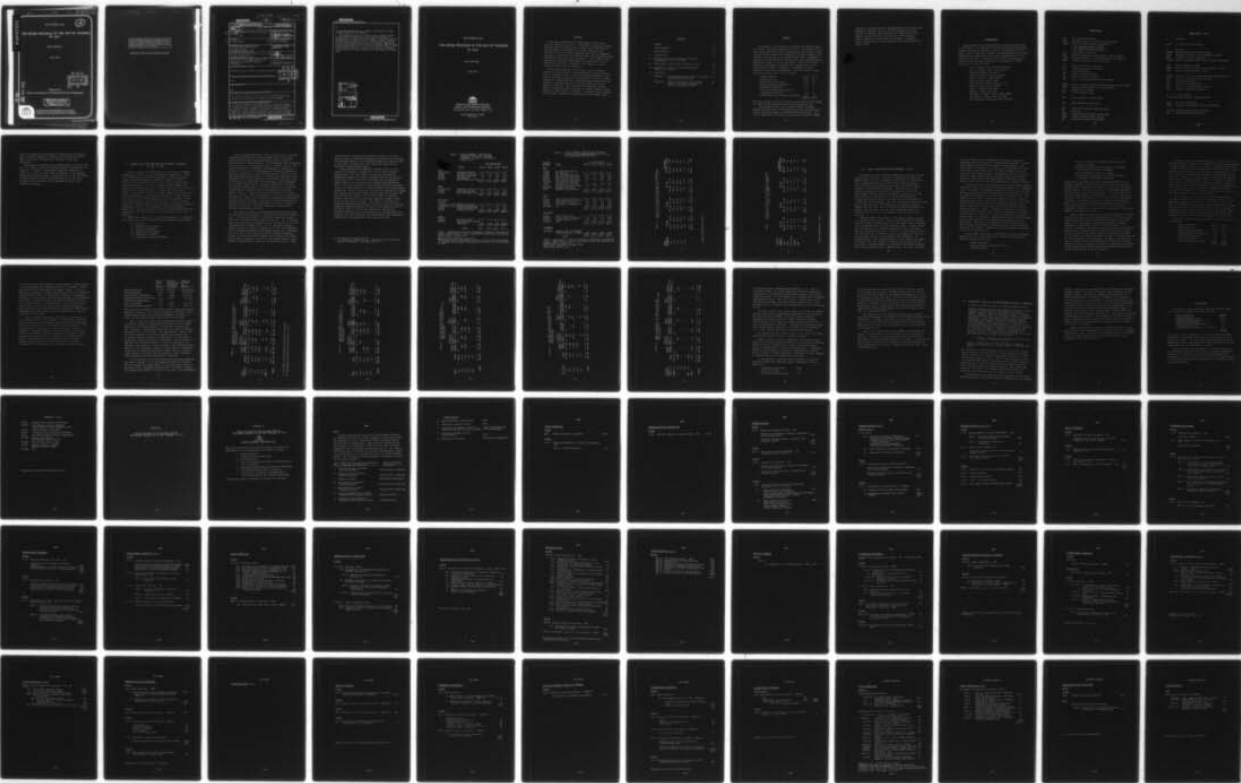
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THE RDT&E PROGRAM OF THE DoD ON TRAINING,
FY 1977

Jesse Orlansky

July 1977

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This analysis is part of an overall study to evaluate methods and data useful for determining the cost and effectiveness of alternative ways of training military personnel. Particular attention is directed in the study to the use of flight simulators, training devices, computer-assisted instruction and methods of analyzing the cost and effectiveness of various methods of training. R&D activities are identified in this paper to define the nature and scope of current research efforts directed to major areas of training. A companion report reviews R&D on flight simulation and other reports will appear later.

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THE RDT&E PROGRAM OF THE DoD ON TRAINING,
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Jesse Orlansky

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ABSTRACT

This paper identifies the RDT&E program of the DoD on military training for FY 1977. An analysis of Work Units shows that the areas of training which receive major attention are the development and evaluation of flight simulators (all services, with the Air Force expending most funds), engagement simulation of battlefield activities (Army) and computer-assisted instruction (Navy, Air Force, and DARPA). Lesser efforts are expended on performance measurement in training and on cost-effectiveness studies of training. The adequacy of these research programs was not addressed.

This analysis is part of an overall study to evaluate methods and data useful for determining the cost and effectiveness of alternative ways of training military personnel. Particular attention is directed in the study to the use of flight simulators, training devices, computer-assisted instruction and methods of analyzing the cost and effectiveness of various methods of training. R&D activities are identified in this paper to define the nature and scope of current research efforts directed to major areas of training. A companion report reviews R&D on flight simulation and other reports will appear later.

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SUMMARY

The purpose of this paper is to identify the RDT&E program of the DoD on military training for FY 1977. An analysis of Work Units shows that the areas of training which receive major attention are the development and evaluation of flight simulators (all services, with the Air Force expending most funds), engagement simulation of battlefield activities (Army) and computer-assisted instruction (Navy, Air Force, and DARPA). Lesser efforts are expended on performance measurement in training and on cost-effectiveness studies of training. The adequacy of these research programs was not addressed. Funds for RDT&E on training were allocated in FY 1977 as follows:

Flight simulation	\$27.4M	35 %
Training devices	24.9	31
Instructional technology	11.7	15
Computer-assisted instruction	6.3	8
Performance measurement	5.5	7
Costs of training and methods of developing cost data	1.9	2
Cost-effectiveness studies of training	<u>1.7</u>	<u>2</u>
	\$79.4M	100 %

This sum (\$79.4M) is about 62 percent of the total FY 1977 budget for RDT&E on Training and Personnel Technology (\$127.7M).

This analysis is part of an overall study to evaluate methods and data useful for determining the cost and effectiveness of alternative ways of training military personnel. Particular attention is directed in the study to the use of flight

simulators, training devices, computer-assisted instruction and methods of analyzing the cost and effectiveness of various methods of training. R&D activities are identified in this paper to define the nature and scope of current research efforts directed to major areas of training. A companion report reviews R&D on flight simulation and other reports will appear later.

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ABBREVIATIONS

ACM	Air Combat Maneuvering
ADIT	Automated Data on Instructional Technology
AFHRL	Air Force Human Resources Laboratory
	- AS Advanced Systems Division
	- FT Flight Training Division
	- TT Technical Training Division
ARI	Army Research Institute
ARPA	Advanced Research Projects Agency (same as DARPA)
ASUPT	Advanced Simulator for Undergraduate Pilot Training
AWAVS	Advanced Wide Angle Visual Simulator
CAI	Computer Assisted Instruction
CCTV	Computer Controlled Television
CE	Cost-Effectiveness
CIG	Computer Image Generation
CNA	Center for Naval Analyses
CTEA	Cost and Training Effectiveness Analysis
DARPA	Defense Advanced Research Projects Agency (same as ARPA)
DDR&E	Director Defense Research and Engineering
DoD	Department of Defense
DSB	Defense Science Board
EVS	Electro-Optical Viewing System
HEL	Human Engineering Laboratory
IETS	Individual Extension Training System
IR	Infrared
IR&D	Independent Research and Development
IRETS	Infantry Remoted Target Systems
ISD	Instructional System Development

ABBREVIATIONS cont'd

K Thousands

LLLTV Low-Light-Level Television

M Millions

MAGLAD Marksmanship Gunnery Laser Devices

MILES Multiple Integrated Laser Engagement Systems

M&RA Manpower and Reserve Affairs

MISTER Mobile Integrated System Trainer Evaluator Recorder

NOE Nap-of-the-Earth Flight

NPRDC Naval Personnel Research and Development Center

NTEC Naval Training Equipment Center

ODDR&E Office of Director Defense Research and Engineering

OJCS Office of the Joint Chiefs of Staff

OJT On the Job Training

ONR Office of Naval Research

OSD Office of the Secretary of Defense

OSR Office of Scientific Research

PE Program Element

PM Trade Program Manager, Training Devices

RAND The Rand Corporation

RDT&E Research, Development, Test and Evaluation

Sim SPO Simulator Systems Project Office

SQT Skill Qualification Training

ABBREVIATIONS cont'd

TAC Tactical Air Command
TAEG Training Analysis and Evaluation Group
TAGS Tactical Air/Ground Simulators
TRADOC Training and Doctrine Command

USAREUR United States Army, Europe

VTOL Vertical Take Off and Landing

I. INTRODUCTION

The purpose of this paper is to identify the Research, Development, Test and Evaluation (RDT&E) program of the Department of Defense on military training.* This was accomplished by identifying the amount of effort, i.e., funds, allocated by each military service and Defense Agency to RDT&E on flight simulation, computer-assisted instruction, training devices, costs of training, performance measurement, cost-effectiveness studies and instructional technology. Four of these, flight simulation, training devices, computer-assisted instruction and cost-effectiveness studies of training are identified in the Task Order. The areas of instructional technology and performance measurement were added to insure more complete coverage of R&D relevant to training; no areas of R&D on training were excluded.

Large procurements are underway or are planned by all military services for flight simulators, computer-assisted instructional systems and many types of training devices. There are, in addition, large expenditures each year for military training which uses the equipments and procedures developed by R&D on training. Current concern with the cost and effectiveness of military training is an important reason for identifying R&D efforts intended to improve our knowledge about the costs of training, performance measurement and the cost-effectiveness of military training systems. Finally, the

* This study was performed for ODDR&E (R&AT) on Task Order T-134 Costing and Effectiveness Methods for Defense Training.

area of instructional technology is concerned with the development of improved methods of training, and includes any type of R&D on training not appropriately included in the other categories.

The analysis is limited to the RDT&E program for Fiscal Year 1977. No effort is made to determine trends or requirements for research. A review of expenditures identifies magnitudes of effort but it does not imply that the adequacy of the research programs has been evaluated. Training is part of the DoD program on Training and Personnel Technology monitored by the Deputy Director of Defense Research and Engineering (Research and Advanced Technology).

II. FUNDING LEVELS FOR TRAINING AND PERSONNEL TECHNOLOGY, FY 1976 - FY 1978

Funds to support the RDT&E program on Training and Personnel Technology are found in 33 Program Elements (Appendix A). There is no routine way to estimate the amount of funds allocated by various military services and agencies for R&D to selected portions of this program, such as flight simulation or computer-assisted instruction. The use of common Program Element (PE) numbers and common definitions for funds allocated by the Military Services to the same purpose is a concept that is not now in effect. Each Service or Defense Agency combines various portions of its R&D efforts on personnel and training in a unique way and uses unique Program Element numbers for its own purposes. There are two exceptions to this general statement: the Army and Air Force use a common PE number for Research on Training and Personnel Technology (61102A, F) and another for Studies and Analyses (65101A, F). The Army groups its efforts on Training and Personnel Technology in 13 PE's, the Navy in 8, the Air Force in 8, and ARPA in 2.

RDT&E funds (Program 6 of the DoD) are organized in categories that reflect the flow of information from research to application:

- 6.1 Research
- 6.2 Exploratory Development
- 6.3 Advanced Development
- 6.4 Engineering Development
- 6.5 Management and Support
- 6.6 Operational System Development

The term "Technology Base" refers to efforts that contribute scientific knowledge and technical capabilities not directly associated with a particular application, such as a specific weapon system or flight simulator. The Technology Base is supported by funds for 6.1, 6.2 and some of the 6.3 category (called 6.3A); system development is funded by the remainder of category 6.3 as well as by 6.4 and 6.6; Management and Analytical Studies are funded in category 6.5. The distinction within category 6.3 is that some Advanced Development is for work that demonstrates the feasibility of certain technology (6.3A) whereas the rest (6.3B) is for work that constitutes the first phase in the development of a specific weapon system. Technology Base work in Training and Personnel Technology is performed, although not exclusively, by personnel and organizations in the behavioral and social science fields. Defense laboratories either perform or direct most of this work. System development (6.4 and 6.6) is generally performed, but again not exclusively, by engineering organizations (oriented towards aerospace in the case of flight simulation and towards electronics or data processing in the case of computer-assisted instruction.) Industrial organizations are heavily involved in performing this work.

The summary of funds for Training and Personnel Technology, by Service and Program Element, for FY76-FY78 is shown in Tables 1 and 2. The Tables are based on information available in March 1977, with some modifications added in May 1977. All of the data come from authoritative documents, but an explanation is in order concerning their enduring value. The FY 1976 data represent history and are not likely to change; the FY 1977 data represent current research programs and may change slightly by 30 September 1977, the end of the fiscal year; the FY 1978 data represent a request for funds upon which Congress had not taken final action at the time of writing (1 June 1977), after which they are still subject to Appropriation Review by each military service. These

qualifications, especially with respect to data for FY 1978, should be kept in mind when reading the discussion which follows. The detailed analysis of the training program which appears later in this paper is based on FY 1977 fiscal data which are not expected to change significantly.

These data have been combined in Tables 3 and 4 to show trends in categories of research (6.1 - 6.6) and in Service expenditures. The total budget for Training and Personnel Technology increased from \$92M to \$163M or by \$71M (77 percent) from FY76 to FY78. There were increases in all categories of RDT&E (Table 3), the largest being in Engineering Development (6.4). As will be seen later, this primarily reflects increased efforts on flight simulators, training devices, and computer-aided instruction. Table 4 shows that the Air Force increased its budget for Training and Personnel Technology by \$32M (146 percent), the Army by \$25M (88 percent) and the Navy by \$11M (34 percent). In FY78, the Army and Air Force have comparable budgets (\$54M), while the Navy has less (\$41M). The budget for Training and Personnel Technology increased by 77 percent, while the total DoD budget for RDT&E increased by 25 percent (from \$9.5B in FY76 to \$11.9B for FY78).* Some of the increase for Training and Personnel Technology over this period may be interpreted as more apparent than real, resulting from the unusually small appropriation made by the Congress for these areas in FY 1976.

* DoD Programs of RDT&E, FY 1977, Statement of Dr. Malcolm R. Currie to Congress, 3 February 1976, p. A-1

TABLE 1. FISCAL SUMMARY. TRAINING AND PERSONNEL TECHNOLOGY, PROGRAM ELEMENTS 6.1 and 6.2, BY SERVICE FOR FY 76-78

		(\$ in Millions)			
	<u>Title</u>	<u>FY 76</u>	<u>FY 77</u>	<u>FY 77</u>	<u>FY 78</u>
<u>Army</u>					
61102A(74)*	Training & Personnel	\$ 2.4	\$ 0.6	\$ 3.3	\$ 3.1
62716A	Hum Factors in Mil Sys	4.0	1.2	3.9	5.5
62717A	Army Pers & Manp Tech	2.3	0.3	2.4	4.1
62722A	Army Tng Tech	3.1	1.1	3.9	5.0
62727A	Non-Sys Tng Devices Tech	-	-	2.5	2.3
		<u>\$11.8</u>	<u>\$ 3.2</u>	<u>\$16.0</u>	<u>\$20.0</u>
<u>Navy</u>					
61153N(42)*	Behavioral & Social Sci.	\$ 3.3	\$ 0.9	\$ 4.1	\$ 5.5
62757N	Tng & Human Eng Tech	6.7	1.7	7.8	9.0
62763N	Naval Pers Support Tech	1.7	0.5	2.6	2.9
		<u>\$11.7</u>	<u>\$ 3.1</u>	<u>\$14.5</u>	<u>\$17.4</u>
<u>Air Force</u>					
61102F					
(project 2313)*	Training & Personnel	\$ 1.5	\$ 0.4	\$ 2.9	\$ 3.2
62202F(TPO 4,7)**	Aerospace Biotechnology	4.9	-	5.7	7.1
62205F	Train & Simulation Tech	3.4	1.2	6.3	8.6
62703F	Personnel Util Tech	2.7	0.9	2.6	3.0
		<u>\$12.5</u>	<u>\$ 2.5</u>	<u>\$17.5</u>	<u>\$21.9</u>
<u>DARPA</u>					
61101E*	Def Res Sci (ARPA)	\$ 2.6	\$ 0.6	\$ 3.1	\$ 3.1
62709E	Tng Forecasting & Decision Technology	6.1	1.7	7.5	8.9
		<u>\$ 8.7</u>	<u>\$ 2.3</u>	<u>\$10.6</u>	<u>\$12.0</u>
	TOTAL	\$44.7	\$11.1	\$58.6	\$71.3

Source: Training and Personnel Technology, Technical Area Descriptions, 1 March 1976, p. 255; incorporates revised data provided by ODDR&E (R&AT) 23 March 1977

*Training and Personnel items only

**The human factors engineering portion of this PE was transferred to Training and Personnel Technology from Medical and Life Sciences in 1976.

TABLE 2. FISCAL SUMMARY, TRAINING AND PERSONNEL TECHNOLOGY, PROGRAM ELEMENTS 6.3, 6.4 and 6.5, BY SERVICE FOR FY 76-78

Program Element	Title	(\$ in Millions)			
		FY 76	FY 77	FY 78	FY 79
<u>Army</u>					
63209A	Air Mobility Support				
DB39	Flt Sim Comp.	\$ 0.3	\$ 0.1	\$ 0.9	\$ 1.4
63731A	Mil Personnel Perf Dev	2.3	0.8	3.5	2.6
63738A	Non-Sys Tng Devices Dev	2.0	-	2.9	5.2
63743A	Tng & Util in Mil Sys	4.2	1.0	5.5	8.4
63744A	Army Contemp Issues Dev	0.5	0.1	0.3	0.5
64204A*	Air Mobility Sup Equip				
D275	Synthetic Flt Tng Sys	2.9	0.9	5.4	6.2
64715A	Non-Sys Tng Devices Engr	4.5	0.8	7.6	8.2
65101A**	Studies & Analysis				
M746	Manpower and Personnel	0.2	0.4	0.3	1.4
		<u>\$16.9</u>	<u>\$ 4.1</u>	<u>\$26.4</u>	<u>\$33.9</u>
<u>Navy</u>					
63701N	Human Factors Engr Dev	\$ 1.6	\$ 0.3	\$ 2.1	\$ 3.5
63707N	Navy Manp Control Sys Dev	1.6	0.3	2.5	4.9
63720N	Education & Training	6.4	1.8	7.7	8.6
64703N	Tr Devices Prototype Dev	9.3	1.5	6.2	6.7
65154N**	CNA	0.3	0.1	0.3	0.3
		<u>\$19.2</u>	<u>\$ 4.0</u>	<u>\$18.8</u>	<u>\$24.0</u>
<u>Air Force</u>					
63227F	Adv Simulator Dev	\$.3	\$.6	\$ 3.0	\$ 4.9
63751F	Train & Educ Innovations	5.4	1.6	6.0	4.6
64227F	Flight Simulator Dev	2.8	0.8	7.7	21.7
65101F**	RAND	1.0	0.2	1.0	1.0
		<u>\$ 9.5</u>	<u>\$ 3.2</u>	<u>\$17.7</u>	<u>\$32.2</u>
<u>OSD(M&RA)</u>					
65105D**	General Supt to OSD/OJCS				
	Manpower Research (M&RA)	1.3	0.3	1.5	1.5
	TOTAL	<u>\$46.9</u>	<u>\$11.6</u>	<u>\$64.4</u>	<u>\$91.6</u>

Source: Training and Personnel Technology, Technical Area Descriptions, 1 March 1976, p. 256; incorporates revised data provided by ODDR&E (R&AT) 24 March 1977

*Not under cognizance of ODDR&E (R&AT)

**Personnel aspects only

TABLE 3. TOTAL DOD PROGRAM FOR TRAINING AND PERSONNEL
TECHNOLOGY BY RDT&E CATEGORIES, FY 76 - FY 78*

<u>RDT&E Category</u>	<u>FY 76</u>	<u>FY 77</u>	<u>FY 78</u>	<u>Increase FY 76 - FY 78</u>
6.1	\$ 9.8M 10.7%	\$13.4M 10.9%	\$14.9M 9.1%	\$ 5.1M 52%
6.2	34.9 38.1	45.2 36.7	56.4 34.6	21.5 62
6.3	24.6 26.9	34.4 28.0	44.6 27.4	20.0 81
6.4	19.5 21.3	26.9 21.9	42.8 26.3	23.3 119
6.5	2.8 3.1	3.1 2.5	4.2 2.6	1.4 50
	<u>\$91.6 100.1%</u>	<u>\$123.0 100.0%</u>	<u>\$162.9 100.0%</u>	<u>\$71.3 77%</u>

* Data from Tables 1 and 2

TABLE 4. TOTAL DOD PROGRAM FOR TRAINING AND PERSONNEL
TECHNOLOGY BY SERVICE AND DEFENSE AGENCY,
FY 76 - FY 78*

<u>Service or Agency</u>	<u>FY 76</u>	<u>FY 77</u>	<u>FY 78</u>	<u>Increase FY 76 - FY 78</u>
Army	\$28.7M 31.3%	\$42.4M 34.5%	\$53.9M 33.1%	\$25.2M 88%
Navy	30.9 33.7	33.3 27.1	41.4 25.4	10.5 34
Air Force	22.0 24.0	35.2 28.6	54.1 33.2	32.1 146
DARPA	8.7 9.5	10.6 8.6	12.0 7.4	3.3 38
OSD	1.3 1.4	1.5 1.2	1.5 0.9	0.2 15
	<u>\$91.6 99.9%</u>	<u>\$123.0 100.0%</u>	<u>\$162.9 100.0%</u>	<u>\$71.3 77%</u>

* Data from Tables 1 and 2

III. RDT&E EFFORTS ON MILITARY TRAINING, FY 1977

The previous section provides background to the main concern of this paper, which is to describe the magnitude and types of RDT&E efforts on military training in the areas of flight simulation, computer-assisted instruction (CAI), training devices, costs of training, performance measurement, cost-effectiveness studies and instructional technology. The basic data on the research programs were provided by the Services for the FY77 Apportionment Reviews conducted by ODDR&E in June and July 1976. Other sources of information were the DoD RDT&E Program in Training and Personnel Technology, Technical Area Descriptions, 1 March 1976 (noted earlier), the Five Year Research and Technology Plans of each Service, the Research and Development Planning Summary (DD Form 1634), and the Research and Technology Work Unit Summary (DD Form 1498). The two latter summaries come from a DoD data bank which stores information on the R&D tasks of all Services.

These documents vary widely in the amount of detail and type of information they provide. The Work Unit describes the purpose and plan of each proposed study and is the lowest level of aggregation of planning data in the DoD research system. A typical Work Unit may require one professional man-year of work, cost about \$60,000, and produce a technical report or a small training device. After the Work Unit, increasing levels of aggregation of work are the Task Area, Project (or sub-element) and, ultimately, the Program Element. The Program Element is a line item in the budget; it provides the least detailed information but provides for the most funds. Program Elements in Training and Personnel Technology vary in size from about \$1M to \$8M per year. The larger ones tend

to be associated with the development of prototype training equipment, simulation devices or instructional programs. Descriptive Summaries are provided to support the submission of the RDT&E budget to Congress. It could be (and undoubtedly has been) said that too much rather than too little information is available about the research budget. Nevertheless, this review of the amount of funds allocated by the Military Services and Defense Agencies to key areas of the R&D program on training required a special effort and could not be accomplished in a routine fashion.

Variations in the way the Services report their RDT&E programs inevitably affect one's ability to describe their work in comparable terms. One source of variation arises from the fact that the Army associates its funds with Projects rather than with Work Units in the Apportionment Review; the other Services use Work Units. The DARPA data are similar in format to those of the Army. Another variation arises from the fact that Laboratory Support Funds which support some in-house research are not always associated with specific Work Units or Task Areas, or with the outside contracts which they support. This is a particular problem in the formal documentation of the Air Force. Thus, if uniformity of reporting is an objective of the DoD, it would be necessary to establish a common format. In addition, planning documents are revised throughout the year and not all the changes may be reflected in our tabulations. Therefore, all tabulations reported in this paper were reviewed for accuracy by representatives of each Service and corrected, as required. Needless to say, the appraisal presented here is not an official one.

Current RDT&E activities of the Military Services and Defense Agencies for FY 1977 were identified in the following areas of training explained previously:

- Flight simulation
- Computer-assisted instruction (CAI)
- Training devices

Costs of training, and methods of developing cost data in training

Performance measurement and methods of measuring effectiveness relevant to training

Cost-effectiveness studies of training

Instructional technology, i.e., R&D on training technology not otherwise identified

Specifically, this means that each identifiable Work Unit (or smallest aggregation of work reported to the DoD) was reviewed carefully and allocated to one or more (or none) of these areas, as appropriate. The review covered the entire RDT&E program and was not limited to the Technology Base. It did not cover R&D activities supported by non-RDT&E funds, i.e., which might occur in weapon system development or in a wide variety of operational activities. The detailed tabulations showing Program Element, Work Unit or Task Area, performing organization and funds, for work being conducted in FY 1977 in each of these areas are contained in Appendix B. These data are summarized in Tables that appear in the body of the report.

Certain RDT&E activities which undoubtedly improve the effectiveness of training were excluded arbitrarily from these tabulations, namely Work Units associated with research on selection, human factors engineering, motivation and morale, manpower management, environmental stress and decision making. It is likely, for example, that improved selection methods could identify personnel who can more readily be trained in particular duties; and that improved human factors design of equipment for easier use by people could reduce the amount and type of training required for their operation and maintenance. In terms of its potential impact, almost all of the DoD program on Training and Personnel Technology could be regarded as relevant to training, but selection and the other areas were excluded from consideration because the primary emphasis here is R&D on training.

Different treatment was also accorded to Research, i.e., 6.1 efforts intended to improve our knowledge and general understanding of human behavior relevant to training. These Work Units tend to be small, are generally not larger than one man-year each, and are performed predominantly by not-for-profit organizations and in-house personnel, although some industrial organizations are also involved. Research on training tends to have broad relevance to many aspects of training and an attempt to identify a study with such specific areas as flight simulation or computer assisted instruction could be quite arbitrary. Therefore, the allocations of 6.1 Work Units to various aspects of training were based entirely on statements of relevance provided by the Services in the Apportionment Review or other documents.

The allocation of funds for FY 1977 to selected areas of training is summarized by military components in Table 5 and by category of RDT&E funds in Table 6. Note that the total of \$127.7M for RDT&E on Training and Personnel Technology is larger than the value shown in Table 3 (\$123.0M for FY 77) because it includes \$4.7M for Independent Research and Development (IR&D) performed by industrial contractors and supported by DoD as an overhead expense. IR&D data were available only for FY 1976.

The total funds allocated in FY 1977 to selected areas of training are:

Flight simulation	\$27.4M	34.5%
Training devices	24.9	31.4
Instructional technology	11.7	14.7
Computer-assisted instruction	6.3	7.9
Performance measurement	5.5	6.9
Costs of training	1.9	2.4
Cost-effectiveness studies	<u>1.7</u>	<u>2.1</u>
	\$79.4M	99.9%

TABLE 5. FUNDS ALLOCATED BY MILITARY COMPONENTS TO RDT&E
ON SELECTED AREAS OF TRAINING, FY 1977 (000 omitted)

Military Component	Total*	Flight Simulation	Computer-assisted Instruction	Training Devices	Costs, Cost Methodology	Performance Measurement	Cost Effectiveness Studies	Instructional Technology
Army	\$ 42.4M	\$6,523	\$ 100	\$14,654	\$ 500	\$3,018	\$ 485	\$ 4,360
Navy	33.3	4,206	2,460	8,850	475	1,923	1,135	4,092
Air Force	35.2	13,105	3,215	700	525	376	33	1,351
DARPA	10.6	-	528	-	75	159	-	1,217
OSD	1.5	-	-	-	-	-	-	-
IR&D **	4.7	3,574	25	736	335	-	-	671
TOTAL	\$127.7M	\$27,408	\$6,328	\$24,940	\$1,910	\$5,476	\$1,653	\$11,691

* All funds for Training and Personnel Technology

** Independent Research and Development, FY 1976

TABLE 6. RDT&E PROGRAMS CLASSIFIED IN MORE THAN ONE CATEGORY (\$000)

Program	Flight Simulation	Computer-assisted Instruction	Training Devices	Costs, Cost Methodology	Performance Measurement	Cost Effectiveness Studies	Instructional Technology
Navy 63720N ZPN 58			\$ 500			\$ 500	\$ 500
							760
AF 63751F 1194			200				200
2361			500				500
65101F 3106				\$ 65		65	
IR&D Simulation Technology	\$736		736				
Technology	25	\$25					
TOTAL	\$761	\$25	\$1,936	\$ 65	-	\$1,325	\$1,960

It is obvious that major emphasis is being given to flight simulation (34.5 percent) and training devices (31.4 percent). Table 5 shows that the Air Force spends the largest amount of its funds (\$13.1M or 37 percent) on flight simulation and the Army emphasizes training devices (\$14.7M or 35 percent) primarily for engagement simulation, a term given to devices which simulate field operations with tanks, artillery, missiles and hand-held weapons, and which also simulate targets for these weapons. The difference between \$79.4M and the total of all funds for Training and Personnel Technology (\$127.7M) supports research in selection, human factors engineering and other areas which, as explained above, were not considered in this paper.

Some of the R&D programs were relevant to more than one of the categories used in this analysis. In these cases, the funds were allocated to both categories, since there was no information available on which to base a 50%-50% or any other division. The consequence, of course, is that the funds shown in Table 5 represent the maximum amount of effort allocated to each area of research on training. Multiple allocations were made for seven programs totalling \$2.8M or 3.5 percent of the funds shown in Table 5; the programs and allocations are shown in Table 6. Deleting these funds would obviously result in different estimates for the amount of effort allocated to each category:

	Totals Shown in <u>Table 5</u>	Multiple Allocations Identified in <u>Table 6</u>	Range in Estimate of <u>Effort</u>
Flight simulation	\$ 27.4M	\$0.761M	\$26.6-27.4M
Training devices	24.9	1.936	23.0-24.9
Instructional technology	11.7	1.960	9.7-11.7
Computer-assisted instruction	6.3	0.025	6.3- 6.3
Performance measurement	5.5	-	5.5
Cost of training	1.9	0.065	1.8- 1.9
Cost-effectiveness studies	1.7	1.325	0.4- 1.7

There would be no change in the order in which these areas receive emphasis. However, if all amounts estimated as relevant to cost-effectiveness studies were allocated elsewhere, the amount of effort in this category would shrink from \$1.7M to \$0.4M.

Table 7 shows that large funds (about \$13M and \$14M, respectively) are assigned to Engineering Development (6.4) of flight simulators and training devices. No other area receives this type of support. Appreciable amounts are also spent for Advanced Development (6.3) in all areas. The expenditure of larger funds for the development of prototype equipment and software and of smaller funds for research is characteristic of all areas of technology, including Training and Personnel. It was possible to identify only very small amounts of funds for Research (6.1), especially with respect to flight simulation and training devices (\$200 K). The independent research efforts (IR&D) of industrial contractors are directed principally towards the major market in flight simulation (\$3.6M), with much smaller efforts concerned with training devices and instructional technology.

The allocations of the Military Services and Defense Agencies are shown in Tables 8 to 11, and summarized briefly as follows. The Army assigns the largest amount of its funds (see totals) to training devices (engagement simulations for artillery, infantry and combined arms support) and most of this goes to the development

TABLE 7. CATEGORIES OF RDT&E FUNDS ALLOCATED TO
SELECTED AREAS OF TRAINING, FY 1977
(000 omitted)

RDT&E Category	Total *	Computer-			Costs,		Performance Measurement	Cost Effectiveness Studies	Instruc- tional Tech- nology
		Flight Simu- lation	Instruc- tion	Training Devices	Method- ology	Cost			
6.1	\$ 13.4M	\$ 170	\$ 200	\$ 200	\$ 125	\$ 597	\$ -	\$ 1,347	
6.2	45.2	2,036	1,463	4,620	350	1,763	133	4,172	
6.3	34.4	8,737	4,575	5,579	1,035	3,116	1,520	5,430	
6.4	26.9	12,891	-	13,805	-	-	-	-	
6.5	3.1	-	65	-	65	-	-	71	
IR&D **	4.7	3,574	25	736	335	-	-	671	
TOTAL	\$127.7M	\$27,408	\$6,328	\$24,940	\$1,910	\$5,476	\$1,653	\$11,691	

* All funds for Training and Personnel Technology

** Independent Research and Development, FY 1976

TABLE 8. ARMY ALLOCATIONS FOR RDT&E ON
SELECTED AREAS OF TRAINING, FY 1977
(000 omitted)

Army	Total	Flight Simu- lation	Computer- assisted Instruc- tion	Training Devices	Costs, Cost Method- ology	Performance Measurement	Cost Effec- tiveness Studies	Instruc- tional Tech- nology
6.1	\$ 3.3M	\$ -	\$ -	\$ 200	\$125	\$ -	\$ -	\$ 530
6.2	12.7	-	100	2,925	180	730	-	1,375
6.3	13.1	1,132	-	3,949	195	2,288	485	2,455
6.4	13.0	5,391	-	7,580	-	-	-	-
6.5	0.3	-	-	-	-	-	-	-
TOTAL	\$42.4M	\$6,523	\$100	\$14,654	\$500	\$3,018	\$485	\$4,360

TABLE 9. NAVY ALLOCATIONS FOR RDT&E ON
SELECTED AREAS OF TRAINING, FY 1977
(000 omitted)

<u>Navy</u>	<u>Total</u>	<u>Flight Simulation</u>	<u>Computer-assisted Instruction</u>	<u>Training Devices</u>	<u>Costs, Cost Methodology</u>	<u>Performance Measurement Studies</u>	<u>Effectiveness Studies</u>	<u>Instructional Technology</u>
6.1	\$41.M	\$ -	\$ -	\$ -	\$ -	\$ 495	\$ -	\$ 732
6.2	10.4	631	585	1,695	-	600	100	1,085
6.3	12.3	3,575	1,875	930	475	828	1,035	2,275
6.4	6.2	-	-	6,225	-	-	-	-
6.5	0.3	-	-	-	-	-	-	-
TOTAL	\$33.3M	\$4,206	\$2,460	\$8,850	\$ 475	\$1,923	\$1,135	\$4,092

TABLE 10. AIR FORCE ALLOCATIONS FOR RDT&E ON
SELECTED AREAS OF TRAINING, FY 1977
(000 omitted)

Air Force	Total	Flight Simu- lation	Computer assisted Instruc- tion	Training devices	Costs,		Cost Effec- tiveness Studies	Instruc- tional Tech- nology
					\$	\$		
6.1	\$ 2.9M	\$ 170	\$ 200	\$ -	\$ -	\$ 102	\$ -	\$ 85
6.2	14.6	1,405	250	-	95	274	33	495
6.3	9.0	4,030	2,700	700	365	-	-	700
6.4	7.7	7,500	-	-	-	-	-	-
6.5	1.0	-	65	-	65	-	-	71
TOTAL	\$35.2M	\$13,105	\$3,215	\$ 700	\$ 525	\$ 376	\$ 33	\$ 1,351

TABLE 11. OTHER ALLOCATIONS FOR RDT&E ON SELECTED AREAS OF TRAINING, FY 1977 (DARPA, OSD, IR&D) (000 omitted)

Defense Agencies/ IR&D	Total	Flight Simulation	Computer assisted Instruction	Training Devices	Costs, Cost Methodology	Performance Measurement Studies	Cost Effectiveness	Instructional Technology
DARPA 6.1	\$ 3,100	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
" 6.2	7,500	-	528	-	75	159	-	1,217
" 6.3	-	-	-	-	-	-	-	-
" 6.4	-	-	-	-	-	-	-	-
OSD 6.5	1,500	-	-	-	-	-	-	-
IR&D	4,741	3,574	25	736	335	-	-	671
TOTAL	\$16,841	\$3,574	\$ 553	\$ 736	\$ 410	\$ 159	\$ -	\$1,888

of prototype devices (Engineering Development, 6.4). This is followed by support for flight simulation (primarily Engineering Development of the Synthetic Flight Training System) and instructional technology. The Army appears not to conduct R&D on computer-assisted instruction. This may be due to a difficulty in interpreting data provided in the Apportionment Review; some of the R&D shown here as "Instructional Technology" may in fact be relevant to CAI.

The Navy allocates the largest share of its funds to training devices, principally to Engineering Development of the Sub-Ocean Acoustic Trainer and MISTER. This is followed by Advanced Development in flight simulation (AWAVS, Advanced Wide Angle Visual Simulation) and adaptive training systems relevant both to CAI and instructional technology. The Navy is also pushing simulation for maintenance training on the Trident and other programs (i.e., OAST, Organic Application of Shipboard Technology).

The largest Air Force efforts relate to all aspects of flight simulation, followed by CAI for technical training.

DARPA's budget of \$10.6M in Cybernetic Technology includes about \$1.2M for Exploratory Development on instructional technology and \$0.5M for CAI (distribution of effort within these areas cannot be identified with currently available data). Independent Research and Development of industrial organizations is almost wholly related to flight simulation, with smaller amounts assigned to training devices and instructional technology.

It is necessary to note that smaller amounts of funds are directed towards three important areas. Returning to Table 5, these are:

Performance measurement	\$5.5M
Costs of training	1.9
Cost-effectiveness studies	1.7

Each Military Service allocates about \$500K for efforts related to collecting data on costs. The Army spends about \$3M and the Navy about \$2M for studies on performance measurement in the area of training; the Air Force \$0.4. The Navy has the largest effort on the pay-off question in training, i.e., on cost-effectiveness studies of training. All of the service efforts on performance measurement, costs of training and cost-effectiveness studies are supported by Technology Base funds; about \$0.3M in IR&D is also spent on cost studies (Table 7).

The suggestion that the Military Services do not conduct Engineering Development on equipment for performance measurement may be incorrect. Although such efforts are not shown directly in Table 7, it may be that scoring equipment useful for performance measurement is developed as an integral part of flight simulators and training devices.

Table 7 also suggests that little RDT&E is accomplished on costs of training and on cost-effectiveness studies relevant to training. This does not necessarily mean that the Services do not conduct cost-effectiveness studies of training. Cost-effectiveness studies are known to be conducted, with non-RDT&E funds, by such organizations as the Army's TRADOC and the Navy's TAEG. This is discussed below.

IV. EVALUATION: STATUS OF COST-EFFECTIVENESS STUDIES OF TRAINING

In 1976, the DSB Task Force on Training Technology said:

"Defense training is apparently effective: trainees complete courses and are assigned to operational units in the numbers required to operate and maintain the DoD's weapon systems. However, with few exceptions, almost no training cost-effectiveness ratios are employed in OSD or the Military Departments. As a consequence, the DoD cannot presently assess the true impact of alternative training systems, and ODDR&E cannot assess the true or potential worth of its R&D program on training technology. In addition, non-corresponding management information categories are employed in the major OSD documents relating to training and R&D on training; this makes it difficult to determine which R&D areas are more likely to produce beneficial cost-effective results. To improve the effectiveness of training and Training Technology R&D, the DoD should:

1. Develop a capability to perform cost-effectiveness analyses of training technology."

Source: Summary Report of the Task Force on Training Technology, Defense Science Board, ODDR&E, 27 February 1976, page x

The only R&D on cost-effectiveness found in the FY 1977 program was performed by the Navy at NTEC on flight simulation and maintenance training and at NPRDC on shipboard training and on performance aids (total of \$1.2M). The Air Force had a small effort on courseware development in technical training (\$33K); the Army supported work on the cost-effectiveness of embedded training and of collective tank and infantry training. The present data, which were collected 6 to 9 months after the DSB report was published, are consistent with the findings of that report.

Nevertheless, the Services have been responsive to the recommendation made by the DSB Task Force as illustrated by the following

actions. The Army is conducting a Cost and Training Effectiveness Analysis (CTEA) of the CH-47 helicopter flight simulator at Fort Rucker, Alabama. The Navy has completed the first phase of a training effectiveness evaluation, including a cost analysis of the P-3C operational flight trainer at the Training Analysis and Evaluation Group, Orlando, Florida. The Air Force has established an Economic and Cost Analysis function at the Headquarters of the AF Human Resources Laboratory, Brooks Air Force Base, Texas, to monitor cost analyses in its entire program. The efforts of the Army and Navy are not RDT&E activities, i.e., they are not supported by RDT&E funds; the effort of the Air Force is an RDT&E activity. However they may be funded, we may anticipate that, in the future, there will be an increased number of cost-effectiveness studies in the area of training.

Because this review was limited to RDT&E activities, it may also have overlooked improvements to flight simulators or training devices which occur as part of the procurement cycle or as modifications to these equipments after procurement based on their operational use by the Services.

V. CONCLUSIONS

An analysis of Work Units shows that the following funds were allocated to RDT&E activities in FY 1977:

Flight simulation	\$27.4M
Training devices	24.9
Instructional Technology	11.7
Computer-assisted instruction	6.3
Performance measurement	5.5
Costs of training and methods of developing cost data	1.9
Cost-effectiveness studies of training	1.7
	<hr/>
	\$79.4M

This amount is about 62 percent of the total budget for RDT&E on Training and Personnel Technology (\$127.7M) for FY 1977, of which it is a part. The latter amount includes about \$4.7M for Independent Research and Development (IR&D) performed by private organizations for the Department of Defense.

Areas receiving major attention in the RDT&E program are the development and evaluation of flight simulation, engagement simulation of battlefield activities and computer-assisted instruction. Less attention is being given in the RDT&E program to performance measurement in training and to cost-effectiveness studies of training.

APPENDIX A

PROGRAM ELEMENTS FOR RDT&E ON
TRAINING AND PERSONNEL TECHNOLOGY

APPENDIX A

PROGRAM ELEMENTS FOR RDT&E ON TRAINING AND PERSONNEL TECHNOLOGY

61101E* Defense research sciences
61102A,F* Training and personnel
61153N* Behavioral and social sciences
62202F* Aerospace biotechnology
62205F Training and simulator technology
62703F Personnel utilization technology
62709E Training forecasting and decision technology
62716A Human factors in military systems
62717A Army personnel and manpower technology
62722A Army training technology
62727A Non-systems training devices technology
62757N Training and human engineering technology
62763N Naval personnel support technology
63209A Air mobility support
DB39 flight simulation components
63227F Advanced simulator development
63701N Human factors engineering development
63707N Navy manpower control system development
63720N Education and training
63731A Military personnel performance development
63738A Non-system training devices development
63743A Training and utilization in military systems
63744A Army contemporary issues development

*Training and personnel sub-elements only

APPENDIX A cont'd

63751F Training and education innovations
64204A* Army mobility support equipment
D275 synthetic flight training system
64227F Flight simulator development
64703N Training devices prototype development
64715A Non-system training devices engineering
65101A* Studies and analysis
M746 manpower and personnel
65101F* Studies and analysis, RAND
65105D General support to OSD/JCS
Manpower research (M&RA)
65154N* CNA

*Training and personnel sub-elements only

APPENDIX B

RDT&E ACTIVITIES OF THE MILITARY SERVICES
AND DEFENSE AGENCIES ON MILITARY TRAINING, FY 1977

APPENDIX B

RDT&E ACTIVITIES OF THE MILITARY SERVICES
AND DEFENSE AGENCIES ON MILITARY TRAINING, FY 1977

ARMY
NAVY
AIR FORCE
DEFENSE AGENCIES, INCLUDING IR&D

Work Units and Funds of each Military Service and Agency are identified in the following areas of military training:

1. Flight simulation
2. Computer-assisted instruction
3. Training devices
4. Costs of training and methods of developing cost data in training
5. Performance measurement and methods of measuring
6. Cost-effectiveness studies of training
7. Instructional technology (including R&D on training technology not otherwise identified)

All data are given in thousands of dollars (000 omitted).

ARMY

NOTE:

Data provided by ARI for the FY 77 Apportionment Review do not identify the amount of effort assigned to particular studies. The assistance of Dr. A. Birnbaum of ARI in providing funding data is very much appreciated. Where detailed information was not available, the allocation of effort to the areas of flight simulation, CAI, non-systems training devices, etc., was based on allocations shown in "Project/TCP sub-area funding matrix, Education and Training, FY 77" submitted by ARI for the Apportionment Review. The following arbitrary assignments were made to produce the attached estimates:

<u>ARI: Project/TCP Sub-area Funding Matrix, FY 77 - Education and Training</u>	<u>Areas of training, this paper</u>
A. Plan and evaluate education/ training programs	Instructional technology
B. Design education/training methods and media	Instructional technology
C. Evaluate trainees	Performance measurement
D. New generation education/ training systems	Instructional technology
E. Applications to special training problems	Instructional technology
F. Design & engineering of devices, components for training system	Training devices
G. Prototype training devices, simulation and computer systems	Training devices

Human Factors

- | | |
|---|--|
| A. Human performance capabilities | None |
| B. Simulation, analyses, models | None |
| C. Personnel and manpower factors in system design and life-cycle costing | Costs of training and cost methodology |
| D. Operability design concepts and criteria | None |
| E. Operational assessment | Performance measurement |

ARMY

FLIGHT SIMULATION

63209A

DB39 Flight simulation components \$ 882

63743A

A 722 Aircrew performance in tactical environment.
ARI

Task B. Flight simulation 250

ARMY

COMPUTER-ASSISTED INSTRUCTION

62725A

A 778 Software research in human factors. ARI \$ 100

ARMY

TRAINING DEVICES

61102A

B 74F	Manpower and human resources. ARI	
	Design and engineering of devices, components for training system	\$ 100
	Prototype training devices, simulation and computer systems	100
		<hr/> 200

62716A

AH 70	Army human factors engineering. HEL (funding for FY 77 and FY 78)	\$ 150
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62722A

A 764	Training and education. ARI	
	Design and engineering of devices, components for training system	100
	Prototype training devices, simulation and computer systems	165
		<hr/> 275

62727A

A 230	Non-systems training devices technology. (Formerly AH 70). PM Trade	
-01	Laser simulation technology Indirect area fire simulation. Laser guided weapons integrated training system High performance aircraft - MILES Engagement simulation	403
-02	Visual display technology. Wide angle laser scan. 360° annular visual system Optical image display Visual simulation analysis	658

ARMY

TRAINING DEVICES Cont'd

62727A cont'd

A 230 cont'd

-03	Electronic simulation technology. Command group training support system Maneuver control, casualty assessment reporting system Electronic warfare simulator Engineering equipment simulator	\$ 75
-04	Electromechanical simulation technology	1274
-05	Maintenance simulation technology	<u>90</u>
		2500

63731A

A 770	Performance oriented individual skill Design and engineering of devices, components for training system	110
	Prototype training devices, simulation and computer systems	<u>165</u>
		275

63738A

A 115	Non-systems training devices - infantry.	
-11	Infantry remoted target systems IRETS	2406
-12	Marksmanship gunnery laser devices. MAGLAD I	<u>438</u>
		2844

ARMY

TRAINING DEVICES Cont'd, p.2

63743A

A 771	System embedded training development. ARI	
	Task A: Training concepts and delivery system development	\$360
	Task B: Automation, simulation & evaluation	295
A 773	Combat unit training. ARI	
	Prototype training devices, simulation and computer systems	75
A 775	Prototype training devices, simulation and computer systems	<u>100</u>
		830

64715A

D 237	Artillery, air defense, engineering support	989
D 239	Infantry support	4350
D 241	Combined arms support	943
D 572	Armor - anti-armor support	598
D 573	Army support, Naval Training Eqpt Center	<u>700</u>
		\$7580

ARMY

COSTS OF TRAINING

61102A

B 74F	Manpower and human resources. ARI	
	Personnel and manpower factors in system design and life cycle costing	\$125

62722A

A 765	Human factors in system development and operation. ARI	180
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63743A

A 772	Aircrew performance enhancement in tactical environment. ARI	60
A 775	Human performance in field assessment. ARI	135
		<hr/>
		195

ARMY

PERFORMANCE MEASUREMENT

62722A

A 764	Training and education. ARI	
	Evaluate trainees	\$550
A 765	Human factors in system development and opn. ARI	
	Operational assessment	<u>180</u>
		730

63731A

A 770	Performance oriented individual skill develop. and evaluation. ARI	
	TASK C: Development of a performance-based individual extension training system (IETS) for the combat arms	315
	TASK D: Determination of methods for increasing the combat proficiency of individual armor crewmen	370
	TASK E: Performance based training & evalua- tion in air defense	100
	TASK F: Task criticality & dimensions pertinent to a training, OJT and SQT feedback system	75
	TASK G: Increasing combat effectiveness of individual infantry soldiers	<u>180</u>
		1040

63743A

A 773	Combat unit training. ARI	
	TASK B: Unit performance evaluation	474

ARMY

PERFORMANCE MEASUREMENT Cont'd

63743A cont'd

A 775	Human performance in field assessment.	ARI	
	TASK A: Development of evaluation methodologies for use in field test evaluations		163
	TASK B: Human factors & training evaluations for selected weapons systems		221
	TASK C: Human factors in operational test and evaluation		130
	TASK D: Field assessment of training, doctrine and combat developments using engagement simulation techniques		<u>260</u>
			1248

ARMY

COST-EFFECTIVENESS STUDIES OF TRAINING

63743A

A 771	System embedded training development. ARI	
	TASK C: Techniques for developing cost-effective training for the Missile Minder (AN/TSQ 73)	\$145
A 773	Combat unit training	
	TASK C: Development of cost effective methods for collective tank training programs	80
	TASK D: Development of cost effective methods for collective training in infantry	<u>260</u>
		\$340

ARMY

INSTRUCTIONAL TECHNOLOGY

61102A

B 74F Manpower and human resources. ARI

Plan and evaluate education, training programs.	\$130
Design education, training methods and media	150
New generation education, training systems	<u>250</u>
	530

62722A

A 764 Training and education. ARI

Plan and evaluate education/training programs	715
Design education/training methods and media	440
New generation education/training systems	110
Applications to special training problems	<u>110</u>
	1375

63731A

A 770 Performance oriented individual skill development and evaluation. ARI

TASK A: Individual performance-based training methods, materials, programs and resources for soldiers in schools and at duty stations 130

TASK B: Performance-based, job-relevant evaluation and feedback techniques and materials for individual training and personnel management 225
\$355

ARMY

INSTRUCTIONAL TECHNOLOGY Cont'd

63743A

A 771	Systems embedded training development. ARI	
	Plan and evaluate education/training programs	\$360
	Design education/training methods and media	280
	New generation education/training systems	-
	Application to special training problems	160
A 772	Aircrew performance enhancement in tactical environment. ARI	
	TASK A: NOE, night & instrument flight training	250
A 773	Combat unit training. ARI	
	TASK A: Tactical engagement simulation training	490
	TASK E: Command and control training	150
	TASK F: Unit training techniques in USAREUR	320
A 775	Human performance in field assessment	
	Plan and evaluate education/training programs	<u>90</u>
		\$2100

NAVY

FLIGHT SIMULATION

62757N

F-55-522 Training. NTEC

4751	Cost effective simulation in flight training	\$100
5751	Instructor pilot's role in simulation tng.	60
4742	Computer generated visual displays for tng	125
3714	Forward looking infrared simulation in Naval training devices	45
3718	Holography for carrier landing	47
4744	Generalized VTOL simulation mathematical model	45
5714	TV projection system	40
5742	Flight simulation system test technology	14
6711	Standards for visual systems	33
7711	Holographic displays for training devices	30
7744	Motion drive signals for flight simulators	42
6714	Laser air to ground and air to air weapon delivery systems	50
		<hr/>
		631

63720N

WPN 09 Training devices technology. NTEC

4781	Aviation wide angle visual system (AWAVS)	3575
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NAVY

COMPUTER-ASSISTED INSTRUCTION

62757N

F 55-522	Training. NPRDC	
010	Developments in technology applications in training and education	
-03-01	Adaptive techniques for automated instruction	\$ 70
012	Technique development for adaptive criterion referenced testing	
-03-01	Criterion referenced training, testing programs (50% CAI; 50% instructional technology)*	50
013-03-01	Computer-based techniques for modelling learner knowledges	<u>45</u>
		165
F 55-525	Human engineering, NTEC	
3754	Human performance measurement in air systems	230
7754	Automated adaptive training for the landing signal officer	<u>190</u>
		420

NAVY

COMPUTER-ASSISTED INSTRUCTION (cont'd)

63720N

ZPN 07	Education and training development. NPRDC: NTEC, TAEG	
-03D	Computer applications for improving communications flow, NPRDC/NTEC	125
14B	Shipboard computer-supported and mgmt and readiness system	275
23	Individualized adaptive training system NPRDC/NTEC	350
30A	Adaptive experimental approach to instructional design (33% CAI; 66% Inst. Technology)*	235
30B	Computer managed instruction in Navy Tech. tng.	225
32	Advanced computer-based system for instructional dialogues	<u>665</u>
		1875

*Letter from NPRDC, 9 May 1977

NAVY

TRAINING DEVICES

62757N

F-55-525	Human engineering.	NTEC	
3751	Command and control training for Naval Ordnance Systems		\$100
3753	Application of voice technology in voice technology in automated systems		132
4753	Generalized sonar/acoustic warfare operator training		150
5752	Assessment and prediction of training device effectiveness		50
7754	Automated adaptive training for the landing signal officer		190
1745	TRADOC operation		103
3719	Optical memory for sensor simulation		60
5741	Simulation computing techniques		115
6716	Holographic memory for training applications		38
6718	Advanced sensor simulation utilizing charge coupled devices		62
3741	Air cushion vehicle feasibility model for opt/training		200
4712	Surface navigation and orientation trainer		75
6722	High resolution CCTV multiple target insertion for Nav. tng. devices		53
6724	Solid state image sensors		7
7714	Multiple image display system for periscope navigation		50
7716	Optical systems for training device development		30
7719	360° non-programmed visual display		150
7726	Land vehicle convoy and personnel signature synthesizer		50
3764	Universal infantry weapons trainer		50
7715	Lasers for training device development		30
			<hr/>
			1695

63720N

ZPN 09	Training devices technology.	NTEC	
5754	Intermediate hands-on maintenance trainers for avionic systems		430
*ZPN 58	Performance aids test and evaluation.	NPRDC	<hr/>
			500
			<hr/>
			930

* Figures also used for Cost-effectiveness studies and Instructional Technology

NAVY

TRAINING DEVICES Cont'd

64703N

SPN 14	Mine warfare trainer. NTEC	\$170
XPN 16	Warfare analysis research system	550
XPN 51	Simulations	570
XPN 45	Simulated avionics maintenance trainer	487
XPN 47	Laser and holographic applications	447
XPN 50	Electronics equipment maintenance sim.	500
SPN 12	MISTER	1506
SPN 15	Sub ocean acoustic training system	1795
XPN 49	Aviation weapons system simulation	200
		<hr/>
		\$6225

NAVY

COSTS OF TRAINING

63707N

ZPN 43

-04 Manpower cost in system design. NPRDC \$475

NAVY

PERFORMANCE MEASUREMENT

61153N (42) Learning and training. ONR. (RR 042-06) \$495

62757N

F 55-522 Personnel training. NPRDC

003-33	Techniques for evaluating individualized instruction	80
-04	Techniques for measurement of job proficiency	45
010-030-1A	Parameter estimation in parameter-dependent programs	70
102-03-03	Techniques for evaluating Marine Corps training	125

F 55-525 Human engineering. NTEC

3754	Human performance measurement in air systems	230
5752	Assessment and prediction of training device effectiveness	50
		<hr/> 600

63701N

WPN02	Air combat performance criteria: air crew performance measurement and prediction technology. Block 05. NAMRL	405
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63707N

ZPN 01-05	Personnel performance capabilities. NPRDC OJT personnel performance measurement, propulsion system	150
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63720N

ZPN 07-31	Performance proficiency assessment system. NPRDC	273
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NAVY

COST-EFFECTIVENESS STUDIES OF TRAINING

62757N

F55-525 Human engineering. NTEC

4751 Cost effective simulation in flight training \$100

63720N

ZPN 07 Education and training development

25 Maintenance training. NTEC 360

33 Application of instructional technology to shipboard training problems. NPRDC 175

*ZPN 58 Performance aids test and evaluation 500

\$1035

*Figures also used for Training Devices and Instructional Technology.

NAVY

INSTRUCTIONAL TECHNOLOGY

61152N

ZRO 4206

03.01 Instructional psych. NPRDC \$ 60

61153N (42)

RR 042-06 Learning and training. ONR 772

62757N

F 55-522 Training. NPRDC

002-03-32 Comprehensive strategy for reducing attrition in Navy tech. tng. 100

-34 Instructor's role in individualized instruction 85

010-03-02 S-3A tact. optr. team training improvement 50

011-03-01 Language skills: assessment and enhancement 150

012-03-01 Criterion referenced training, testing programs (50% instructional technology; 50% CAI)* 50

435

F 55-525 Human engineering.

6754 Instructional systems development and effectiveness evaluation. NTEC 650

*Letter from NPRDC, 9 May 1977

NAVY

INSTRUCTIONAL TECHNOLOGY Cont'd

63720N

ZPN 07	Educational and training development.	NPRDC	
01C	Design of training systems/prototype models.	TAEG	\$200
*25	Maintenance training.	NTEC	360
26	T&E of a Navy instructor system for the 1980 decade		125
30A	Adaptive experimental approach to instructional design (66% Instructional Technology; 33% CAI)**		465
*30B	Computer-managed instruction in Navy tech. tng.		225
*33	Application of instructional technology to shipboard training problems		175
34	Prerequisite skills training system		225
*ZPN 58	Performance aids test and evaluation.	NPRDC	<u>500</u>
			\$2275

*Figures also used in CE.

**Letter from NPRDC, 9 May 1977

AIR FORCE

FLIGHT SIMULATION

61102F

2313 Human resources. OSR

T3	Human factors in system design: fidelity of simulation. AFHRL-AS	\$ 35
T5	Perceptual, motor and cognitive components of the flying task. AFHRL-FT (+ \$177K in-house)	
	ASU research support	15
	Learner-instructor strategies	30
	Information storage & retrieval	50
	Visual motion cue analysis	40
		<hr/> 135

62205F

1123 Flying training development. AFHRL-FT

	Maintenance of TAC flying skills	70
	ASUPT stratified sampling	2
	TTB motion/no-motion study	270
	ACM motion/no-motion study	263
		<hr/> 605

6114 Simulation techniques for AF training. AS

	CIG image improvement	62
	High res. color projector	45
	Multiviewer display	53
	Multiviewer display	58
	CIG edge utilization	75
	Schlieren display	75
	Sensor characterization	50
	Sensor data base	70
	Sensory modeling	119
	IOS display evaluation	70
	Simulation software	60
	Simulator testing	53
		<hr/> 800

AIR FORCE

FLIGHT SIMULATION, Cont'd

63227F

1958	Training simulator technology integration. AFHRL-AS	
	Holographic monochrome visual display	\$625
	Holographic color visual display	150
	High resolution color camera	30
	High resolution liquid crystal projector	100
	Wide angle multiviewer	-
	Advanced low cost G-cuing system	195
	Advanced motion & force simulation capability	50
	Advanced sensor simulation system	350
	Alternate sensor implementations	-
		<hr/>
		1500
2363	Advanced tactical air combat simulation. AFHRL-AS (plus \$50K in-house)	500
2364	Advanced CIG visual/sensor system AFHRL-AS (plus \$25K in-house)	130

63751F

1192	Advanced simulator for undergraduate pilot training (ASUPT) (AFHRL-FT)	
	CIG. GE	962
	Computer. SEL	497
	Simulator. Singer	416
	Resource protection	25
	(plus in-house effort)	<hr/>
		(73)
		<hr/>
		1900

AIR FORCE

FLIGHT SIMULATION, Cont'd

64227F Flight simulator development. Sim. SPO

2201	KC-135 Boom operator trainer	\$ 800
	B-52 Aerial refueling trainer	2700
2269	Electro-optical viewing system (EVS)	1700
2322	Multi-crew visual systems, wide field of view (MCVW)	
-01	Low-cost wide-angle display	600
-02	Low-cost high-resolution, wide-angle image generator	400
-03	Requirements verification	500
2360	Tactical air/ground simulations (TAGS) A-10	<u>1000</u>
		7500

AIR FORCE

COMPUTER-ASSISTED INSTRUCTION

61102F

2313 Human resources. AFHRL

T3	Human factors in system design: Automated data on instructional technology (ADIT) AFHRL-AS	\$150
T4	Psychological factors in ISD: optimum CAI AFHRL-TT (plus \$40K in-house)	<u>50</u>
		200

63751F

1193 Advanced instructional systems. AFHRL-TT 2700

62205F

1121 Technical training development. AFHRL-TT

	Intelligent CAI	70
	Student management	20
	Sequential testing	40
	Micro terminal	40
	Low fidelity simulation	50

1710 Training for advanced AF systems.

	Computer-generated maintenance logic diagrams	<u>30</u>
		250

65101F

3106 MODIA method of developing instructional alternatives.* Project RAND 65

*Figure also used for Costs of Training

AIR FORCE

TRAINING DEVICES (None)

AIR FORCE

COSTS OF TRAINING

62205F

1124 Demonstrate/evaluate human resources in design
and life-cycle costs. AFHRL-AS \$ 95

63243F

2051 Impact of DAIS on life-cycle costs. AFHRL-AS 170

63751F

1959 Analysis of C-130 life-cycle costs. AFHRL-AS 195

65101F

3106 MODIA method of developing instructional
alternatives.* Project RAND 65

*Figure also used for Computer-Assisted Instruction

AIR FORCE

PERFORMANCE MEASUREMENT

61102F

2313 Human resources

T3	Human factors in system design; performance measurement modelling. AFHRL-AS	\$ 40
T4	Psychological factors in ISD: adaptive testing. AFHRL-TT (plus \$50K in-house)	<u>62</u>
		102

62205F

1121 Technical training development. AFHRL-TT

Performance eval:		
	Symbolic performance tests	40
	Performance carrel II	60
	Advanced field evaluation system	70
	Instruct. innov. field performance	44
	OJT performance evaluation	30

1123 Flying training development. AFHRL-FT

C-5	aircrew performance measurement system requirements	<u>30</u>
		\$274

AIR FORCE

COST-EFFECTIVENESS STUDIES OF TRAINING

62205F

1121 Technical training development. AFHRL-TT

Cost effective courseware development

\$ 33

AIR FORCE

INSTRUCTIONAL TECHNOLOGY

61102F

2313 Human resources

T4 Psychological factors in ISD. AFHRL-TT

Criterion checklist (plus \$30K in-house)	\$ 60
APS	25
Learning characteristics	<u>25</u>
	85

62205F

1121 Technical training development. AFHRL-TT

JDRP	20
Automated comprehensability	50
Literacy gap	55

1123 Flying training development. AFHRL-FT

ISD in flying training	65
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1710 Training for advanced AF systems. AFHRL-AS

Simulation and training requirements effectiveness study	315
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Specs and handbook for logic tree troubleshooting aids for intermediate maintenance	<u>90</u>
	595

63751F

1194 Fully proceduralized job performance aids.* AFHRL-AS (plus \$77K in-house)	200
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*Figure also used for Training Devices

6

AIR FORCE

INSTRUCTIONAL TECHNOLOGY

63751F cont'd

2361 Maintenance trainer simulation. AFHRL-TT

6883	401	
Maintenance simulation plan	<u>99</u>	<u>\$500*</u>
(plus \$890 support costs		
190 6.1 reported elsewhere)		700

65101F

3106 Personnel and training support for advanced
avionics. Project RAND 71

*Figure also used for Training Devices

DEFENSE AGENCIES

FLIGHT SIMULATION

IR&D (1)

Flying Training Technology

0509-76DL	Air combat visual simulation Goodyear Aerosp. Corp.	\$450
7048	Advanced-tactical fighter simulation. McDonnell Douglas/McDonnell Acft Co.	224
76-R-1036	Pilot tng technology. Northrop Corp. Aircraft Div.	80
		<hr/> 754

Simulation technology for training

*0509-76-D11	Simulator software development Goodyear Aerospace Corp.	50
**76R611	Flight simulator adaptive training development. Lockheed-Georgia	25
76005401	Digital visual hardware development - Image Gen. Corp. Singer	100
76005402	Digital visual software studies scene content. Singer	200
76005414	Development of high resolution color monitor. Singer	80
76005444	Wide angle display system eval. Singer	200
75005433	Wide angle digital image gen. display. Singer	-
76005405	Advanced simul. tech. software systems. Singer	425
76005432	Calligraphic-digital gen. visual system. Singer	24
*76005445	Laser camera system study. Singer	15
76D5C53	CGI system technology. General Electric	225
76D5C55	Electro-optical viewing system sim. GE	60
*76D5C57	High resolution digital radar landmass simulation. GE	350
*7047.01	Development of adv. simulation concepts. McDonnell Douglas	321
75R5C03	Human factors in computer generated imagery. GE/Valley Forge Space Center	40

*Figures also used for Training Devices

**Figures also used for Computer Assisted Instruction

(1) Note: All data on IR&D taken from "FY 78-82 Research and Technology Plan, Part III," Air Force Human Resources Laboratory, 15 August 1976. Data apply to FY 1976

DEFENSE AGENCIES

FLIGHT SIMULATION Cont'd

Simulation technology for training, cont'd

74R102	Area of interest display technology for GCI. GE	\$ 44
74R103	GCI terrain presentation. GE/Valley Forge Space Center	43
75RC04	Advanced GCI architecture. GE/Valley Forge Space Center	55
74R105	Advanced GCI data base technology. GE/Valley Forge Space Center	9
5001.01	Visual simulation technology studies. McDonnell Douglas Corp/Electronics Co.	300
5002.02	Military simulation system study. McDonnell Douglas Corp/Electronics Co.	112
60203001	Aerial gunnery part-task trainer. Honeywell, Inc/Marine Systems Div.	62
60604002	IR&LLTV simulation study. Honeywell, Inc/Marine Systems Div.	80
		<hr/> \$2820

DEFENSE AGENCIES

COMPUTER-ASSISTED INSTRUCTION

DARPA⁽¹⁾

62709E

TFD-2 Advanced training technology \$528

IR&D

Simulation technology for training

76R611 Flight simulator adaptive training
development. Lockheed-Georgia 25

(1) Data provided by Program Manager

DEFENSE AGENCIES

TRAINING DEVICES

IR&D

Simulation technology for training

*76005445	Laser camera system study. Singer	\$ 15
*76D5C57	High resolution digital radar landmass simulation. GE	350
*7047.01	Development of adv. simulation concepts. McDonnell Douglas	321
*0509-76-D11	Simulator software development. Goodyear Aerospace Corp.	<u>50</u>
		\$736

*Figure also used for Flight Simulation

DEFENSE AGENCIES

COSTS OF TRAINING

DARPA⁽¹⁾

62709E

TFD-2 Advanced training technology \$ 75

IR&D

Personnel and training factors in advanced systems

D5-76-16R	Logistics research. Westinghouse Elec.	175
7026.01	Avionics cost reduction. McDonnell Douglas/McDonnell Acft Co.	55
4.1.5	Life cycle cost modeling. Unit Technologies/Norden Div.	25
76D408	Development of aircraft life cycle estimating methodology. Lockheed- Georgia Co.	80
		<hr/>
		\$335

(1) Data provided by Program Manager

DEFENSE AGENCIES

PERFORMANCE MEASUREMENT

DARPA (1)

62709E

TFD-2 Advanced instructional technology

\$159

(1) Data provided by Program Manager

DEFENSE AGENCIES

COST-EFFECTIVENESS STUDIES (None)

DEFENSE AGENCIES

INSTRUCTIONAL TECHNOLOGY

DARPA (1)

62709E

TFD-2 Advanced training technology \$1217

IR&D

Flying training technology

150 Pilot and flight officer training program.
Rockwell International/Columbus Div. \$225

7047 Development of advanced simulation
concepts. McDonnell Douglas/
McDonnell Acft Co. 321

76005451 Advanced Tng Techniques. Singer Co./
Simulation Prod. Div. 60

606

Technical training technology

76-D-1527 Systems analysis technology studies -
maintainability and system support.
Northrop Corp/Aircraft Div. 65

(1) Data provided by Program Manager