

AD-A286 905



DEFENSE ADVANCED RESEARCH
PROJECTS AGENCY



**FY 1998/1999
DEFENSE BUDGET REVIEW
DESCRIPTIVE SUMMARIES**

SEPTEMBER 1996 96 1021 518

DECLASSIFICATION STATEMENT A
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DEFENSE ADVANCED RESEARCH
PROJECTS AGENCY



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DEFENSE BUDGET REVIEW
DESCRIPTIVE SUMMARIES

SEPTEMBER 1996

UNCLASSIFIED

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

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**DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT**

(\$ in millions)

FY 1996/1999 BUDGET ESTIMATE SUBMISSION (BES)

Budget Activity	Title	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1	Basic Research	77.860	77.246	76.009	80.936	74.000	76.886	76.286	79.286
2	Applied Research	754.520	725.188	777.976	862.372	899.099	1000.397	1059.966	1127.512
3	Advanced Technology Development	1370.345	1333.610	1258.317	1173.306	1174.854	1075.726	1013.654	993.893
6	RDT&E Management Support	<u>80.467</u>	<u>41.879</u>	<u>43.192</u>	<u>44.686</u>	<u>45.347</u>	<u>46.191</u>	<u>47.794</u>	<u>48.409</u>
	TOTAL RDT&E - DIRECT	2283.192	2177.923	2155.500	2161.300	2193.300	2199.200	2197.700	2249.100
	Reimbursements	<u>17.500</u>	<u>17.000</u>	<u>17.000</u>	<u>17.000</u>	<u>17.000</u>	<u>17.000</u>	<u>17.000</u>	<u>17.000</u>
	TOTAL PROGRAM	2300.692	2194.923	2172.500	2178.300	2210.300	2216.200	2214.700	2266.100

**DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT**
(\$ in millions)

FY 1998/1999 BUDGET ESTIMATE SUBMISSION (BES)

FE	PROJ	TITLE	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
61101E	CCS-02	INFORMATION SCIENCES	23.103	23.539	19.005	18.900	20.900	20.400	23.700	20.700
	ES-01	ELECTRONIC SCIENCES	37.217	42.007	42.004	44.345	33.478	36.533	31.533	37.533
	MS-01	MATERIALS SCIENCES	17.540	11.700	15.000	17.691	19.622	19.953	21.053	21.053
61101E		MATERIALS SCIENCES	77.860	77.246	76.009	80.936	74.000	76.886	76.286	79.286
62301E	ST-01	JASONS	1.000	1.196	1.190	1.200	1.200	1.200	1.200	1.200
	ST-11	INTELLIGENT SYSTEMS & SOFTWARE	91.316	96.805	105.912	110.481	110.256	127.007	143.007	147.007
	ST-19	HIGH PERFORMANCE COMPUTING	185.950	190.396	189.529	200.857	213.081	236.811	233.492	241.292
	ST-22	SOFTWARE ENGINEERING TECHNOLOGY	26.342	18.072	19.609	20.196	20.803	21.428	21.428	21.428
	ST-23	MONITORING TECHNOLOGIES	27.759	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	ST-24	INFORMATION SURVIVABILITY	26.134	38.098	45.812	46.113	50.115	55.048	70.654	75.000
	ST-25	ADAPTIVE COMPUTING	0.000	0.000	0.000	0.000	0.000	10.000	30.000	30.000
62301E		COMPUTING SYS & COMM TECHNOLOGY	358.561	344.567	362.052	378.847	395.455	451.492	499.781	515.927
62702E	TT-03	NAVAL WARFARE TECHNOLOGY	38.915	31.219	27.422	39.296	54.553	59.172	59.172	60.172
	TT-04	ADVANCED LAND SYSTEMS TECHNOLOGY	33.742	22.125	20.000	30.000	33.909	51.686	61.686	69.886
	TT-05	ADVANCED TARGETING TECHNOLOGY	6.919	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	TT-06	ADVANCED TACTICAL TECHNOLOGY	37.253	45.995	63.753	58.418	57.024	82.728	72.728	82.728
	TT-07	AERONAUTICS TECHNOLOGY	2.000	3.000	12.000	12.000	8.000	10.011	10.000	15.000
	TT-10	ADVANCED LOGISTICS TECHNOLOGY	4.328	19.154	25.738	27.665	10.633	10.000	0.000	0.000
62702E		TACTICAL TECHNOLOGY	123.157	121.493	148.913	167.379	164.119	193.597	203.586	227.786
62708E	IC-03	INTEGRATED COMMAND & CONTROL TECH	44.416	45.000	43.000	45.000	45.000	45.000	0.000	0.000
62712E	MPT-01	MATERIALS PROCESSING TECHNOLOGY	117.372	111.428	86.476	90.287	111.350	120.927	146.127	169.327
	MPT-02	MICROELECTRONIC DEVICE TECHNOLOGIES	54.399	66.133	71.331	95.660	96.222	98.881	110.972	120.972
	MPT-06	CRYOGENIC ELECTRONICS	29.042	9.835	13.190	13.203	12.546	15.000	20.000	25.000
	MPT-07	MILITARY MEDICAL/TRAUMA CARE TECHNOLOGY	27.633	26.672	26.714	37.686	54.407	55.500	59.500	58.500
62712E		MATERIALS & ELECTRONICS TECHNOLOGY	228.446	214.128	191.711	236.846	274.525	290.308	336.599	373.799
62XXXE	BW-01	BIOLOGICAL WARFARE DEFENSE	0.000	0.000	32.300	34.300	20.000	20.000	20.000	10.000

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
(\$ in millions)

FY 1998/1999 BUDGET ESTIMATE SUBMISSION (BE3)

FE	PROJ	TITLE	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
63226E	EE-21	COMMAND & CONTROL INFORMATION SYSTEMS	41.980	50.927	61.208	66.300	80.369	91.234	100.234	99.034
	EE-27	AEROSPACE SURVEILLANCE TECHNOLOGIES	3.000	0.000	24.900	26.800	18.100	11.000	6.000	27.000
	EE-34	GUIDANCE TECHNOLOGY	11.876	11.499	27.661	29.600	29.212	28.000	34.200	52.000
	EE-36	ADVANCED SHIP/SENSOR SYSTEMS	24.239	15.886	22.943	46.144	83.478	89.696	109.696	119.696
	EE-37	ADVANCED SIMULATION	61.065	47.340	33.492	21.698	0.000	0.000	0.000	0.000
	EE-39	UNARMED UNDERSEA VEHICLE SYSTEMS	15.091	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	EE-40	CRITICAL MOBILE TARGETS	114.461	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	EE-41	AIR DEFENSE INITIATIVE	24.881	21.377	0.000	0.000	0.000	0.000	0.000	0.000
	EE-45	GLOBAL GRID COMMUNICATIONS	42.807	45.190	41.982	43.916	44.750	49.549	54.549	49.549
	EE-46	DEFENSE SIMULATION INTERNET (DSI)	25.612	37.119	2.880	1.500	1.500	1.500	0.000	0.000
	EE-47	FAST SHIP/FUTURE SHIP	0.000	16.000	48.000	50.000	36.000	22.000	0.000	0.000
	EE-48	COMBAT HYBRID POWER SYSTEM	0.000	15.400	25.000	28.500	18.000	17.000	4.000	0.000
	EE-49	TER III UAV	23.201	14.749	5.000	0.000	0.000	0.000	0.000	0.000
	EE-50	SENSORS & EXPLOITATION SYSTEMS	0.000	68.139	83.220	85.755	94.200	111.487	135.287	135.287
	EE-51	SMALL UNIT OPERATIONS	20.636	54.066	51.580	68.398	71.413	77.800	88.000	40.000
	EE-53	INFORMATION INTEGRATION SYSTEMS	0.000	64.904	104.424	115.300	115.000	121.000	118.800	110.000
	EECLS	CLASSIFIED	180.247	173.038	166.051	98.110	107.440	92.848	85.648	80.648
	63226E	EEBIT	589.076	635.634	698.241	682.021	699.462	712.914	736.414	713.214
63569E	AS-01	ADVANCED SUBMARINE TECHNOLOGY	31.369	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	63570E	DEFENSE REINVESTMENT	180.752	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MT-03	MT-03	INFRARED FOCAL PLANE ARRAY	39.493	23.995	9.000	11.000	3.000	0.000	0.000	0.000
	MT-04	ELECTRONIC MODULE TECHNOLOGY	93.376	62.377	62.006	94.090	125.160	125.312	127.240	132.425
	MT-05	TACTICAL INFORMATION SYSTEMS	20.697	25.078	34.884	35.846	31.000	27.500	27.500	27.500
	MT-06	MICROWAVE & ANALOG FRONT END TECHNOLOGY	39.665	43.221	43.071	39.000	25.000	0.000	0.000	0.000
	MT-07	CENTERS OF EXCELLENCE	16.841	14.000	0.000	0.000	0.000	0.000	0.000	0.000
	MT-08	MANUFACTURING TECHNOLOGY APPLICATIONS	59.539	33.591	30.155	25.000	21.951	0.000	0.000	0.000
	MT-10	ADVANCED LITHOGRAPHY	57.509	51.404	40.000	40.000	40.000	40.000	37.500	35.754
	MT-11	ELECTRONIC COMMERCE RESOURCE CENTERS	31.073	20.704	0.000	0.000	0.000	0.000	0.000	0.000
	MT-12	MEMS	30.738	57.800	72.060	71.549	69.281	80.000	50.000	50.000
	MT-13	ADVANCED MICROSYSTEMS	0.000	0.000	0.000	0.000	15.000	35.000	35.000	35.000
	63739E	ADVANCED ELECTRONICS TECHNOLOGIES	388.931	332.168	291.176	316.245	330.392	287.812	277.240	280.679

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
PROJECT LEVEL SUMMARY REPORT
(\$ in millions)

FY 1998/1999 BUDGET ESTIMATE SUBMISSION (BES)

PE	PROJ	TITLE	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
63744E	SM-01	ADVANCED SIMULATION - NATIONAL GUARD	4.809	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63745E	EM-01	SEMICONDUCTOR MANUFACTURING TECHNOLOGY	85.440	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63746E	MIR-01	MARITIME TECHNOLOGY	48.351	37.408	50.000	0.000	0.000	0.000	0.000	0.000
63747E	EV-01	ELECTRIC VEHICLES	14.694	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63800E	JA-01	JOINT STRIKE FIGHTER PROGRAM	28.917	78.400	23.900	0.000	0.000	0.000	0.000	0.000
63805E	GC-01	DUAL USE APPLICATIONS PROGRAMS	0.000	250.000	195.000	175.000	145.000	75.000	0.000	0.000
65114E	BL-01	BLACKLITE	4.623	4.730	4.683	5.000	5.000	5.000	5.000	5.000
65502E	SB-01	SMALL BUSINESS INNOVATIVE RESEARCH	42.425	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65898E	MIH-01	MANAGEMENT HEADQUARTERS (R&D)	33.419	37.149	38.515	39.686	40.347	41.191	42.794	43.409
	AGENCY TOTAL		2283.192	2177.923	2155.500	2161.300	2193.300	2199.200	2197.700	2249.100
BA-01	TOTAL		77.860	77.246	76.009	80.936	74.000	76.886	76.286	79.286
BA-02	TOTAL		754.520	725.188	777.976	862.372	899.099	1000.397	1059.966	1127.512
BA-03	TOTAL		1370.345	1333.610	1258.317	1173.306	1174.854	1075.726	1013.654	993.893
BA-06	TOTAL		80.467	41.879	43.198	44.686	45.347	46.191	47.794	48.409
	AGENCY TOTAL		2283.192	2177.923	2155.500	2161.300	2193.300	2199.200	2197.700	2249.100

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
RESEARCH, DEVELOPMENT, TEST AND EVALUATION, DEFENSEWIDE
OBJECT CLASSIFICATION
(\$ in Thousands)

	FY 1996 Actual	FY 1997 Estimate	FY 1998 Estimate	FY 1999 Estimate
<u>Personnel Compensation</u>				
11.1 Full-Time Permanent	10,144	10,614	10,849	11,068
11.3 Other Than Full-Time Permanent	951	980	1,009	1,039
11.5 Other Personnel Compensation	476	496	594	606
11.8 Special Personnel Services Payments	5,291	2,700	2,164	2,686
Total Personnel Compensation	16,862	20,790	21,616	22,399
<u>Direct Obligations</u>				
11.9 Total Personnel Compensation	16,862	20,790	21,616	22,399
12.0 Civilian Personnel Benefits	2,191	2,204	2,207	2,289
21.0 Travel and Transportation of Persons	3,367	3,441	3,517	3,598
23.1 Rental Payments to GSA	1,932	1,975	2,018	2,064
23.2 Rental Payments to Others	145	149	152	155
23.3 Communications, Utilities and Miscellaneous Charges	12,481	12,756	2,176	2,226
24.0 Printing and Reproduction	25	26	26	27
25.5 R&D Contracts	2,297,574	2,106,895	2,078,584	2,077,679
25.1 Advisory & Assistance Services	45,626	44,342	46,116	47,038
26.0 Supplies and Materials	675	690	705	721
31.0 Equipment	3,691	2,024	2,084	2,147
Total Direct Obligations	2,384,569	2,195,292	2,159,201	2,160,343
<u>Reimbursable Obligations</u>				
25.5 R&D Contracts	17,500	17,000	17,000	17,000
Total Obligations	2,402,069	2,212,292	2,176,201	2,177,343

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1986

Budget Plan

		Estimate	Estimate	Estimate	Estimate
		FY 1986	FY 1987	FY 1988	FY 1989
Identification code: 97-0400-DE					
Program by activities:					
Direct Program:					
01.000	Basic Research	77,866	77,246	76,009	80,936
02.000	Applied Research	754,520	725,188	777,978	862,372
03.000	Advanced Technology Development	1,370,345	1,333,610	1,258,317	1,173,206
06.000	Management Support	80,467	41,879	43,198	44,686
	Total Direct Program	2,283,192	2,177,923	2,155,500	2,161,300
R01.000	Reimbursable Program	17,500	17,000	17,000	17,000
	Total Program	2,300,692	2,194,923	2,172,500	2,178,300
Financing:					
F11.010	New Federal Funds (-)	-17,500	-17,000	-17,000	-17,000
	Total Budget Authority	2,283,192	2,177,923	2,155,500	2,161,300
Budget authority:					
F40.010	Appropriation ENVEST	2,391,877	2,177,923	2,155,500	2,161,300
F40.720	Reduction pursuant to P.L. 104-61	-8,370			
F40.730	Reduction pursuant to P.L. 104-134	-21,487			
F41.000	Transferred to other accounts	-83,129			
F42.000	Transferred from other accounts	4,301			
	Total Budget Authority	2,283,192	2,177,923	2,155,500	2,161,300

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

Budget Plan

Estimate
 FY 1996

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research	77,860
02.000	Applied Research	754,520
03.000	Advanced Technology Development	1,370,345
06.000	Management Support	<u>80,467</u>

Total Direct Program

2,283,192

R01.000 Reimbursable Program

17,500

Total Program

2,300,692

Financing:

F11.010 New Federal Funds (-)

-17,500

Total Budget Authority

2,283,192

Budget authority:

F40.010	Appropriation EN/EST	2,391,677
F40.720	Reduction pursuant to P.L. 104-61	-8,370
F40.730	Reduction pursuant to P.L. 104-134	-21,487
F41.000	Transferred to other accounts	-83,129
F42.000	Transferred from other accounts	<u>4,301</u>
	Total Budget Authority	2,283,192

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

Budget Plan

Estimate
 FY 1997

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research	77,246
02.000	Applied Research	725,186
03.000	Advanced Technology Development	1,333,610
06.000	Management Support	<u>41,879</u>

Total Direct Program

2,177,923

R01.000 Reimbursable Program

17,000

Total Program

2,194,923

Financing:

F11.010 New Federal Funds (-)

-17,000

Total Budget Authority

2,177,923

Budget authority:

F40.010	Appropriation ENVEST	2,177,923
F40.720	Reduction pursuant to P.L. 104-61	
F40.730	Reduction pursuant to P.L. 104-134	
F41.000	Transferred to other accounts	
F42.000	Transferred from other accounts	
	Total Budget Authority	<u>2,177,923</u>

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

Budget Plan

Estimate
 FY 1996

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research	76,009
02.000	Applied Research	777,976
03.000	Advanced Technology Development	1,258,317
06.000	Management Support	<u>43,198</u>

Total Direct Program

2,155,500

R01.000 Reimbursable Program

17,000

Total Program

2,172,500

Financing:

F11.010 New Federal Funds (-)

-17,000

Total Budget Authority

2,155,500

Budget authority:

F40.010	Appropriation EN/EST	2,155,500
F40.720	Reduction pursuant to P.L. 104-61	
F40.730	Reduction pursuant to P.L. 104-134	
F41.000	Transferred to other accounts	
F42.000	Transferred from other accounts	
	Total Budget Authority	<u>2,155,500</u>

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

Budget Plan

Estimate
 FY 1999

Identification code: 97-0400-DE

Program by activities:

Direct Program:

01.000	Basic Research	80,936
02.000	Applied Research	862,372
03.000	Advanced Technology Development	1,173,306
06.000	Management Support	<u>44,686</u>

Total Direct Program:

2,161,300

R01.000 Reimbursable Program

17,000

Total Program

2,178,300

Financing:

F11.010 New Federal Funds (-)

-17,000

Total Budget Authority

2,161,300

Budget authority:

F40.010	Appropriation ENVEST	2,161,300
F40.720	Reduction pursuant to P.L. 104-61	
F40.730	Reduction pursuant to P.L. 104-134	
F41.000	Transferred to other accounts	
F42.000	Transferred from other accounts	
	Total Budget Authority	<u>2,161,300</u>

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

		Obligation Summary			
Identification code: 97-0400-DE		Estimate FY 1996	Estimate FY 1997	Estimate FY 1998	Estimate FY 1999
Program by activities:					
Direct Program:					
01.000	Basic Research	69,262	77,347	76,214	80,123
02.000	Applied Research	733,576	730,028	769,266	848,447
03.000	Advanced Technology Development	1,512,985	1,339,671	1,270,741	1,187,333
06.000	Management Support	58,746	48,246	42,980	41,440
	Total Direct Obligations	2,384,569	2,195,292	2,159,201	2,160,343
R01.000	Reimbursable Obligations	17,500	17,000	17,000	17,000
	Total Obligations	2,402,069	2,212,292	2,176,201	2,177,343
Financing:					
Offsetting Collections From:					
F14.020	New Non-Federal Sources	0	0	0	0
F11.010	New Federal Funds (-)	-17,500	-17,000	-17,000	-17,000
F21.020	Unobligated balance available at start of year:				
F22.410	for completion of prior year budget plans	-481,453	-376,727	-359,358	-355,657
	Unobligated balance transferred from other accounts	-2,600			
F24.020	Unobligated balance available end of year				
	For completion of prior year budget plans	376,727	359,358	355,657	356,615
	Total Budget Authority	2,384,569	2,195,292	2,159,201	2,150,343
Budget authority:					
F40.010	Appropriation ENVEST	2,549,203	2,195,292	2,159,201	2,160,343
F40.720	Reduction pursuant to P.L. 104-61	-8,370			
F40.730	Reduction pursuant to P.L. 104-134	-27,436			
F41.000	Transferred to other accounts	-83,129			
F42.000	Transferred from other accounts	4,301			
	Total Budget Authority	2,384,569	2,195,292	2,159,201	2,160,343

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1996

Identification code: 97-0400-DE

Obligations

Fiscal Year 1995 Funds

FY 1996 Estimate

Program by activities:

Direct Program:

01.000	Basic Research	4,249
02.000	Applied Research	103,552
03.000	Advanced Technology Development	368,747
06.000	Management Support	1,558
	Total Direct Obligations	478,104
	Total Obligations	478,104

Financing:

F21.020	Unobligated balance available, start of year:	-481,453
F22.410	For completion of prior year budget plans	-2,600
	Unobligated balance transferred from other account	
	Total Budget Authority	-5,949

F40.730 Reduction pursuant to P.L. 104-134

-5,949

Total Budget Authority

-5,949

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands) September 1996

		Obligations
Identification code: 97-0400-DF		Fiscal Year 1996 Funds
Program by activities:		FY 1996 Est. FY 1997 Est.
Direct Program:		
01.000	Basic Research	6,013 12,847
02.000	Applied Research	630,024 124,496
03.000	Advanced Technology Development	1,144,238 226,107
06.000	Management Support	57,190 13,277
	Total Direct Obligations	1,908,465 376,727
R01.000	Reimbursable Obligations	17,500
	Total Obligations	1,923,965 376,727
Financing:		
F11.010	Offsetting collections from: New Federal Funds	-17,500
F21.020	Unobligated balance available, start of year: For completion of prior year budget plans	-376,727
F24.020	Unobligated balance available, end of year: For completion of prior year budget plans	376,727
	Total Budget Authority	2,283,192 0
F40.010	Appropriation ENVEST	2,391,877 0
F40.720	Reduction pursuant to P.L. 104-61	-8,370
F40.730	Reduction pursuant to P.L. 104-134	-21,487
F41.000	Transferred to other accounts	-83,129
F42.000	Transferred from other accounts	4,301
	Total Budget Authority	2,283,192 0

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1998

Obligations

Fiscal Year 1997 Funds

Identification code: 97-0400-DE

FY 1997 Est. FY 1998 Est.

Program by activities:

Direct Program:

01.000	Basic Research	64,500	12,748
02.000	Applied Research	805,532	119,656
03.000	Advanced Technology Development	1,113,564	220,046
06.000	Management Support	34,969	6,910
	Total Direct Obligations	1,818,565	359,358
R01.000	Reimbursable Obligations	17,000	
	Total Obligations	1,835,565	359,358

Financing:

F11.010	Offsetting collections from: New Federal Funds	-17,000	
F21.020	Unobligated balance available, start of year: For completion of prior year budget plans		-359,358
F24.020	Unobligated balance available, end of year: For completion of prior year budget plans	359,358	
	Total Budget Authority	2,177,923	0

F40.010 Appropriation EN/EST

2,177,923 0

Total Budget Authority

2,177,923 0

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1998

Obligations

Fiscal Year 1998 Funds

Identification code: 97-0400-DE

FY 1998 Est. FY 1999 Est.

Program by activities:

Direct Program:

01.000	Basic Research	63,468	12,541
02.000	Applied Research	648,610	128,388
03.000	Advanced Technology Development	1,050,695	207,622
06.000	Management Support	36,070	7,128

Total Direct Obligations

1,799,843 355,657

R01.000 Reimbursable Obligations

17,000

Total Obligations

1,816,843 355,657

Financing:

Offsetting collections from:
 New Federal Funds

-17,000

F11.010

Unobligated balance available, start of year:
 For completion of prior year budget plans

-355,657

F21.020

Unobligated balance available, end of year:
 For completion of prior year budget plans

355,657

F24.020

Total Budget Authority

2,155,500 C

F40.010 Appropriation EN/EST

2,155,500 0

Total Budget Authority

2,155,500 0

Exhibit PB-2A

Research, Development Test and Evaluation, Defensewide
 Defense Advanced Research Projects Agency
 Program and Financing
 (Dollars in Thousands)

September 1998

----- Obligations

----- Fiscal Year 1999 Funds

Identification code: 97-0400-DE

----- FY 1999 Est.

Program by activities:

Direct Program:

01.000	Basic Research	87,582
02.000	Applied Research	720,081
03.000	Advanced Technology Development	979,711
06.000	Management Support	<u>37,312</u>

Total Direct Obligations

1,804,686

R01.000

Reimbursable Obligations

17,000

Total Obligations

1,821,686

Financing:

Offsetting collections from:

New Federal Funds

F11.010

-17,000

Unobligated balance available, start of year:

For completion of prior year budget plans

F21.020

Unobligated balance available, end of year:

For completion of prior year budget plans

F24.020

356,615

Total Budget Authority

2,161,301

F40.010

Appropriation EN/EST

2,161,301

Total Budget Authority

2,161,301

----- Exhibit PB-2A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE									
RDT&E, Defense-wide BA 1 Basic Research		Defense Research Sciences, PE 0601101E									
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Defense Research Sciences	77,860	77,246	76,002	80,936	74,000	76,886	76,286	79,286	Continuing	Continuing	
Information Sciences CCS-02	23,103	23,539	19,005	18,900	20,900	20,400	23,700	20,700	Continuing	Continuing	
Electronic Sciences ES-01	37,217	42,007	42,004	44,345	33,478	36,533	31,533	37,533	Continuing	Continuing	
Materials Sciences MS-01	17,540	11,700	15,000	17,691	19,622	19,953	21,053	21,053	Continuing	Continuing	
(U) Mission Description: The Defense Research Sciences program element is budgeted in the Basic Research Budget Activity because it provides the technical foundation for long-term improvements through the discovery of new phenomena and the exploration of the potential of such phenomena for military, national security and commercial applications. It supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information, electronic and materials sciences. (U) The Information Sciences project supports basic scientific study and experimentation in software technology, intelligent systems technology, human-computer interface technology, facets of microelectronic sciences, and varied aspects of high performance computing. (U) The Electronic Sciences project explores and demonstrates electronic and optoelectronic device, circuit, and processing concepts that will provide: (1) new technical options for meeting the information gathering, transmission and processing required to maintain near real-time knowledge of the enemy, and the ability to communicate decisions based on that knowledge to all forces in near real time; and (2) a substantial increase in performance and reduction in cost of military systems providing these capabilities. (U) The Materials Sciences project is concerned with the development of: high power density/energy density mobile and portable power sources (including batteries and fuel cells); forward combat casualty care medical technologies; technologies for defense against biological warfare agents; magneto-resistive materials for use in radiation hardened memories and motion sensors; processing and design approaches for nanoscale and/or biomolecular materials and interfaces; and medical pathogen countermeasures.											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE									
RDT&E, Defensewide BA 1 Basic Research		Defense Research Sciences, PE 0601101E									
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Information Sciences CCS-02	23,103	23,539	19,005	18,900	20,900	20,400	23,700	20,700	Continuing	Continuing	

(U) **Mission Description:** This project supports the scientific study and experimentation that is the basis for more advanced knowledge and understanding in information sciences technology areas such as software foundations and environments, intelligent systems, human computer interface, language technology, microelectronic science, and high performance computing related to long-term national security requirements.

(U) In the area of software technology: advanced concepts are developed for methods and tools to produce high assurance software; language concepts that facilitate the rapid specification and evolution of systems; and techniques to manage complex structured data objects in larger heterogeneous, distributed information systems. The intelligent systems technology focus is on advanced techniques for knowledge representation, reasoning, and machine learning, which enables computer understanding of spoken and written language and images. Also included is advanced methods for planning, scheduling, and resource allocation. The focus in the human computer interaction technology area is design methods and enabling technology for more natural interaction between people and computers. Lastly, the high performance computing (HPC) focus is on science generated concepts and methods for validating and verifying design components, and unique approaches to rapidly develop high performance libraries across multiple HPC architectures.

(U) **Program Accomplishments and Plans:**

(U) **FY 1996 Accomplishments:**

- Developed complex software languages and tools to integrate architecture-level representations of software systems and used these representations for analysis and testing. (\$7.6M)
- Enhanced advanced information processing methods in spoken language understanding, written language understanding and automated planning systems. (\$3.7M)
- Experimentally evaluated tool kits for interactive, dialogue-based human computer interaction. (\$4.2M)
- Refined and began experimental evaluation of design technology to include high performance computational prototyping of systems. (\$1.5M)
- Demonstrated utility of scalable libraries for defense tasking; completed basic research effort in scalable operating systems and runtime services; initiated Quorum architecture definition; and demonstrated adaptive computing systems for defense applications. (\$1.9M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 1 Basic Research

R-1 ITEM NOMENCLATURE

Defense Research Sciences,

PE 0601101E, Project CC5-02

- Developed theoretical classifications of ultrascale computational power. (\$2.1M)
- Experimentally evaluated planning and decision aids prototypes for heterogeneous, distributed software system architectures and tools to support construction and maintenance of advanced intelligent systems. (\$2.1M)

(U) FY 1997 Program:

- Complete the development of the tools and tool kits for development and evaluation of highly interactive, agent and dialogue-based human computer interactions. (\$4.7M)
- Advance the capabilities of spoken and written language understanding to solve real-world problems and provide widely usable functionality. (\$5.8M)
- Experimentally evaluate design technology for high performance computational prototyping of systems. (\$2.2M)
- Experimentally support software evolution by integrating numerous formal and informal information sources in a "hyperweb"; enhance formal notations for software design to include both syntactic and semantic information; and demonstrate multi-language architecture definition and analysis tools. (\$5.8M)
- Continue the experimental evaluation of supporting both task and data parallelism for scalable software library technology, and the utility of adaptive computing systems for defense applications. (\$1.2M)
- Demonstrate the feasibility of using ULTRASCALE computing techniques to store & retrieve information. (\$1.9M)
- Define Quorum architecture and validate findings, and define and validate the next generation of languages & runtime services for supporting parallel task applications. (\$1.9M)

(U) FY 1998 Program:

- Demonstrate symbolic simulation linked with hardware emulation for complex design technology. (\$2.0M)
- Complete the experimental evaluation of design technology for high performance computational prototyping of systems, supporting both task and data parallelism for scalable software library technology. (\$1.0M)
- Develop robust spoken and text language technologies with emphasis on affordable dialog grammars and understanding in spite of noise; all technology developed in response to systems experiments focused on critical military needs. (\$9.0M)
- Demonstrate a computational model using ULTRASCALE computing techniques. (\$5.0M)
- Evaluate the quality of service specifications relative to the Quorum architecture. (\$1.1M)
- Demonstrate the languages & runtime services in defense applications, and complete the scalable software library technology demonstration. (\$.9M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE

Defense Research Sciences,
PE 0601101E, Project CCS-02(U) FY 1999 Program:

- Develop algorithms to deal with high noise conditions for speech recognition and then evaluate automatic transcription of conversational speech over phone and battlefield radio with a goal of producing a transcript that is human readable. (\$7.0M)
- Integrate the multi-attributes of performance, realtime and fault-tolerance for Quorum. (\$1.0M)
- Complete this phase of demonstrations, and validations of adaptive computing systems architectures for defense applications. (\$2.0M)
- Complete the design technology demonstration effort. (\$1.9M)
- Continue the demonstration and validation of ULTRASCALE computing technologies and the scalability of these techniques in defense application. (\$6.0)
- Complete validation and demonstrate scalability of languages & runtime services. (\$1.0M)

(U) Program Change Summary: (In Millions)

FY 1996 FY 1997 FY 1998 FY 1999

President's Budget

24.8

23.5

23.0

22.9

Appropriated

22.4

N/A

N/A

N/A

Current Budget

23.1

23.5

19.0

18.9

(U) Change Summary Explanation:

FY 1996 Increase reflects minor program repricing.

FY 1998-99 Reductions reflect greater emphasis on basic research in Materials Technology.

(U) Other Program Funding Summary Cost: N/A(U) Schedule Profile: N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE		September 1996	
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE									
RDT&E, Defensewide				Defense Research Sciences,									
BA 1 Basic Research				PE 0601101E									
COST (In Thousands)		FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost		
Electronic Sciences ES-01		37,217	42,007	42,004	44,345	33,478	36,533	31,533	37,533	Continuing	Continuing		
(U) <u>Mission Description:</u> This project seeks to continue the phenomenal progress in microelectronics innovation that has characterized the last decades through exploring and demonstrating electronic and optoelectronic devices, circuits and processing concepts that will: 1) provide new technical options for meeting the information gathering, transmission and processing required to maintain near real-time knowledge of the enemy, and the ability to communicate decisions based on that knowledge to all forces in near real-time, and 2) provide new means for achieving substantial increases in performance and cost reduction of military systems providing these capabilities. Research areas include new electronic and optoelectronic device and circuit concepts, operation of devices at higher frequency and lower power, extension of diode laser operation to new wavelength ranges relevant to military missions, development of uncooled and novel infrared detector materials for night vision and other sensor applications, development of innovative optical and electronic technologies for interconnecting modules in high performance systems, research to realize field portable electronics with reduced power requirements, research addressing affordability and reliability, and research on microelectromechanical systems (MEMS) technology.													
(U) <u>Program Accomplishments and Plans:</u>													
(U) <u>FY 1996 Accomplishments:</u> - Continued investigation of revolutionary approaches to electronics enabled by very small scale devices (nanoelectronics) which operate in a regime where physical phenomenon not important in conventional devices dominate. Demonstrated that compound semiconductor nanoelectronic devices integrated with conventional devices results in significant reductions in chip area required for complex logic functions. Demonstrated the extension of nanoelectronic device designs to silicon-based devices, compatible with future integration with conventional silicon circuits. (\$12.3M) - Demonstrated optical materials and device designs that enable an order of magnitude reduction in threshold current requirements for diode lasers, demonstrated a means for increasing the bandwidth for direct laser modulation by 25%, and demonstrated technology for applying arrays of optical devices for applications in future high-speed, high capacity switching systems. (\$4.4M) - Demonstrated photonic device applications of non-semiconductor thin films doped with optically active ions and explored material technologies for monolithically integrated optoelectronic components. (\$3.0M)													

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research		R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E, Project ES-01	
• Demonstrated development of high-density integrated electrical/mechanical MEMS along with requisite developments of CAD tools, materials data base, test and characterization methods, and manufacturing processes. (\$6.2M) • Initiated development of uv-blue gallium nitride based LEDs and lasers for high density memory, lightwave countermeasures, covert communications, and warfare. (\$5.5M) • Assessed thermal response characteristics of thin film material for improved sensitivity uncooled infrared detectors. (\$.8M) • Continued low-power electronics program in the area of circuit architecture and power management techniques. Demonstrated Computer Aided Design (CAD) tool for modeling low power circuit designs and estimating circuit static power dissipation. (\$5.0M)			
(U) <u>FY 1997 Program:</u> • Continue the ultra-electronics program with emphasis on the following thrusts: combined nanoelectronics and conventional electronics, silicon-based nanoelectronics, chemical self-assembly, and molecular beam epitaxy (MBE) process control and other fabrication techniques. (\$11.0M) - Demonstrate potential for chemical self-assembled films' use in nanoelectronics. - Demonstrate precision process control of semiconductor heterostructures for advanced nanoelectronic devices. - Demonstrate improved patterning with critical dimensions below 50 nanometers. • Demonstrate monolithically integrated optoelectronics for information processing and demonstrate feasibility of three-dimensional optically addressed memory. (\$5.7M) • Fabricate small (5 x 5) infrared sensitive arrays as verification of material properties. (\$3.0M) • Develop and demonstrate efficient low-voltage conversion/distribution circuits and self-regulating, use-driven power allocation systems. (\$6.7M) • Develop and demonstrate uv pulsed laser diode operation in the gallium nitride system. Identify relationship between defect density and applicability to military applications such as uv solar blind detectors for missile threat warning. (\$10.0M) • Continue low-power electronics program in the areas of circuit architecture and power management techniques. Demonstrate 256 x 256 pixel sensor with on-chip 10-bit Analog to Digital Converter (ADC). Demonstrate strategies for non-disruptive power supply switching for reduced power consumption. (\$5.6M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE
Defense Research Sciences,
PE 0601101E, Project ES-01

(U) FY 1998 Program:

- Optoelectronics - Demonstrate feasibility of using Gallium Nitride detectors as a UV solar-blind detector for missile threat warning and demonstrate UV/blue lasers operating continuous wave for high density memory and chemical/biological detection. (\$10.9M)
- Infrared Detector Materials - Determine process for low temperature deposition of thin film uncooled materials. (\$3.0M)
- Ultra-Electronics - Demonstrate feasibility of combining a resonant tunneling device (RTD) with conventional devices, silicon based quantum MOS technology, and simple quantum cellular automatic logic circuits using silicon and silicon germanium structures. (\$11.6M)
- Ultra-Photonics - Demonstrate practical means for implementing high speed optical buffer memories and signal address recognition based on coherent all-optical (photon-echo) technology. Demonstrate the utility of low cost silicon electronic devices doped with optically active elements (such as Erbium) for applications that are now the exclusive domain of more expensive compound semiconductor devices or glassy materials. (\$10.6M)
- Low Power Electronics - Complete low-power electronics programs in the areas of circuit architecture and power management techniques. Demonstrate 256 x 256 pixel image sensor with on-chip 10-bit Analog-Digital Converter. (\$5.9M)

(U) FY 1999 Program:

- Infrared Detector Materials - Establish feasibility of new uncooled detector structures, including micromachined arrays, thin film ferroelectrics and bolometric materials. (\$3.0M)
- Ultra Electronics - Demonstrate programmable matched filter operating at gigahertz speed with substantially less power than silicon complementary metal oxide semiconductor (Si CMOS), completely integrated molecular beam epitaxy (MBE) growth system which realizes closed-loop control of atomic layer growth and quantum device structures. (\$4.9M)
- Ultra-Photonics - Identify the device properties limiting performance of vertical cavity lasers and demonstrate methods for controlling their output beam quality. (\$7.7M)
- Advanced Microelectronics - Explore new concepts, directed at demonstrating feasibility of radical device and systems architecture concepts. Of particular emphasis will be device concepts in microelectronics and optoelectronics enabled by technology advances in related areas, particularly those in sub 0.1 micron lithography and mixed-technology integration. (\$13.7M)
- Integrate promising new elements of ultra-electronics, high power electronics, non-volatile memory and Electro-Magnetic Interference (EMI) electronics to address current thrusts in smaller, lighter, more mobile information systems and highest performance components and systems. (\$15.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE		
RDT&E, Defensewide BA 1 Basic Research		Defense Research Sciences, PE 0601101E, Project ES-01		
(U)	<u>Program Change Summary:</u> (In Millions)	FY 1996	FY 1997	FY 1998
	President's Budget	42.6	39.7	40.1
	Appropriated	38.3	N/A	N/A
	Current Budget	37.2	42.0	44.3
(U)	<u>Change Summary Explanation:</u>			
	FY 1996 Decrease reflect minor repricing adjustments.			
	FY 1997-99 Increase reflects program adjustments.			
(U)	<u>Other Program Funding Summary Cost:</u> N/A			
(U)	<u>Schedule Profile:</u> N/A			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 1 Basic Research				R-1 ITEM NOMENCLATURE Defense Research Sciences, PE 0601101E							
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Materials Sciences MS-01	17,540	11,700	15,000	17,691	19,622	19,953	21,053	21,053	Continuing	Continuing	

(U) **Mission Description:** This project is concerned with the development of: high power density/high energy density mobile and portable power sources (including batteries and fuel cells); forward combat casualty care medical technologies; technologies for defense against biological warfare agents; magneto-resistive materials for use in radiation hardened memories and motion sensors; advanced thermoelectric materials for cooling and power generation; processing and design approaches for nanoscale and/or biomolecular materials and interfaces; and medical pathogen countermeasures.

(U) **Program Accomplishments and Plans:**

(U) **FY 1996 Accomplishments:**

- Electrochemistry. (\$10.4M)
 - Developed and demonstrated a high efficiency fuel reformer for fuel cell applications to process logistic fuel (e.g., DF-2, JP-8).
 - Demonstrated fuel cell operation using either hydrogen or methanol with performance adequate for soldier applications.
 - Tested a novel direct oxidation logistics fuel cell concept.
- Biomedical. (\$1.7M)
 - Exploited technology base developments in microelectronics, sensors, communications, imaging and simulation to enhance far-forward combat casualty care. This project provides component and modular additions to the Personnel Status Monitor (PSM) under development in PE 0602712E, project MPT-07.
 - Accelerated development of a Ranger Overwatch personnel status monitor (RO-PSM) with standard PSM configuration and added temperature and shiver sensors to detect hypothermia.
 - Developed haptic interface for virtual environments and holographic display for virtual images in simulation.
- Biological Warfare (BW) Defense. (\$3.2M)
 - Continued development of technology for antibody deposition on chips for real-time BW sensing.
 - Initiated structure-based design of antibody combining site for spore identification.
 - Initiated engineering analysis for miniature environmental air sampler to transfer biological materials into fluids.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE
Defense Research Sciences,
PE 0601101E, Project MS-01

- Demonstrated the feasibility (in the laboratory) of using red blood cells and stem cells to eliminate pathogens from the blood for the purpose of potential defense against biological weapons.
- Magnetic Materials and Devices. (\$2.3M)
- Demonstrated enhanced magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of magnetic devices.
- Evaluated spin transistor and spin tunneling devices for use in sensors and non-volatile memories.

(U) FY 1997 Program:

- Electrochemistry. (\$8.6M)
- Develop and test a thermally integrated fuel cell stack and reformer which operates on logistics fuel.
- Demonstrate direct oxidation, liquid-feed methanol fuel cell stack operation with performance adequate for soldier applications.
- Biomedical. (\$1.7M)
- Develop miniaturized and rechargeable polymer power sources for the Personnel Status Monitor (PSM); augment sensor suite with "sensitive liner" intelligent clothing.
- Magnetic Materials and Devices. (\$1.4M)
- Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.

(U) FY 1998 Program:

- Electrochemistry. (\$11.5M)
- Construct and test a logistics fueled fuel cell power plant for mobile electric power applications.
- Begin component and system study/demonstration of a direct oxidation fuel cell for replacement of military standard batteries.
- Explore alternative sources of energy for portable power applications.
- Develop and demonstrate thermoelectric materials with significantly improved figure of merit.
- Nanoscale/Biomolecular Materials. (\$1.5M)
- Exploit recent advances in materials design and processing to demonstrate nanostructural control of materials properties with an emphasis on emulating the complex microstructure and scale of biological materials.
- Pathogen Countermeasures. (\$2.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 1 Basic Research

R-1 ITEM NOMENCLATURE

Defense Research Sciences,
PE 0601101E, Project MS-01

- Determine one or more mechanisms a stem cell could use to link detection of a pathogen to the production by the cell of vaccines and/or therapeutics.

(U) FY 1999 Program:

- Portable Power. (\$11.0M)
- Optimize catalysts, polymeric membranes, and separator plates for high energy density fuel cell operation.
- Brassboard testing of compact, high performance energy sources for portable power applications.
- Demonstrate novel thermoelectric cooling and power generation devices based on advanced materials.
- Nanoscale/Biomolecular Materials. (\$3.7M)
- Demonstrate the applicability of nanostructural and/or biomolecular materials in defense applications such as armor, high strength fibers, or coatings.
- Pathogen Countermeasures. (\$3.0M)
- Develop understanding of disease-causing (virulence) factors in pathogens of concern to DoD.

(U) Program Change Summary: (In Millions)

	FY 1996	FY 1997	FY 1998	FY 1999
President's Budget	22.4	11.7	11.5	18.7
Appropriated	18.2	N/A	N/A	N/A
Current Budget	17.5	11.7	15.0	17.7

(U) Change Summary Explanation:

- FY 1996 Decrease reflects inflation related reductions.
FY 1998 Increase reflects new efforts in nanoscale/biomolecular materials and thermoelectric materials.
FY 1999 Decrease reflects minor program repricing.

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile: N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
APPROPRIATION/BUDGET ACTIVITY					DATE				
RDT&E, Defensewide BA 2 Applied Research					September 1996				
R-1 ITEM NOMENCLATURE					Computing Systems and Communications Technology, PE 0602301E				
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Total Cost
Computing Systems and Communications Technology									
JASON	358,501	344,567	362,052	378,847	395,455	451,492	499,781	515,927	Continuing
ST-01	1,000	1,196	1,190	1,200	1,200	1,200	1,200	1,200	Continuing
Intelligent Systems & Software ST-11	91,316	96,805	105,912	110,481	110,256	127,007	143,007	147,007	Continuing
High Performance Computing ST-19	185,950	190,396	189,529	200,857	213,081	236,811	233,492	241,292	Continuing
Software Engineering Technology ST-22	26,342	18,072	19,609	20,196	20,803	21,428	21,428	21,428	Continuing
Monitoring Technologies ST-23	27,759	0	0	0	0	0	0	0	N/A
Information Survivability ST-24	26,134	38,098	45,812	46,113	50,115	55,046	70,654	75,000	Continuing
Adaptive Computing ST-25	0	0	0	0	0	10,000	30,000	30,000	Continuing
(U) Mission Description: This program element is budgeted in the Applied Research Budget Activity because it funds projects directed toward the application of advanced, innovative computing systems and communications technologies. These programs include: (U) DARPA leadership of the Federal High Performance Computing and Communications Initiative to develop technologies that lead to successive generations of more secure, higher performance, and more cost-effective scalable systems critical to defense operations and federal needs.									

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E		
(U) The efforts funded in the Intelligent Systems and Software project focus on the development of new information processing technology concepts that lead to fundamentally new software and intelligent system capabilities. Emphases are in intelligent systems including autonomous systems, interactive problem solving, intelligent integration of information, software development, and manufacturing automation and design engineering. (U) The Software Engineering Technology project supports the Software Engineering Institute (SEI) that works to transition state-of-the-art technology, and introduce and promulgate modern software in the defense industry. (U) The Monitoring Technologies project provides the technology to collect and fuse surveillance sensor data, with particular focus on those technologies needed by the U.S. to support the Comprehensive Nuclear Test Ban Treaty (CTBT) negotiations which began in 1994, the Non-Proliferation Treaty conference which convened in 1995, and the regimes established to verify these treaties. CTBT verification readiness transfers to Air Force P.E. 0305154F in FY 1997. (U) The Information Survivability project develops the technology base underlying the solutions to protecting DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high-performance computing technologies. (U) The JASON Group supports studies for the national security community.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research				R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E							
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
JASON ST-01	1,000	1,196	1,190	1,200	1,200	1,200	1,200	1,200	Continuing	Continuing	
(U) <u>Mission Description:</u> This project supports the JASONS, an independent group of distinguished scientists and technical researchers that provides analysis of critical National Security issues. JASON membership is carefully balanced to provide a wide spectrum of scientific expertise and technical analysis in theoretical and experimental physics, materials, information sciences, and other allied disciplines. The JASON process ensures senior government leaders have available the full range of U.S. academic expertise on issues critical to National Security involving classified and unclassified information. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> - Continued studies in: Nuclear and chemical weapons proliferation, precision strike weapons, global surveillance and communications; counter drug surveillance techniques; shallow water ASW; advanced signal processing; and counter terrorism. (U) <u>FY 1997 Program:</u> - Continue studies in: Counter proliferation of chemical and biological weapons; precision deep strike weapons, battlefield information systems, battlefield planning and control, law enforcement surveillance techniques; land mine detection; advanced sensor technologies; global surveillance and intelligence; and counter terrorism. (U) <u>FY 1998 Program:</u> - Continue studies of interest to DoD in multiple disciplines such as: Counter proliferation of chemical and biological weapons; precision deep strike weapons, battlefield information systems, battlefield planning and control, law enforcement surveillance techniques; land mine detection; advanced sensor technologies; global surveillance and intelligence; and counter terrorism. (U) <u>FY 1999 Program:</u> - Continue studies of interest to DoD.											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-01			
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998
	President's Budget		1.2	1.2	1.2
	Appropriated		1.2	N/A	N/A
	Current Budget		1.0	1.2	1.2
(U)	<u>Change Summary Explanation:</u>				
	FY 1996 Reduction reflects transfer to SBIR program element.				
(U)	<u>Other Program Funding Summary Cost:</u> N/A				
(U)	<u>Schedule Profile:</u> N/A				

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Computing Systems and Communications Technology,
PE 0602301E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Intelligent Systems and Software ST-11	91,316	96,805	105,912	110,481	110,256	127,007	143,007	147,007	Continuing	Continuing

(U) Mission Description: This project develops new information processing technology concepts that lead to fundamentally new software and intelligent systems capabilities. This will enable advanced information systems to more effectively accomplish decision-making tasks in stressful, time sensitive situations and create efficient software systems supporting computer and software intensive defense systems. Major areas of technical emphasis are:

(a) intelligent systems (artificial intelligence) including autonomous systems, image understanding, interactive problem solving and intelligent integration of information from heterogeneous sources; (b) software development technology including languages, algorithms, data and object bases, domain specific software architectures, software prototype technology, software design tools, software reuse, and advanced software engineering environments; (c) manufacturing automation and design engineering, including the development of advanced software systems which support sharing of engineering knowledge, advanced product and process design representations, integrated product and process design, software tools for design process management, manufacturing process planning, manufacturing process control and demonstrations; (d) Text Video Speech (TVS) technology focusing on the integration and application of emerging language understanding technology for both C4I and Intelligence community needs; and (e) organizing resources to obtain access to multiple systems and decision aids that provide logistical information when and where it is needed.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Demonstrated and evaluated advanced reconnaissance, surveillance, and target acquisition algorithms on unmanned ground vehicle; installed baseline RADIUS Site Monitoring System at National Photographic Interpretation Center; delivered first version image understanding environment. (\$10.9M)
- Experimentally evaluated implementations for human-aided machine language translation, document understanding, and robust speech understanding in adverse acoustic conditions. (\$12.9M)
- Experimentally evaluated implementations of real-time planning and control algorithms. (\$1.8M)
- Evaluated knowledge-based planning and decision aids to support the rapid construction of multiple crisis action plans in an operational exercise. (\$9.5M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-11	
- Developed new techniques for intelligently locating, filtering, accessing, and integrating information from disparate, heterogeneous, distributed information sources and demonstrated the use of those techniques in accessing information for air campaign planners, logistics planners, satellite imagery users, weapon system engineers, and others. (\$11.9M) - Developed an initial library of knowledge base components to support the creation and maintenance of High Performance Knowledge Bases in military command and control. (\$1.8M) - Developed planning and control algorithms for tasking multiple homogeneous assets in support of small unit operations. (\$3.5M) - Integrated Artificial Intelligence based research technologies with numerical simulations and CAD Models, and demonstrated a three fold reduction in trade-off analysis and collaborative design optimization. (\$11.2M) - Continued the human computer interaction heterogeneous testbed product development and insertion. Tested, evaluated, and demonstrated enhancements to the user community. (\$6.9M) - Defined consensus Architecture Description Language and Interactive Architecture Synthesis Tools and initiated development of tools for complex system design. (\$4.2M) - Developed and demonstrated multi-echelon, collaborative logistical support tools that integrate planning, execution, monitoring and decisions support systems to achieve real time logistical reallocation and redeployments within and between commands. (\$4.1M) - Supported software initiatives at the National Applied Software Engineering Center (NASEC), Johnstown. (\$9.6M) - Supported Software Productivity Consortium. (\$3.0M)			
(U) <u>FY 1997 Program:</u> - Continue development of human-computer interaction, heterogeneous testbed products and insertion. Test, evaluate and demonstrate enhancements to the developer and user communities. (\$6.3M) - Experimentally evaluate methods for building information detection filters from text, and baseline topic concept recognition from radio news broadcasts. (\$4.6M) - Evaluate distributed design tools and demonstrate multi-agent systems for capture of collaborative design history. (\$14.7M) - Develop modular Human Language Technologies to support easy, low-cost, rapid technology transfer and application development for Document Understanding, Machine Translation, and Speech Understanding. (\$6.4M) - Develop performance enhancements in planning/scheduling algorithms and advanced architectures planning and decision aids systems. (\$10.1M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM MONITORING Computing Systems and Communications Technology, PE 0602301E, Project ST-11	
• Extend Architecture Description Language for complex systems to include performance and context information. (\$6.1M) • Initial implementation of distributed dynamic language and real-time dynamic language. (\$5.0M) • Initial web-structure configuration management capability. (\$4.4M) • Support software initiatives at the MASEC, Johnstown. (\$10.0M) • Develop new image understanding technologies for image exploitation, automatic population of geospatial databases, and video surveillance and monitoring to enhance battlefield awareness. (\$6.0M) • Perform university research toward development of automated target recognition technologies that operate effectively under difficult circumstances involving obscuration, camouflage, and urban settings. (\$9.9M) • Develop, in the Intelligent Integration of Information area, tools and techniques to enable the rapid construction of information filtering, accessing, and integration software to enable the dynamic management of massive amounts of battlefield information. (\$11.3M) • Develop a library of knowledge base components, composition tools, and an initial integrated development environment to support the creation and maintenance of High Performance Knowledge Bases in battlefield awareness and military command and control. (\$9.2M) • Develop site-monitoring technology and testbed for evaluating utility of automated tools for image analysts. (\$1.8M)			
(U) FY 1998 Program:			
• Integrate several MADE design computation tools to demonstrate robust multi-disciplinary design. Demonstrate a 5X reduction in early design trade-off time by combining qualitative and quantitative models. (\$10.5M) • Develop initial prototypes for multi-language text extraction and audio transcription where performance is baselined against that of human operators. (\$6.7M) • Continue development of human-computer interaction, heterogeneous testbed products and insertion. Test, evaluate and demonstrate enhancements to the developer and user communities. (\$11.4M) • Develop modular Human Language Technologies to support easy, low-cost, rapid technology transfer and application development for Document Understanding, Machine Translation, and Speech Understanding. (\$5.7M) • Develop, in the Intelligent Integration of Information area, tools and techniques to enable the rapid construction of information fusion, aggregation, and summarization software to filter, access, and integrate information from 100's of disparate, heterogeneous, distributed data sources. (\$11.5M) • Integrate mixed-initiative planning and decision aids techniques to exploit human planning abilities. Develop methods for closed-loop management of command-and-control processes in dynamic environments. (\$10.4M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project 3T-11	
• Demonstrate use of web to integrate rationale, system models and implementation. (\$4.0M) • Initial demonstration of ability to incrementally reanalyze a system using propagation bounding. (\$8.0M) • Release of real-time dynamic language to demo team. (\$5.1M) • Support software initiatives at the NASEC, Johnstown. (\$10.0M) • Continue to develop, demonstrate, and evaluate image understanding technologies for image exploitation, automatic population of geospatial database, video surveillance and monitoring, and automatic target recognition to enhance battlefield awareness. (\$13.0M) • Use unified knowledge representations in tools for focused knowledge acquisition, extend learning methods, and add new, high-performance, problem-solving methods to the High Performance Knowledge Base library. (\$9.6M)			
(U) <u>EX 1999 Program:</u> • Extend Architecture Description Language for complex systems to include performance and context information. (\$4.3M) • Linkage of design rationale to system modeling artifacts in design web. (\$4.7M) • Demonstration of web-based environment that combines design and analysis on realistic examples. (\$5.0M) • Develop language comprehension technology to provide extraction of content and production of summary information focused on information access, manipulation and creation tasks in order to demonstrate improved readiness for military planning and situation awareness. (\$12.0M) • Develop and demonstrate human/system interaction technology to augment human strengths and compensate for human weakness with emphasis on map based and web based interaction for command and control and planning. (\$13.0M) • Develop and demonstrate fully automatic algorithms to determine the structure of radio and TV news broadcasts in several languages allowing military planners and intelligence analysts to detect and track emerging topics. (\$7.8M) • Demonstrate a 2X reduction in detailed design by integrating Design Web and Computational Tools made for multi-disciplinary optimization. (\$12.7M) • Demonstrate and transition intelligent integration of information tools and techniques to enable the rapid construction of large scale information associates to filter, access, and integrate information from 100's of disparate, heterogeneous data sources. (\$12.0M) • Integrate most successful new image understanding and automatic target recognition technologies into feasibility demonstrations for UAV image exploitation, battlefield visualization, and video surveillance.			

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM DESCRIPTION

Computing Systems and Communications Technology,
PE 0602301E, Project ST-11

Demonstrate and evaluate impact of embedded image understanding technologies on battlefield awareness.
(\$14.0M)

- Develop adversarial planning tools for countering intelligent foes. Continue close interaction with Rome Labs. (\$10.0M)
- Develop and demonstrate a situation assessment knowledge base through reuse of knowledge base components. (\$10.0M)
- Demonstrate commanders decision tools for planning and control on highly stressed operations environments. (\$5.0M)

(U) Program Change Summary: (In Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget 95.0 98.4 107.5 112.8

Appropriated 95.8 N/A N/A N/A

Current Budget 91.3 96.8 105.9 110.5

(U) Change Summary Explanation:

FY 1996 Decrease reflects below threshold reprogramming for the High Performance Knowledge Base Program (\$+1.9 million), transfer to the SBIR program element, and inflation savings reductions.
FY 1997-99 Decrease reflects revised program reprioritization.

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile: N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research					DATE September 1996				
R-1 ITEM MONUMENTATURE Computing Systems and Communications Technology, PE 0602301E									
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Total Cost
High Performance Computing ST-19	185,950	190,396	189,529	200,857	213,081	236,811	233,492	241,292	Continuing

- (U) Mission Description:** This project develops the computing, networking, and associated software technology base underlying the solutions to computational and information-intensive applications for future defense and federal needs. These technologies lead to successive generations of more secure, higher performance, and more cost-effective scalable systems associated software technologies, advanced mobile information technology and prototype experimental applications critical to defense operations. The High Performance Computing program is comprised of the following components:
- Global Mobile Information Systems effort deals with the activities required for defense-based mobile systems, including modal architectures, adaptive extensions, changing resources and robust mobile services.
 - The Systems Environments component develops scalable software which is tailored toward easing the use of systems by application programmers. This includes languages, run-time services, scalable software library technologies, and experimental applications.
 - The Networking component develops high performance networking technologies and associated network management capabilities. Research is coordinated with network technology and Service deployments made by DoD, NASA, and other federal agencies.
 - The Scalable Systems and Software component develops software and hardware technologies leading to a secure scalable computing and communications technology base for systems configured over a wide performance range, from mobile handheld devices to desktop workstations to the largest-scale, highest performance systems.
 - The Microsystems component develops design tools, environments, and design infrastructure to support the research and development of advanced scalable parallel computing components and embedded computing systems. Microsystems is the incubator and delivery mechanism of future generation defense advanced information systems components. Microsystems is the critical bridge that leverages other DARPA technology in low-power processes, advanced packaging, materials, and electronic componentry to develop the critical architecture and building blocks of the most advanced defense computing and communication systems.
 - Defense Technology Integration and Infrastructure combines state-of-the-art computing and information technologies focused on critical defense applications. These include developing embeddable systems based upon scalable technologies, and projects which accelerate technology transition of advanced research to intelligence, command and control, and other major DARPA and DoD programs. Technologies addressed include

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E	
- information management, integration of systems, real-time, multimedia collaboration and visualization and application adaptivity. (U) Each of the above components of this program will integrate capabilities developed under the Information Survivability initiative (Project ST-24) to satisfy defense requirements for secure systems. (U) <u>Program Accomplishments and Plans:</u> (U) FY 1996 Accomplishments: • Global Mobile Information Systems. (\$15.9M) - Developed initial prototype of adaptive extensions; and untethered node hardware/software architectures. - Demonstrated design environments supporting simulation and synthesis of wireless systems. - Completed the experimental evaluation of the integration of multiple advanced intelligent systems. • Systems Environments. (\$22.0M) - Evaluated first generation of fully scalable operating system software and programming environments on small-scale versions of teraops computing systems. - Defined second generation of High Performance Fortran with extensions for task parallelism and support for scalable Input/Output (I/O). - Demonstrated extensions of portable scalable libraries to incorporate object-oriented technology and a broader set of applications. - Enhanced and experimentally evaluated advanced software environment that supports composition tools. • Networking. (\$26.8M) - Prototyped networks at greater than 40-gigabit-per-second speed using optical technologies; experimentally validated scalable network protocols at the higher speeds; and secure nomadic computing architecture integrated into existing wide area networks. - Deployed reference implementation of protocol-independent, multicast-capable infrastructure as basis for development of advanced services. - Demonstrated robust and secure network-level infrastructure protocols to include directory services and resource allocation; and technology for autonomous, node-level network management.			

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DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Computing Systems and Communications Technology,
PE 0602301E

- Scalable Systems and Software. (\$37.6M)
 - Demonstrated user-extensible microkernel operating system technology, integrating compiler and run-time support services; computing node architectures that dramatically increase internal memory and communications bandwidths; and I/O enhancements to a scalable operating system that overcomes identified bottlenecks leading to significant improvements in throughput.
- Microsystems. (\$34.7M)
 - Performed early demonstration of parallel, fully-hierarchical Automatic Test Generation for both combinational and sequential circuits.
 - Demonstrated fault-tolerant and reliability design tools supporting large-scale HPC systems developments; distributed computing architectures based on low-cost, low-latency switching technology; and integrated module-level synthesis capability.
 - Prototyped emulation-enhanced system simulation capabilities for microsystems design.
 - Developed highest performance open interconnect component for embedded defense systems, future demos in various systems, missiles and satellites.
 - Designed message-passing/shared-memory hybrid architecture protocol accelerator component.
 - Defense Technology Integration and Infrastructure. (\$41.2M)
 - Developed and provided experimental testbed services employing advanced high performance computing technologies for defense users; and prototype distributed, object-oriented architecture for scalable, interoperable, multimedia digital library repositories.
 - Prototyped embedded computing system modules with scalability concepts containing memory hierarchy and power on a single unit of replication.
 - Performed integration tests in key defense applications such as advanced distributed simulation, advanced distributed collaboration, advanced communications and control, and advanced human computer interfaces.
 - Demonstrated first fine-grained high performance embedded and scalable computer system; graphical program environments for embedded systems; prototype toolkits supporting development of applications adaptive to changes in the computing and communication environment; and prototype of information services through a testbed incorporating information management and secure transactions.
- Metacomputers. (\$7.7M)
 - Established a metacomputing center testbed in the National Capital Region.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E	
(U) <u>FY 1997 Program:</u> • Global Mobile Information Systems. (\$17.9M) - Demonstrate location-transparent computing re/location and data access within a mobile application support environment. - Develop adaptive networking extensions to Internet services in support of mobility; and prototypes of untethered node architectures for mobile computing. • Systems Environments. (\$17.7M) - Enable scalable structural dynamics applications using scalable software library technology for sparse symmetric Eigen problems. - Demonstrate experimental, scalable Advanced Distributed Simulation applications enabling STOW-97 to utilize 50,000 entities; and automatic optimization of data movement across the memory hierarchy in distributed shared memory systems using languages and runtime services. - Define HPC++ languages and runtime services with extensions for data and task parallel exploitation of concurrency. • Networking. (\$33.7M) - Network Engineering. * Develop plan for Network Engineering and Management Program, and manage large-scale scalable network engineering technology. - High Performance Networking. * Demonstrate high performance networking systems for coordinating sets of workstations as a single computing system, and test high-performance subsystem. - Active Networks. * Define Enhanced Networking Services Architecture for routing, multicast, location aware, and proxy services. * Develop definition and protocols of SmartPacket Format, and of Execution Environment. • Scalable Systems and Software. (\$39.2M) - Scalable Computing. * Demonstrate integration of parallel communication and processing; of scalable, MAGIC-based, system prototype and operational protocols; and performance of distributed shared-memory hardware supporting several commodity processors.			

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RD&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RD&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Computing Systems and Communications Technology,
PE 0602301E

- Ultrascale Computing.
 - * Design ultrascale quantum architecture model that addresses error-correction, computation in a noisy environment, and multipin entanglements; and develop and exercise computing simulator computation model to evaluate parallel behavior and performance structure.
- QUORUM.
 - * Define and integrate architecture, and develop quality-of-service specification language.
 - * Demonstrate order of magnitude performance improvement of translucent system layers using network-attached secure disks.
- Microsystems. (\$32.5M)
 - Microsystems Design.
 - * Release comprehensive complex system design benchmark suite.
 - * Draft specifications for common descriptive format for complex system design hardware verification.
 - * Demonstrate multi-site parallel processing design colabatory; formal methods for early complex system design microprocessor verification; sequential complex system design processor verification; and integrated environment spanning of advanced parallel processing microcomponents.
 - * Develop complex system design functional error modeling and test generation.
 - Adaptive Computing Systems.
 - * Develop 1 million gate standard form factor boards and hybrid system prototypes using configurable component technology; automatic process of template design and integration (for ATR library templates).
 - * Demonstrate 10x performance improvement of user-level software on challenge problems.
- Defense Technology Integration and Infrastructure. (\$35.1M)
 - Prototype System of Systems.
 - * Develop prototype Mediated Link application.
 - * Evaluate the experimental Mediated Link on a LAN.
 - * Evaluate Phase II feasibility and cost; and complete Phase II Program Plan.
 - Information Management.
 - * Deploy net-accessible prototype demonstrating vocabulary switching and object categorization; deploy operational prototype with active references to technical literature to licensed institutions.
 - * Develop scalable information value framework to characterize prior use of objects; and testbed for electronic deposit, registration and recordation of digital objects.
 - * Demonstrate agent architecture for cross-collection search and results fusion.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E	
- Intelligent Collaboration and Visualization. * Develop initial design of collaboration architecture; definition of candidate approaches to represent self-describing objects; and initial specification of evaluation approach and benchmarking of performance measures. * Demonstrate multimedia annotation for graphical representations, shown through a collaborative application where a user can attach multimedia comments to objects in a 2-D/3-D graphical space and where collaborating users can review and add to these annotations. - Embeddable Computing. (\$14.3M) - Demonstrate first DoD lab coordinated flight technology; 100 gigapops/cu. ft.; and heterogeneous architectures. - Integrate support for instrumentation and visualization of real-time operating systems; ability to monitor performance of realtime systems and interact in-situ; and system and application software technologies. - Fabricate and test digital signal processing(DSP) chips for advanced vision systems. - Develop first prototype accelerator module: Alacron, Westinghouse/ASI for advanced vision systems; signaling technology, Signaling Workshop; and initial set of visualization tools for cpu and memory.			
(U) FY 1998 Program: - Global Mobile Information Systems. (\$16.9M) - Demonstrate application support services for adapting mobile application support to changing infrastructure resources; and robust, mobile networking based on packet radio algorithms. - Systems Environments. (\$14.7M) - Demonstrate order of magnitude reduction in design time with experimental scalable applications; experimental scalable application versions of new iterative solvers for radar cross-section modeling; and languages and runtime services supporting parallel applications such as Advanced Distributed Simulation; and HPC++ languages and runtime services supporting both task and data parallelism. - Networking (\$32.0M) - Networking Engineering. * Complete and release specification language for network engineering elements and management system. - High Performance networking. * Demonstrate additional high performance networking systems, and enhanced ATM-switching, high-performance, networking technology.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E	
* Test subsystem in a testbed and demonstrate subsystems scalability in a defense application. - Active Networks. * Implement prototype of Enhanced Networking Services utilizing composable modules. * Complete composite protocol prototype implementation of execution environment; of fast compiler for SmartPacket Methods; and of basic switch functions. * Initiate operation of wide area Active Network on composite prototype platforms. • Scalable Systems and Software. (\$40.2M) - Scalable Computing. * Demonstrate highly efficient, parallel nodes; auto-parallelization performance of file I/O from Scalable I/O Consortium; first node-level performance of ultra-low-power systems; performance of novel backplane networks supporting security; and hardware-accelerated, distributed, shared-memory performance on workstation clusters. - Ultrascale Computing. * Design, model, and assess quantum-to-SI hardware and software interface; and language for expressing amorphous algorithmic computations. * Develop tools and mechanisms to build bioelectronic systems. * Demonstrate 256-component addressed array of molecular computational mechanisms; and a computational paradigm mechanism in an engineered living cell, and evaluate surface patterning mechanisms for culturing neural components on silicon. - QUORUM. * Develop quality-of-service negotiation protocols for performance architecture attributes; and adaptive resource discovery protocols. * Demonstrate order of magnitude improvement in operating systems/network interface of translucent system; and LAN-based quality-of-service performance assurance for Quorum Prototype #1. • Microsystems. (\$33.8M) - Microsystems Design. * Develop formal complex system design semantics for common intermediate format and extend arithmetic verification of complex system design to floating point. * Verify complex system, in-order execution superscalar processors and automate complex system error modeling and test generation.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM DESCRIPTION Computing Systems and Communications Technology, PE 0602301E	
* Demonstrate scalability beyond 128 nodes of parallel design environment; scalable, parallel-processing; and symbolic simulation linked with hardware emulation for complex system design. - Adaptive Computing Architectures. * Complete architecture designs using configurable component technology for low-power, hybrid, reduced overhead prototypes. * Develop high-level language and demonstrate adaptive template matching concept software prototype showing auto runtime remapping. • Defense Technology Integration and Infrastructure. (\$36.9M) - Information Management. * Develop algorithms to effectively search collections of documents for words used only in restricted senses; and design query and preferences languages incorporating similarity and value filtering. * Demonstrate translanguag search aids for military type documents in English, Korean and a European language; electronic document management with access controls; statistical co-occurrence techniques for texture classification of images; and semi-automatic generation of metadata. - Intelligent Collaboration and Visualization. * Develop initial software library of critical collaboration middleware for data sharing, coupling and coordination. * Demonstrate the meaning of machine-assisted structuring using an irregular information space; mutually-enhancing views, shown by a collaborative application; and real-time multimedia ad hoc collaboration applications with automated setup. - Prototype System of Systems: Phase 1. * Develop prototype information transformer application; and semantic component application. * Evaluate the mediated link information transformer on a LAN/WAN; and integrated system of mediated link information transformer, and semantic component on a LAN/WAN/Mobile. • Embeddable (\$15.0M) - Demonstrate missile application technology; in-system, high-speed, reconfigurable advanced vision switches; HPC portable/scalable instantiations of domain-specific tools and middleware; and UUV technology. - Develop hard realtime/operating systems with security; systems tools and middleware with adaptive scheduling of tasks; and wrapper generator for encapsulating advanced vision systems.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Computing Systems and Communications Technology,
PE 0602301E

(U) FY 1999 Program:

- Global Mobile Information Systems. (\$16.8M)
 - Demonstrate distributed computing in mobile application support environment; continuous networking mobility between wireless domains; and integrated high data-rate untethered node.
- Systems Environments. (\$14.2M)
 - Demonstrate experimental scalable image processing application using DARPA embedded systems platform.
- Networking. (\$34.3M)
 - High Performance Networking.
 - * Demonstrate Interoperable Execution Environments on multiple, high-end workstations for packet formats, languages and protocols.
 - * Complete evaluation of high-performance subsystem in a testbed and demonstrate the scalability of subsystems in defense application.
 - Networking Engineering.
 - * Evaluate prototype robust distributed, large-scale, network engineering management systems in a testbed.
 - Demonstrate reliable service foundation for routing, multicast, and location-aware Enhanced Networking Services on multiple high end workstations.
 - Active Networks.
 - * Initiate operation of secure Enhanced Networking Services proxies crossing independent administrative domains; of Enhanced Network Services on Active Network Testbed across ~10 sites of ~10 switches each; and of Active Network Testbed across ~10 sites of ~10 switches each using composite protocols.
 - * Release initial formal specification and composite protocols of Enhanced Networking Services for critical review.
 - * Demonstrate resource protection, security, and survivability functions as defined in goals and composite protocols.
- Scalable Systems and Software. (\$47.9M)
 - Scalable Computing Systems.
 - * Release efficient, high-speed, parallel signaling design scripting tools.
 - * Demonstrate 32-port, fault-tolerant switch performance at 2.5 Gbps/wire signaling rate, ultra low power; and performance of 4 Gbps/wire backbone switch technology and release designs.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		P-1 ITEM DESCRIPTION Computing Systems and Communications Technology, PE 0602301E	
- Ultrascale Computing. * Conduct system-level detailed design study of a computation model and design/fabricate/demonstrate testbed prototype of a computation model concept. * Demonstrate silicon/neuronal information transfer mechanism; distributed sensor model application on amorphous array with >1,000 elements; and feasibility of DNA computation mechanisms on 64,000 component surface. - QUORUM. * Integrate multi-attribute quality-of-service specification language architecture. * Demonstrate dynamic quality-of-service architecture in LAN; order of magnitude improvement in operating systems/network; fast, multiconstraint, adaptive resource discovery and allocation in LAN environment; and LAN-based, quality-of-service, integrated assurance for Quorum Prototype #2. - Microsystems. (\$32.0M) - Microsystems Design. * Verify out-of-order execution superscalar processor for complex system. * Demonstrate formal complex system design verification techniques; and distributed parallel processing computation with remote visualization. * Develop first 21st-century, parallel processing microsystems through distributed approach-prototype environment provides open access. - Adaptive Computing Architectures. * Debug and validate novel, configurable component technology architectures, and develop ability to auto map 500,000 gates and demonstrate estimators. * Demonstrate 100x user-level software performance improvement over commodity microprocessors on challenge problems, and release new algorithm design software environment optimized to leverage adaptive software technology. - Information Management. (\$14.0M) - Develop framework for combined text, image and relational interoperation. - Demonstrate translingual query by entering English language query and retrieving documents in at least two foreign languages; and semi-automatic topic assignment for unrestricted documents with acceptable accuracy. - Validate design of secure repository architecture for digital objects up to 100 MB in size.			

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RD7&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		September 1996
R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E		
- Intelligent Collaboration and Visualization. (\$16.0M) - Develop composition of application-specific and generic collaboration middleware. - Demonstrate the meaning of multimedia archiving and review of sessions using video/audio indexing and synopsizing; and interoperable asynchronous collaboration prototype applications among mobile users. - Prototype System of Systems. (\$10.7M) - Complete the development of the prototype information transformer application and the semantic component application and evaluate; the evaluation of the mediated link information transformer on a LAN/WAN; and the evaluation of network survivability in prototype system of systems. - Evaluate the scalability issues of the prototype system of systems. - Embeddable. (\$15.0M) - Demonstrate graphics algorithms tools and middleware on a complex system. - Develop advanced vision system compiler for digit-serial DSP, and vision system FFT/DFT chips, clockless logic.		
(U)	<u>Program Change Summary:</u> (In Millions) President's Budget Appropriated Current Budget	FY 1996 234.6 194.4 185.9 FY 1997 191.2 N/A 190.4 FY 1998 192.0 N/A 189.5 FY 1999 208.2 N/A 200.9
(U)	<u>Change Summary Explanation:</u> FY 1996 Decrease reflects Bosnia reprogramming action (\$-3.3 million); JCS reprogramming action (\$-.8 million) and below threshold reprogramming action for SBIR (\$-4.4 million). FY 1997-99 Decrease reflects minor program repricing.	
(U)	<u>Other Program Funding Summary Cost:</u> N/A	
(U)	<u>Schedule Profile:</u> N/A	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM ENCELOSURE										DATE	September 1996
RDT&E, Defensewide BA 2 Applied Research		Computing Systems and Communications Technology, PE 0602301E											
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost			
Software Engineering Technology ST-22	26,342	18,072	19,609	20,196	20,803	21,426	21,428	21,428	Continuing	Continuing			

(U) **Mission Description:** Software is key to meeting DoD's increasing demand for quality, affordability, and timeliness of national defense systems. There is a critical need to rapidly transition state-of-art technology and best practices to improve the acquisition, engineering, fielding, and evolution of software-intensive L&D systems. This project funds the technology transition activities of the Software Engineering Institute (SEI) at Carnegie Mellon University. The SEI is a DARPA sponsored Federally Funded Research and Development Center (FFRDC). It was established in 1984 as part of the DoD's software initiative to identify high leverage technologies and practices and to establish transition mechanisms that enable technology exploitation by both "in-house" government facilities and the industrial base where the bulk of defense software is produced. The Institute works across government, industry, and academe to: (1) improve current software engineering practice for DoD systems; (2) provide value-added transition of technology to practice; and (3) evaluate and calibrate emerging technologies to determine their potential for improving the evolution of software-intensive DoD systems.

(U) The SEI enables the exploitation of emerging software technology by bringing engineering discipline to software development and evolution. The SEI focuses on software technology areas judged to be of the highest payoff in meeting defense needs. Current focus areas include Trusted Systems and Information Warfare, Software Acquisition Risk Management, Architecture-Centered Software Engineering, and Software Processes and Process Improvement.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Improved practice of software engineering for DoD systems -- validation of Capability Maturity Model (CMM) as guide to effective software process; education in Personal Software Process to improve performance of individual engineers; repository of software risk management experience; guide to current practice of software reengineering; guidelines for adoption of CASE tools; and case studies of product line engineering. (\$8.0M)
- Evaluation of software technology to facilitate transition -- guide to software architecture description languages; approaches to architecture evaluation and comparison; lessons learned in software technology evaluation; and software process measurement guidebook. (\$7.0M)

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APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM MONITOR/CLATURE

Computing Systems and Communications Technology,
PE 0602301E, Project ST-22

- Technology focus in trusted software and information warfare -- continued operation of CERT team for network incident responses; SIMPLEX architecture approach to providing safety net for system evolution; quality attribute framework to provide taxonomy for four software quality attributes: safety, performance, dependability, and security. (\$2.0M)
- Supported the creation of a software engineering professional structure and broad dissemination of knowledge to the government, industrial, and academic communities. (\$3.6M)
- Software managers network effort supported by the development and application of active learning tools for senior level management. (\$5.7M)

(U) FY 1997 Program:

- Practice improvement: Integrate and enhance models for software processes, process improvement methods, and analytical capabilities to provide common base for process assessments and improvement analysis. Design and establish repository for DoD software risk management experience that is useful to DoD acquisition managers. (\$5.7M)
- Technology evaluation: Expand and improve architecture-centered technologies for product lines and evolutionary systems to develop consensus on guidelines for domain engineering, system reengineering, and open systems. Investigate team approaches to provide improved collaboration capabilities and information dissemination in DoD software development efforts. (\$5.1M)
- Trusted software and information warfare: Develop pilot models for assessing information system survivability. Establish techniques for applying architecture-centered technologies to support the representation and analysis of trust attributes. Study effective countermeasures for information warfare against software-intensive systems including: security risk taxonomy and guidelines, security analysis tool kits, and guidelines for the acquisition of trustworthy open systems. (\$7.3M)

(U) FY 1998 Program:

- Improve practice of software engineering for DoD systems -- Automate process support capabilities by providing mechanisms that provide interoperability among heterogeneous design and manufacturing environments. (\$1.5M)
- Evaluation of software technology to facilitate transition -- Evaluate system reengineering approaches that generate secure "wrappers" around legacy code to guarantee desired system properties. Demonstrate and distribute tools to support design of trustworthy systems by relating requirements, technology, and process descriptions. (\$6.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE
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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Computing Systems and Communications Technology,
PE 0602301E, Project ST-22

- Trusted software and information warfare -- Establish intelligent incident response infrastructure that maintains awareness of current threats and solutions. Provide "immunization" of systems to attack (or other threats) by categorizing the root causes for network security flaws and developing mechanisms to correct these causes. Investigate technology for early analysis of system attributes pertaining to trust based on architectural descriptions of the system. Define and document administrative practices for operating a trustworthy network and distribute on interactive media. (\$12.1M)
- (U) FY 1999 Program:
- Investigate/develop capabilities for rapid and inexpensive creation of Very High Level Languages (VHLLs) and code generators to attain breakthrough improvements in software productivity and quality. (\$3.0M)
 - Develop and distribute methods and tools to support prediction of key system properties during system development and preservation during system evolution. (\$5.2M)
 - Provide tools and techniques to enable rapid adaptation and reconfiguration of systems to ensure survivability in the face of attack. (\$3.0M)
 - Define effective means for interoperation/integration of heterogeneous system components that are generated from architectural descriptions and account for differences in fidelity and semantics as well as protocols. (\$5.0M)
 - Establish analysis and test infrastructure for assessing the survivability of software systems that include COTS products. (\$4.0M)

(U) Program Change Summary: (In Millions)

	FY 1996	FY 1997	FY 1998	FY 1999
President's Budget	19.2	18.1	19.6	20.2
Appropriated	35.6	N/A	N/A	N/A
Current Budget	26.3	18.1	19.6	20.2

(U) Change Summary Explanation:

FY 1996 Decrease reflects DD-1415 reprogramming of Global Broadcast System (\$8.0 million), and below threshold reprogrammings (\$1.3 million).

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-22	
(U) Other Program Funding Summary Cost: N/A		
(U) Schedule Profile: N/A		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research			R-1 ITEM MONITORING Computing Systems and Communications Technology, PE 0602301E								
COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Information Survivability ST-24	26,134	38,098	45,812	46,113	50,115	55,046	70,654	75,000	Continuing	Continuing	

(U) Mission Description: This project develops the technology base underlying the solutions to protect DoD's mission-critical information systems against attack upon or through the supporting infrastructure. These technologies lead to generations of stronger protection, higher performance, and more cost-effective security solutions scalable to several thousand sites and to high performance computing technologies. Technologies developed under this project will be exploited in High Performance Computing (ST-19) and other defense programs to satisfy defense requirements for secure and survivable systems. This program is an expansion of investments in information security made previously in High Performance Computing.

(U) Information Survivability focuses on early prototypes of software and hardware technologies leading to scalable protection for large-scale, heterogeneous systems usable over a wide range of performance in diverse threat environments. High confidence networking technologies will be developed consisting of security mechanisms and value-added security services for integration into network technologies. High confidence computing systems will be developed that provide modular security services and mechanisms, provide high reliability for distributed computations, and allow geographically-separated parts of an organization to interact as if they shared a common security perimeter. This also includes secure and fault-tolerant operating systems, firewalls, and system management tools. Assurance and integration tools will aid the development of high assurance and trusted systems that add expression of modular system structures, networking, and other distributed-system protocols and the ability to reason about their security properties.

(U) Survivability technologies will be developed to mitigate national and defense computing infrastructure vulnerabilities that could be exploited by an information warfare enemy. Intrusion-detection systems will allow attacks on the defense infrastructure to be detected, the damage to be assessed, and appropriate response to be taken. Technologies will be developed to allow crisis-mode operation of critical infrastructure components. Robust networking protocols will be designed to facilitate continuous operations in hostile environments.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		September 1996
R-1 ITEM DESCRIPTION Computing Systems and Communications Technology, PE 0602301E, Project ST-24		
(U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> • High Confidence Networking. (\$8.1M) - Demonstrated prototype of secured routing protocols. - Partially developed cryptographic applications programming interface (CAPI) for algorithm independence and ease of integration of security into applications. • High Confidence Computing Systems. (\$10.2M) - Demonstrated cryptographic-applications programming interface to allow secure applications to be built independent of the cryptography used. - Demonstrated high-assurance microkernel for use in secure operating systems. • Assurance and Integration. (\$3.8M) - Began work on dynamic security metrics and evaluation tool for white-box evaluation of security of systems with respect to a threat model. • Survivability of Large Scale Systems. (\$4.0M) - Began work on verified robust secure multicast protocols able to tolerate Trojan horses and malicious code. - Completed initial intrusion-detection prototype. (U) <u>FY 1997 Program:</u> • High Confidence Networking. (\$10.7M) - Release reference implementation of secure Open Shortest Path First routing protocol. - Demonstrate toolkit for production of network intrusion detection software. • High-Confidence Computing. (\$9.1M) - Demonstrate verified hybrid group membership protocol for tolerating mixed malicious/benign faults. - Demonstrate protocols for end-to-end fault tolerant real-time services on local area network (with Embedded). • Assurance and Integration. (\$7.2M) - Complete implementation of a small set of security and fault tolerance techniques as wrapper components. - Complete a tool for white-box security evaluation with respect to a threat model. • Survivability for Large Scale Systems. (\$8.7M) - Demonstrate technology for continued operation in face of network partition through use of optimistic replicated storage.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Ex) (4)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Computing Systems and Communications Technology, PE 0602301E, Project ST-24	
- Demonstrate technology for detecting the presence of malicious intruders through statistical profiling and behavioral models of benign and malicious users. - Develop microsystems design. (\$2.4M)			
(U) <u>FY 1998 Program:</u> • High Confidence Networking. (\$9.0M) • Release reference implementation of secure Border Gateway Protocol routing protocol. • Release library of application embeddable network security services. • Demonstrate secure signaling and call set-up for Asynchronous Transfer Mode networks. • High-Confidence Computing. (\$12.9M) • Commercial certified B3 workstation featuring trusted computing base available. • Prototype CORBA-compliant Domain and Type Enforcement for secure location interoperability. • Trusted, high assurance OS kernel extensions. • Demonstrate integrated security support in prototype extensible operating system (FY 1996 start) (augments Scalable Software). • Assurance and Integration. (\$8.4M) • Complete design tools for inferring system-level properties in composed systems. • Complete tools for secure refinement of secure software architectures. • Survivability for Large Scale Systems. (\$15.5M) • Demonstrate a primitive survivable "immune system" for responding to attacks and intrusions. • Demonstrate resource allocation mechanisms for adaptive system of systems.			
(U) <u>FY 1999 Program:</u> • High Confidence Networking. (\$12.0M) • Demonstrate suite of secure reliable distributed applications over mobile and wireless networks. • High-Confidence Computing. (\$12.1M) • Demonstrate techniques for general pairwise tradeoffs among fault-tolerance, real-time operations and security. • Assurance and Integration. (\$7.0M) • Characterize a set of security and fault-tolerance techniques by strength and cost, for plug-and-play wrappers. • Demonstrate integration of security composition techniques into software engineering tools.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		P-1 ITEM HOMECOMERS			
RDT&E, Defensewide BA 2 Applied Research		Computing Systems and Communications Technology, PE 0602301E, Project ST-24			
- Survivability for Large Scale Systems. (\$15.0M) - Demonstrate Adaptive Architecture for Survivable System of Systems. - Develop techniques for diagnosing multi-agent multi-staged attack.					
(U)	<u>PROGRAM CHANGE SUMMARY:</u> (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget	35.0	38.1	45.5	44.0
	Appropriated	27.8	N/A	N/A	N/A
	Current Budget	26.1	38.1	45.8	46.1
(U)	<u>Change Summary Explanation:</u>				
	FY 1996 Decrease reflects program repricing and transfer of SBIR funds to a separate program element.				
	FY 1998-99 Increase reflects program repricing.				
(U)	<u>Other Program Funding Summary Cost:</u> N/A				
(U)	<u>Schedule Profile:</u> N/A				

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)									
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM MONITORING							
RDT&E, Defensewide BA 2 Applied Research		Tactical Technology, PE 0602702E							
COST (In thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Total Cost
Tactical Technology	123,157	121,493	148,913	167,379	164,119	193,597	203,586	227,786	Continuing
Naval Warfare Technology TT-03	38,915	31,219	27,422	39,296	54,553	59,172	59,172	60,172	Continuing
Advanced Land Systems Technology TT-04	33,742	22,125	20,000	30,000	33,909	51,686	61,686	69,886	Continuing
Advanced Targeting Technology TT-05	6,919	0	0	0	0	0	0	0	N/A
Advanced Tactical Technology TT-06	37,253	45,995	63,753	58,418	57,024	62,728	72,728	82,728	Continuing
Aeronautics Technology TT-07	2,000	3,000	12,000	12,000	8,000	10,011	10,000	15,000	Continuing
Advanced Logistics Technology TT-10	4,328	19,154	25,738	27,665	10,633	10,000	0	0	N/A

(U) **Mission Description:** This program element is budgeted in the Applied Research Budget Activity because it supports the advancement of concepts and technologies to enhance the next generation of tactical systems. The Tactical Technology program element funds a number of projects in the areas of Naval Warfare, Advanced Land Systems, Advanced Tactical, Aeronautics, and Advanced Logistics technologies.

(U) The Naval Warfare Technology project is focusing on: Simulation Based Design (SBD) and Command, Control, Communications and Intelligence/Synthetic Environments (C3I/SE). The Simulation Based Design program will provide the tools required to integrate cost, performance and manufacturing considerations throughout the design process. The SBD program is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems utilizing virtual prototypes in synthetic environments. In the C3I/SE program, advanced information technologies are being integrated into advanced prototype systems to provide improved battlefield awareness and dominance to mobile command centers in the field.

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APPROPRIATION/BUDGET ACTIVITY: RDT&E, Defensewide BA 2 Applied Research		P-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E	

Ship Systems Automation, a program to develop a highly integrated sensor, weapons control, and battle damage suite to reduce costly shipboard manning requirements, is budgeted to complete in FY 1997.

(U) The Advanced Land Systems Technology project continues efforts in Small Low-cost Interceptor Devices (SLID) and unexploded ordnance detection efforts; and initiates robotics for Urban Warfare, advanced Fire Support Systems and Virtual Strike Force deception systems. The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. The unexploded ordnance program is developing tools such as enhanced sensors, communications upgrades, and new techniques to detect and neutralize mines and other ordnance for use in domestic situations, peacekeeping operations, and low intensity conflicts. Robotics for Urban Warfare will develop and demonstrate small, agile, unmanned systems for use in constrained urban environments. Advanced Fire Support Systems will develop and test advanced locomotion artillery platforms into the combat area commanded by ground forces to designated targets. The Virtual Strike Force will provide deception capabilities to draw enemy weapons off target and defeat surveillance sensors.

(U) The Advanced Tactical Technology project is exploring the application of compact lasers, microwave radiation, advanced displays and advanced mathematical algorithms to enhance the performance of radar, sensors, communications, and electronic warfare and target recognition systems. The technologies under development will improve infrared countermeasures, enable active infrared suppression, permit faster signal processing, improve target recognition, and create smaller, more capable microwave devices. Also included in this project is the Miniature Air-Launched Decoy ACTD.

(U) The Aeronautics Technology project will develop and demonstrate a new family of Micro-Aerial Vehicles. The Micro-Aerial Vehicle will be an order of magnitude smaller than any operational UAV and will be useful in a wide variety of military missions from covert imaging and chemical/biological agent detection to communication enhancement.

(U) Finally, the Advanced Logistics project will develop and demonstrate technologies that will make a fundamental difference in transportation and logistics planning and operations in the 21st Century. Developmental efforts will focus on transportation models and simulations and revolutionary changes to physical systems that impact intermodal system performance and efficiency.

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DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM DESCRIPTION

Tactical Technology,
PE 0602702E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Naval Warfare Technology TT-03	38,915	31,219	27,422	39,296	54,553	59,172	59,172	60,172	Continuing	Continuing

(U) Mission Description: The Naval Warfare Technology project develops advanced technologies for application to a broad range of naval requirements. The enabling technologies include: virtual prototyping and advanced modeling to radically change the DoD acquisition process through integrated product and process design; integrated ship sensor, weapons and platform technologies to demonstrate the feasibility of reduced ship manning; techniques that will reduce acquisition costs through greater reliance on commercially available electric drivers and components, and composite materials; and Command, Control, Communications, and Intelligence/Synthetic Environments (C3I/SE) for littoral warfare.

(U) The Simulation-Based Design (SBD) area is developing and demonstrating a prototype infrastructure that will enable a significant positive change in the acquisition process for large, complex warfighting systems. SBD will utilize virtual prototypes in synthetic environments to enable effective, integrated product and process development. The program will integrate the technologies of distributed interactive simulation, physics-based modeling, and virtual environments and apply them to the design, acquisition, and life cycle support processes of systems. Complete simulation from early in the concept formulation stage through verification of requirements to design, manufacture, operation, training, and logistics will be available prior to initiation of construction. Successful development and deployment of SBD will enable meeting the program's objective of reducing the cost and acquisition time for DoD systems. Overall product quality and capabilities will be enhanced by the timely insertion of the latest technological advances into designs as they progress through the shortened acquisition cycle. SBD will be applicable to a broad range of system domains including land vehicles, aircraft, satellites and marine vehicles. SBD will be applicable to all subsystems, from mechanical to large scale electronic, within an overall system and it will enable cost savings by reducing the need for expensive physical mockups and by eliminating many of the manufacturing inefficiencies caused by inadequate design.

(U) In the Ship Systems Automation (SSA) area, advanced, highly automated sensor, weapons control, and platform systems (including damage control) are being developed and demonstrated for submarine and surface ship applications. Through evolving sequential technology demonstrations, efforts in this area will show how an integrated collection of automated systems could achieve an order of magnitude reduction in crew size. Because personnel account for a significant portion of current ships' life cycle costs, such a reduction would lead to immediate and long term cost savings for ship acquisition programs. SSA technology developments include intelligent command-level advanced

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APPROPRIATION/BUDGET ACTIVITY		X-1 ITEM DESCRIPTION	
RDT&E, Defensewide		Tactical Technology,	
BA 3 Advanced Technology Development		PE 0602702E, Project TT-03	

reasoning components, scalable sensor integration work stations to fuse multi-source data and intelligently display the tactical scene on a situation assessment system, cooperating expert agents conducting mission-context/sensor employment planning, and integrated internal condition sensor and control systems to intelligently display and control ship physical conditions on a ship's internal assessment system.

(U) A new thrust is planned that will develop and demonstrate critical technologies that are focused toward the affordability of future ships. Candidates to be considered include extensive use of advanced electrical machinery and control systems to take advantage of Commercial-Off-the-Shelf (COTS) equipment, and electric drive for ship's propulsion. Other areas for consideration will include widespread use of composites and development of advanced coating systems for reduced maintenance.

(U) In the Command, Control, Communication, and Intelligence/Synthetic Environment (C3I/SE) area, advanced information technologies are being integrated and applied to provide improved battlefield awareness and battlefield dominance to mobile command centers in the field (e.g., Force Commanders. Commander Joint Task Force (CJTF), and deployed Joint Special Operations Task Force (JSOTF) Commanders). The advanced prototype systems developed under this program integrate the latest technologies in high-bandwidth communications, object oriented information system, collaborative planning, intelligent database access, image processing, data exploitation, and high performance computing to address the unique (quick reaction and real-time execution) requirements of forward deployed, mobile commanders. This program also will develop, demonstrate, and transition the tools and systems necessary to recognize, understand, forecast, and develop options to defuse potential crisis situations in hours by reducing the time to form teams, analyze crisis data, and develop and brief options for response. It also develops the Synthetic Test Range (STR), which in conjunction with the Simulation Based Design (SBD) development, is aimed at improving the acquisition process. The STR will conclude in FY 1996 and transition to Naval Sea Systems Command. The C3I/SE program builds upon existing DARPA-developed planning tools while identifying and incorporating other emerging C3I and information system technologies. Starting in FY 1996, the program is emphasizing collaborative crisis understanding and mitigation developing tools and systems necessary to recognize, understand, forecast, and defuse potential crisis situations. This effort will be focused on National Command Authority, National Security Council, and the National Military Command Center.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Conducted Simulation-Based Design (SBD) prototype demonstrations on a complex ship application at distributed design and visualization centers linked via nationwide networks; the first, a joint

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

1-1 ITEM DESCRIPTION

Tactical Technology,
PE 0602702E, Project TT-03

BA 3 Advanced Technology Development

demonstration in support of the Defense Modeling and Simulation Office High Level Architecture, the second, a virtual prototype of a ship combat system using an electronic smart product model to demonstrate functional requirements. (\$9.9M)

- Initiated expansion of Simulation-Based Design (SBD) through application to development programs for small rapid satellite manufacturing, selected aircraft sub-system manufacturing, land vehicle power train design, and ship manufacturing enterprise. (\$4.9M)
- Conducted high fidelity radar simulation with an operational radar system, transitioned to Navy users. (\$1.8M)
- Initiated collaborative crisis understanding and mitigation effort, developed concept of operations and visualization demonstration emphasizing data mining, modeling and collaboration in response to pre-crisis indicators. (\$1.7M)
- Conducted demonstration and testing of campaign operations planning system applied to joint forces command and control in a deployable package. (\$3.9M)
- Demonstrated advanced Ship Systems Automation (SSA) technologies which enable a few operators to collaborate with advanced-reasoning systems to manage the construction of a complex multi-warfare, multi-sensor fusion tactical scene and the effective operation of a combatant ship in that scene. Intelligent System Interface and advanced sensors technologies will continue to be developed and demonstrated. (\$9.8M)
- Continued most promising ocean sciences efforts at the Center of Excellence for Research in Ocean Sciences (CEROS). Issued a Broad Agency Announcement and selected eleven innovative marine technology projects for initiation. (\$6.9M)

(U) FY 1997 Program:

- Conduct Interim Simulation-Based Design (SBD) prototype engineering demonstration tests of multi-disciplinary engineering analysis for an advanced maritime application. (\$8.9M)
- Initiate SBD prototype engineering tests of the smart product model in support of integrated life cycle requirements and analyses of an evolving maritime application. (\$2.2M)
- Commence deliveries and support of prototype and interim SBD software to DoD Service's beta sites for use, evaluation, and feedback. (\$3.3M)
- Demonstrate automated situation assessment and fusion of a complete multi-warfare tactical scene (air, surface, subsurface), tactical planning, and self-defense capabilities for ownership and associated commanding platforms. Also demonstrate advanced reasoning systems for platform monitoring and control, intelligent construction and presentation of platform status and planning, and automated damage control/recovery reasoning. (\$9.1M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE	
RDT&E, Defensewide		Tactical Technology,	
BA 3 Advanced Technology Development		PE 0602702E, Project TT-03	
(U)	Initiate the development of a software system for collaboratively constructing quantifiable crisis and an "intelligent agent" which can browse across dissimilar, existing databases. (\$7.7M)		
(U)	FY 1998 Program: - Conduct Simulation-Based Design (SBD) prototype engineering tests of a large scale smart product model in support of integrated life cycle requirements and analyses of an evolving maritime application. (\$8.5M) - Deliver and support prototype and interim SBD software to DoD Service's beta sites for use, evaluation, and feedback. (\$3.5M) - Continue systems development and initiate development of a tool for rapid, collaborative plan development, evaluation, and briefing; demo and evaluate retrieval agents; demo use of access templates and profiles; evaluate filters. Demonstrate the ability to navigate several of the most important, crisis-related databases for acquiring information on a simulated crisis. (\$4.4M) - Evaluate ability to quantify centers-of-gravity and pressure points for plan development, and demonstrate modeling capabilities at JTF ATD/GCCS LES Insertions. Demonstrate crisis briefing capability for prioritizing policy and plans at NSC/NMCC and supporting intelligence agencies. (\$6.1M) - Develop initial system options that define the technology paths for an "all electric" ship that will consider prime movers, control systems, and power consuming components. (\$4.9M)		
(U)	FY 1999 Program: - Conduct Simulation-Based Design (SBD) prototype engineering tests incorporating a large scale smart product model on a wide area, wide bandwidth collaboration network with emphasis on near real time optimized ship design changes resulting from analyses of the virtual prototype in a complex synthetic operating environment. (\$5.5M) - Delivery and support of prototype and interim SBD software to DoD Service's beta sites for use, evaluation, and feedback. (\$2.0M) - Demonstrate initial operational capability of the data retrieval and visualization capability, initial operational capability of the crisis modeling capability, and begin installation of modeling capability and integration with data retrieval capability at CIA/NMJIC. Begin installation and integration of advanced briefing capability at CIA/NMJIC. (\$6.6M) - Conduct shore based demonstration for a Direct Current (DC) bus controlling a broad array of variable electric loads using Commercial-Off-the-Shelf (COTS) components. The demonstration will be focused toward an all-electric ship. (\$25.2M)		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-03	
(U)	<u>Program Change Summary:</u> (In Millions) FY 1996 President's Budget Appropriated Current Budget	FY 1997 32.6 N/A 31.2	FY 1998 24.8 N/A 27.4
			FY 1999 33.0 N/A 39.3
(U)	<u>Change Summary Explanation:</u> FY 1996-99 Reflects program repricings.		
(U)	<u>Other Program Funding Summary Cost:</u> N/A		
(U)	<u>Schedule Profile:</u> N/A		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research					R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E						
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Advanced Land Systems Technology TT-04	33,742	22,125	20,000	30,000	33,909	51,686	61,686	69,886	Continuing	Continuing	

(U) **Mission Description:** This project is intended to develop technologies for contingency missions and military Operations-Other-Than-War (OOTW) to make U.S. combat forces more deployable, effective, survivable, and affordable. This project supports eight main efforts: OOTW and OOTW/Law Enforcement; Small Unit Operations (SUO); Small Low-Cost Interceptor Device (SLID); a Foreign Cooperative Demonstration; Robotics for Urban Warfare; Multimode Weapons for Future Combat Systems; Advanced Fire Support Systems; and Unexploded Ordnance Detection.

(U) OOTW encompasses a wide range of activities where military power is used for purposes other than large scale combat. The purpose of the DARPA OOTW research and development program is to develop and demonstrate technologies that will enhance the survivability of individual soldiers and military units engaged in OOTW. These technologies have application to both general military operations and civilian law enforcement. Technology developments are being conducted in areas such as personnel armor; limited effects technology; concealed weapons detection; and automatic language interpretation/translation. Funding for this program will be completed in FY 1996.

(U) The SUO program will develop the key technologies to enable more capable, dispersed military units to effectively perform warfighting operations traditionally accomplished with massed forces. The SUO program focuses on enabling comprehensive awareness at the tactical level in restrictive environments. Sniper/mortar detection and hyperspectral infrared mine detection work initiated under the OOTW program will be continued with an emphasis on small unit operations. In FY 1997, these SUO efforts were realigned into Project EE-51.

(U) The SLID program will develop and test a system for providing protection against missiles and projectiles with explosive warheads. This system will detect, track and intercept these threats at a standoff distance sufficient to render them ineffective. Applications for the SLID system include: self-defense of vehicles; high value fixed sites such as command centers, parked aircraft and radars; and may be extended to naval platforms and low-speed aircraft.

(U) The Foreign Cooperative Demonstration program will fabricate and demonstrate a new system for enhancing the survivability of armored vehicles based on technology developed by a foreign source.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM MONOCLATURE Tactical Technology, PE 0602702E, Project TT-04		
(U) The Robotics for Urban Warfare program will develop and demonstrate technology required for the operation of small, agile, extremely capable unmanned systems to support military forces in the highly constrained, unstructured environments characteristic of urban areas. The program will emphasize enhanced mobility through innovative locomotion and manipulation concepts and the development of an intelligent system architecture required for enhanced autonomy. (U) The Multimode Weapons for Future Combat Systems program will develop and test a single vehicle mounted weapon system capable of meeting multiple needs for a Future Combat System, including direct fire against armor, indirect fire with remote designation, and area denial by means of loitering munitions. The effort will include the development of the launch system, remote targeting capability, and prototype launch vehicles for each mission. (U) The Advanced Fire Support System program will develop and test systems to provide the rapid response and lethality associated with gun and missile artillery in packages which require significantly fewer personnel, require decreased logistical support, and have increased survivability compared to current systems. Two concepts are to be investigated: 1) the delivery of loitering platforms into the combat area by means of rockets, which can then be commanded to deliver submunitions to designated targets, and 2) an unmanned missile artillery package which can be delivered to the field by transport aircraft and commanded by ground forces. (U) The Unexploded Ordnance (UXO) Detection program will develop sensors for the chemically specific detection of explosives or other chemicals characteristic of land mines and/or shallowly buried UXOs. The sensors developed under this program will provide soldiers with the effectiveness of canine olfaction detection without the logistics and other constraints imposed by the use of live animals. These chemically specific sensors will work either singly or in conjunction with other technologies (such as the hyperspectral mine detector, developed under the Small Unit Operations program (SUO)) that exploit different physical features. (U) <u>Program Accomplishments and Plans:</u> (U) FY 1996 Accomplishments: • Operations-Other-Than-War (OOTW). (\$6.8M) - Completed the Soldier 911 demonstrations in Korea and Macedonia, and the Korean/English text translator. - Completed modular tag concept definition phase. - Continued mine/unexploded ordnance detection technology development, including chemically-specific detection techniques.			

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DATE		September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM MONOCLATURE
RDT&E, Defensewide		Tactical Technology,
BA 2 Applied Research		PE 0602702E, Project TT-04

- Demonstrated the Korean/English speech translator, the concealed weapons system, extremity armor, and limited effects technology.
- Continued development of sniper, mortar, hyperspectral infrared mine, and thru-wall detection technologies with emphasis on small unit operations. (\$11.7M)
- Initiated Small Low-Cost Interceptor Device (SLID) phase II fabrication and testing effort with remaining contractors. Performed sub-system tests leading to static system tests. (\$13.2M)
- Initiated development of the system for the Foreign Cooperative Demonstration. (\$2.0M)

(U) FY 1997 Program:

- Continue SLID phase II effort. Conduct full system static tests and tests against slowly moving targets. Prepare for live-on-live tests. (\$12.1M)
- Complete the Foreign Cooperative Demonstration testing and transition program to the Army. (\$2.0M)
- Continue chemically-specific unexploded ordnance/mine detection technology development. Characterize explosive and other related chemical contamination at minefield. Evaluate advanced algorithms and sensor fusion capabilities for multiple-sensor detection. (\$8.0M)

(U) FY 1998 Program:

- Complete live-on-live Small Low-Cost Interceptor Device (SLID) testing. (\$7.0M)
- Field demonstration of laboratory scale system for chemically specific detection of land mines. (\$12.0M)
- Initiate development of advanced locomotion concept for small urban warfare robotic platforms and initiate definition and development of intelligent system architecture. (\$1.0M)

(U) FY 1999 Program:

- Extend SLID protection range and demonstrate application to high value fixed site. (\$7.0M)
- Perform concept development of multinode weapons, to include launch, designation, and munitions systems for both direct and indirect fire. (\$4.0M)
- Conduct analysis of advanced remote fire support systems to include investigation of loitering platforms and unmanned missile artillery package concepts. (\$5.0M)
- Field demonstration of prototype chemically specific land mine detector paired with other sensors as appropriate. (\$10.0M)
- Demonstrate navigation of small urban warfare robotic platforms in simplified urban environment. (\$4.0M)

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APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE		
RDT&E, Defensewide BA 2 Applied Research		Tactical Technology, PE 0602702E, Project TT-04		
(U)	<u>Program Change Summary:</u> (in Millions)	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u> <u>FY 1999</u>
	President's Budget	34.1	22.1	19.0 30.0
	Appropriated	33.2	N/A	N/A N/A
	Current Budget	33.7	22.1	20.0 30.0
(U)	<u>Change Summary Explanation:</u>			
	FY 1996 Increase reflects minor repricing (\$+.5 million).			
	FY 1998 Reflects addition of Robotics for Urban Warfare program.			
(U)	<u>Other Program Funding Summary Cost:</u> N/A			
(U)	<u>Schedule Profile:</u> N/A			

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DATE September 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 06C2702E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Advanced Tactical Technology TT-06	37,253	45,995	63,753	58,418	57,024	62,728	72,728	82,728	Continuing	Continuing

(U) Mission Description: This project focuses on the technology and applications of: compact lasers, microwave radiation sources, advanced displays, and mathematical algorithms for signal and image processing and modeling and simulation of nonlinear processes to dramatically improve the performance of radar, sensors, and systems for electronic warfare, target recognition, and military communications. Seven broad technology areas are being investigated: (a) compact, efficient, frequency-agile, diode-pumped, solid-state lasers for infrared countermeasures, laser radar and sensors; (b) compact high density data storage for high bandwidth image processing; (c) high performance computational algorithms for signal processing, target recognition and tracking, electromagnetic propagation, and processing of advanced materials and microelectronics; (d) precision optics components for critical DoD applications; (e) passive infrared signature suppression to counter air-to-air missile threats; (f) tactical landing systems; and (g) miniature air-launched decoy systems.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Compact Lasers. (\$7.3M)
 - Demonstrated compact lasers at mid-infrared wavelengths for infrared (IR) countermeasures.
 - Demonstrated mid-infrared lasers with 2 watts output power and a modulated pulse repetition frequency of 10 kilohertz, packaged in a compact configuration for field testing.
 - Demonstrated pulsed operation of quantum cascade diode lasers operating at mid-infrared wavelengths.
 - Demonstrated frequency conversion into mid-infrared wavelengths using periodically poled lithium niobate crystals.
- Holographic Data Storage (\$5.9M)
 - Performed technology demonstration to establish system trade-offs of various candidate materials for holographic data storage.
 - Demonstrated proof-of-principle digital holographic data storage devices to establish the capability of various multiplexing methods and error detection and correction schemes.
- Fast Computational Algorithms. (\$13.2M)
 - Demonstrated wavelet-based methods for automatic target detection and recognition.
 - Demonstrated multiresolution methods and adaptive waveforms for image formation and processing.
 - Developed hybrid automatic target recognition strategy for synthetic aperture radar exploiting most

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-06	
advantageous features of both wavelets and nonlinear partial differential equation-based methods. - Developed 3D implementation of fast multipole method for radar cross section calculations. - Identified approaches to reducing high-order nonlinear descriptions of thin film processes to real-time sensing and control models. - Precision Optics Technology. (\$3.1M) - Developed requirements and performed initial calculations for conformal and off-axis optical components for next generation tactical systems. - Advanced Infrared Signature Suppression. (\$.9M) - Integrated and demonstrated (flight test) a long-wave infrared (LWIR) suppression system. - Tactical Landing System (TLS). (\$6.2M) - Fabricated and demonstrated a transportable TLS designed for minimal installation/calibration times; accuracy improved through the addition of phase measurement capability; integrity monitoring feature added to permit autonomous operation. - Miniature Air-Launched Decoy. (\$.7M) - Conducted engine independent validation and established system design. FY 1997 Program: - Compact Lasers. (\$6.7M) - Demonstrate breadboard systems of compact high power tunable mid-infrared lasers, and laser diodes operating at mid-infrared wavelengths. - Demonstrate breadboard tunable mid-infrared lasers with 20 watt output power at 20 kilohertz (kHz) pulse repetition rate for ship defense. - Demonstrate room temperature operation of continuous wave mid-infrared laser diodes. - Demonstrate active tracking system at mid-infrared wavelengths. - Holographic Data Storage. (\$4.9M) - Technology demonstration to establish functional limits of holographic data storage. - Demonstrate 1 terabit storage capacity for functional evaluation of write once and read many type storage systems. - High Performance Algorithm Development. (\$14.7M) - Demonstrate classification performance improvement for Longbow fire control radar achieved using a wavelet classifier. - Apply adaptive waveform designs to radar and communication. - Apply multiresolution methods to image processing and formation. - Implement a hybrid automatic target recognition strategy for synthetic aperture radar exploiting most			

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DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Tactical Technology,

PE 0602702E, Project TT-06

advantageous features of wavelets and nonlinear partial differential equation-based methods.

- Select applications for development of wavelet-based detection, discrimination, and classification strategies.
- Begin development of new strategies for data, sensor, and algorithm fusion for signal and image processing applications that exploit the feature extraction capability of wavelets.
- Demonstrate orders-of-magnitude speed-up provided by parallel implementation of fast multipole techniques to radar cross section calculations.
- Develop methods for calculating electromagnetic scattering from objects in ground clutter.
- Advanced Mathematics for Microstructural Process Control. (\$9.5M)
 - Enhancement of strategies for physicochemical modeling of thin film vapor deposition processes that integrate process, sensing, and control considerations and provide understanding of critical microstructure issues needed to design high-quality and high yield manufacturing processes.
 - Develop fast algorithms for modeling and design of large-scale, high-performance circuits.
- Precision Optics Technology. (\$7.0M)
 - Continue development of conformal and off-axis optical components for tactical systems.
 - Develop magneto-rheological finishing for aspheres, toroids and cylinders.
 - Demonstrate design tools for conformal and off-axis optical systems.
- Miniature Air-Launched Decoy (MALD). (\$3.2M)
 - Continue MALD system design, engineering and producibility analysis. Begin system fabrication and qualification testing of subsystems and initiate Seek Eagle process.

(U) FY 1998 Program:

- Compact Lasers. (\$4.0M)
 - Demonstrate compact high power tunable lasers and laser diodes at mid-infrared wavelengths.
 - Develop breadboard tunable mid-infrared lasers for airborne infrared countermeasures.
 - Demonstrate room temperature long wavelength laser diodes in the 7-to-9 micrometer wavelength range.
- Holographic Data Storage. (\$1.0M)
 - Demonstrate 1 terabit storage capacity for functional evaluation of read/erase type storage systems.
- High Performance Algorithm Development. (\$13.5M)
 - Demonstrate hybrid automatic target recognition strategy for synthetic aperture radar exploiting most advantageous features of wavelets and nonlinear partial differential equation-based methods.
 - Develop application-specific wavelet-based automatic target recognition algorithms.
 - Develop new strategies for data, sensor, and algorithm fusion for signal and image processing applications that exploit feature extraction capability of wavelets.

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DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Tactical Technology,
PE 0602702E, Project TT-06

- Develop prototype electromagnetic scattering models for objects in ground clutter.
- Demonstrate toolboxes for generating optimal portable Fast Fourier Transforms and wavelet algorithms and apply to high dimensional synthetic aperture radar.
- Develop mathematical approaches to developing optimal portable applications libraries for selected computational kernels required in signal processing and thin film process simulations.
- Advanced Mathematics for Microstructural Process Control. (\$11.6M)
 - Develop physicochemical models for thin film vapor deposition processes that integrate process, sensing, and control considerations and provide understanding of critical microstructure issues needed to design high-quality and high yield manufacturing processes.
 - Implement fast algorithms for modeling and design of large-scale, high-performance circuits.
 - Develop reduced physicochemical models and algorithms for real-time sensing and control of thin film vapor deposition processes.
- Precision Optics Technology. (\$14.5M)
 - Continue development of conformal optical system components for tactical systems.
 - Complete designs of conformal optics sensor systems for airborne platforms and missiles.
 - Fabricate aspheric optical components and diffractive optical elements on curved substrates.
 - Demonstrate metrology tools.
- Miniature Air-Launched Decoy (MALD). (\$19.2M)
 - System integration and flight demonstration; continue Seek Eagle process.

(U) FY 1999 Program:

- Compact Lasers. (\$5.8M)
 - Complete demonstration of compact high power tunable lasers and laser diodes at mid-infrared wavelengths.
 - Develop packaged tunable mid-infrared lasers for airborne infrared countermeasures.
 - Complete demonstration of laser diode arrays operating at mid-infrared wavelengths.
- High Performance Algorithm Development. (\$15.2M)
 - Demonstrate application-specific wavelet-based automatic target recognition algorithms.
 - Validate prototype electromagnetic scattering models for objects in ground clutter.
 - Develop data, sensor, and algorithm fusion algorithms for signal and image processing applications that exploit the feature extraction capability of wavelets.
 - Demonstrate fast algorithms for modeling and design of large-scale, high-performance circuits.
 - Develop prototype toolboxes for generating optimal portable applications libraries for selected computational kernels required in thin film process simulations.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE		
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM MONITORING				
RDT&E, Defensewide BA 2 Applied Research		Tactical Technology, PE 0602702E, Project TT-06				
- Advanced Mathematics for Microstructural Process Control. (\$13.9M) - Validate physicochemical models for thin film processes that integrate process, sensing, and control considerations and provide understanding of critical microstructure issues needed to design high-quality and high yield manufacturing processes. - Validate reduced order models and algorithms for sensing and control of thin film vapor deposition processes. - Precision Optics Technology. (\$10.0M) - Continue development of conformal optical system components for tactical systems. - Demonstrate near net-shape growth of conformal windows. - Laboratory assembly and demonstration of conformal sensor systems for airborne platforms and missiles. - Miniature Air-Launched Decoy (MALD). (\$13.5M) - Continue system integration, operational demonstrations, acquire flight certification and transition to Service.						
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		39.4	46.0	50.6	56.4
	Appropriated		39.5	N/A	N/A	N/A
	Current Budget		37.3	46.0	63.8	58.4
(U)	<u>Change Summary Explanation:</u>					
	FY 1996	Decrease reflects minor program repricing (\$+1.4 million); offset by Bosnia reprogramming action (\$-2.4 million) and reprogramming of Small Business Innovative Research (SBIR) funds to PE 0605502E (\$-1.2 million).				
	FY 1998-99	Increase due to outyear funding for the Miniature Air-Launched Decoy (MALD) program.				
(U)	<u>Other Program Funding Summary Cost:</u>	FY 1996	FY 1997	FY 1998	FY 1999	
	Funding for Miniature Air-Launched Decoy	0.5	4.7	0.0	0.0	
	PE 0603750D, Advanced Concept Technology Demonstration.					

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APPROPRIATION/BUDGET ACTIVITY

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BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Tactical Technology,
PE 0602702E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Aeronautics Technology TT-07	2,000	3,000	12,000	12,000	8,000	10,011	10,000	15,000	Continuing	Continuing

(U) **Mission Description:** Aeronautics Technology efforts will address high payoff opportunities to dramatically reduce costs associated with advanced aeronautical systems or provide revolutionary new system capabilities for satisfying current and projected military mission requirements.

(U) A new family of Micro-Aerial Vehicles (MAVs) which are at least an order of magnitude smaller than current flying systems (less than 15 cm in any dimension) will be developed and demonstrated. The capability to accomplish unique military missions as diverse as covert imaging in constrained areas, biological-chemical agent detection and characterization, remote precision mines, and urban battlefield communications enhancement, will be stressed through an examination of a variety of vehicle concepts. The resulting capability should be especially beneficial in the emerging urban warfighting environment, characterized by its complex topologies, confined spaces and areas (often internal to buildings), and high civilian concentrations. The MAV program will focus on the technologies and components required to enable flight at these small scales, including flight control, propulsion and lightweight power, navigation and communications, building upon and exploiting numerous DARPA technology development efforts, including advanced communications and information systems, high performance computer technology, Microelectromechanical Systems (MEMS), advanced sensors, lightweight, efficient high density power sources, and advanced electronic packaging technologies.

(U) **Program Accomplishments and Plans:**(U) **FY 1996 Accomplishments:**

- Initiated assessments of operational scenarios, candidate MAV configurations, and critical component technologies. (\$1.0M)
- Conducted Advanced Combat Vehicle feasibility analyses and design trade studies. (\$1.0M)

(U) **FY 1997 Program:**

- Identify potential configurations for an unpowered boost/MAV. Complete assessment of operational scenarios, configurations and component technologies, and initiate design of powered and unpowered MAVs. Initiate development of critical technology components. (\$3.0M)

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NAME/CAPTURE Tactical Technology, PE 0602702E, Project TT-07
September 1996		
(U) <u>FY 1998 Program:</u> The MAV program will initiate development of three functionally diverse flight systems, employing alternative technology solutions, and satisfying user-identified critical military applications. Preliminary designs and key component development will be followed by feasibility demonstrations. Development of separate, individual high-risk, high-payoff technology components will be continued. (\$12.0M)		
(U) <u>FY 1999 Program:</u> The Micro-Aerial Vehicle (MAV) program will finalize system designs and initiate fabrication of candidate systems. These systems will be developed and tested against an operational template derived from the design flight and mission characteristics. (\$12.0M)		
(U)	<u>Program Change Summary:</u> (In Millions) President's Budget Appropriated Current Budget	FY 1996 0 0 2.0
		FY 1997 0 N/A 3.0
		FY 1998 10.0 N/A 12.0
		FY 1999 10.0 N/A 12.0
(U) <u>Change Summary Explanation:</u> FY 1996-97 Reprogrammings to initiate the Micro-Air Vehicle (MAV) program. FY 1998-99 Repricing of the MAV program.		
(U)	<u>Other Program Funding Summary Cost:</u>	N/A

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DATE September 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 0602702E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Advanced Logistics Technology TI-10	4,328*	19,154	25,738	27,665	10,633	10,000	0	0	0	N/A

* The FY 1996 Advanced Logistics effort was partially funded under PE 0602301E, Project ST-11 (\$4.1M).

(U) **Mission Description:** The Advanced Logistics Technology Program will investigate and demonstrate technologies that will make a fundamental difference in transportation and logistics. The program will define, develop, and demonstrate fundamental enabling technologies that will permit logistics and transportation assets to be deployed, tracked, refurbished and redeployed more efficiently than ever before. Currently, these assets are being managed using isolated, independent, and sometimes incompatible computer systems. Therefore, the very rapid replanning and redirection necessary to support missions involving simultaneous local and major regional conflicts cannot be accomplished today. The Advanced Logistics Program will address these shortcomings and enable this significant capability to be developed. In addition, the project has enormous potential for cost savings through greatly improved management of transportation and logistics assets.

(U) Additionally, this program will develop multi-echelon, collaborative logistical/transportation support tools that will provide warfighters an unprecedented capability to monitor, rapidly replan and re-execute movement, even while enroute to the theater. The Advanced Logistics Program will focus on three areas: 1) Development of a computer network infrastructure that allows distributed real-time visualization and interaction with all phases, elements and components of the military and commercial transportation infrastructure; 2) Development of applications providing a technology environment that allows warfighters to rapidly understand and assess the logistics and transportation implications of a crisis situation, to generate effective plans and courses of action, to monitor a plan's execution, and to use that information to re-plan; and 3) Systems that will enable significant efficiency improvements in transportation and logistics, such as monitoring the condition of assets and the infrastructure, the creation of "plan sentinels" to serve as an early warning system for plan deviations, and improved theater distribution. The capabilities from these three areas will be integrated to demonstrate an end-to-end system solution.

(U) The Advanced Logistics Program supports joint initiatives with the Defense Logistics Agency and is coordinated with other related logistics efforts within the DoD. As technology matures, it will immediately transition to these initiatives which include the Defense Logistics Agency Logistics Research and Development (PE 0603712S) and the Joint Logistics Advanced Concept Technology Demonstration (PE 0603750D). The migration path for the end-to-end system

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DATE September 1996

APPROPRIATION/BUDGET ACTIVITY
RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE
Tactical Technology,
PE 0602702E, Project TT-10

solution will be through the Leading Edge Services Joint Program Office for the Global Command and Control System (GCCS) and the Global Combat Support System (GCSS).

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- . Initiated development of a distributed logistics and transportation network including development of information manipulation and planning tools to support planning, execution, monitoring and focused replanning throughout the logistics pipeline. (\$2.3M)
- . Initiated definition of technology requirements for data gathering and measurement of the logistics execution environment including data gathering tools for semi-autonomous capture, search and retrieval of data in disparate defense and commercial logistics sources and advanced tagging/locating/measurement sampling systems and software. (\$2.0M)

(U) FY 1997 Program:

- . Continue architecture development and demonstrate a distributed logistics planning, execution, and monitoring system concept to support inland military logistics planning/replanning from origin to port. (\$6.0M)
- . Conduct a feasibility demonstration of advanced technologies for logistics support planning, measurement sampling, and software systems. (\$3.0M)
- . Initiate proof of principle for advanced software data collection techniques (also referred to as knowledge rovers or intelligent software agents) that search the Global Information Infrastructure for relevant logistics information and data and return it to the user. Initiate development of multi-echelon collaborative logistical support tools that integrate planning, execution, monitoring and decision support systems for testing and deploying these tools. Conduct concept formulation and initial utility demonstration of "plan sentinels" to detect plan deviations within a rapid replanning environment. Develop an integrated software framework that is reusable and reconfigurable. (\$10.2M)

(U) FY 1998 Program:

- . Demonstrate an integrated computer environment to support the planning, execution and monitoring of a major force deployment from fort to port to ship load, including optimized scheduling and routing with minimal staging throughout the move. (\$8.0M)
- . Initiate development of plan deviation detection sentinels and predictive analysis to assist in identification of replanning opportunities. (\$8.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Tactical Technology, PE 0602702E, Project TT-10																				
September 1996																						
• Continue development of advanced software data collection techniques. Initiate development of a Dynamic Critical Items List for sustainment planning and execution. Continue development of multi-echelon collaborative logistical support tools. Develop and demonstrate coarse-grained course of action evaluation that is linked to the war plan. (\$9.7M)																						
(U) <u>FY 1999 Program:</u> • Demonstrate an integrated environment to support the planning, execution and monitoring of a major force deployment from point of debarkation through in-theater distribution, including automated infrastructure assessment and monitoring. (\$10.0M) • Develop and demonstrate the ability to negotiate the exchange of information between suppliers and buyers, including rapid, flexible item and item relationship catalogs. (\$7.0M) • Extend "plan sentinels" for automated deviation detection and triggering of the replanning processes. Continue development of a Dynamic Critical Items List for sustainment planning and execution. Develop and demonstrate medium grained course of action evaluation that is linked to the war plan. (\$10.7M)																						
(U) <u>Program Change Summary:</u> (In Millions) <table style="width:100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">FY 1996</th> <th style="text-align: center;">FY 1997</th> <th style="text-align: center;">FY 1998</th> <th style="text-align: center;">FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td style="text-align: center;">0</td> <td style="text-align: center;">17.2</td> <td style="text-align: center;">28.7</td> <td style="text-align: center;">16.7</td> </tr> <tr> <td>Appropriated</td> <td style="text-align: center;">0</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td>Current Budget</td> <td style="text-align: center;">4.3</td> <td style="text-align: center;">19.2</td> <td style="text-align: center;">25.7</td> <td style="text-align: center;">27.7</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	0	17.2	28.7	16.7	Appropriated	0	N/A	N/A	N/A	Current Budget	4.3	19.2	25.7	27.7
	FY 1996	FY 1997	FY 1998	FY 1999																		
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Appropriated	0	N/A	N/A	N/A																		
Current Budget	4.3	19.2	25.7	27.7																		
(U) <u>Change Summary Explanation:</u> 1996 Reflects the consolidation of transportation technologies from Strategic Computing (ST-19) and Naval Warfare Technology (TT-03) into a new project for greater visibility. 1997-98 Reflects rephrasing of the planned requirements for this project. 1999 Increase supports demonstration and "plan sentinels" extension.																						
(U) <u>Other Program Funding Summary Cost:</u> N/A																						
(U) <u>Schedule Profile:</u> N/A																						

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Integrated Command and Control Technology,

PE 0602708E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
High Definition Systems IC-03	44,416	45,000	43,000	45,000	45,000	45,000	0	0	0	N/A

(U) Mission Description: This program element is budgeted in the Applied Research Budget Activity because it develops the technology and manufacturing capability for high definition displays and is important for virtually all DoD applications that involve visual and graphic information. Major components of this program include: projection, head mounted and direct view displays based on multiple technologies; development of equipment and components required to manufacture advanced display technologies, and prototype display systems for system evaluation. These efforts will establish a domestic technical capability and demonstrate the manufacturing capability of components necessary for military systems that capture, process, store, distribute and display high resolution images.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Continued development of flat panel and projection displays for mobile displays, and shipboard and landbased command and control centers. (\$19.3M)
- Continued development of equipment and components to meet display cost and performance goals. This included efforts in patterning, film deposition and annealing, and field emission display materials and assembly tools, as well as reflective liquid crystal materials and phosphor technology development. (\$17.1M)
- Developed system prototypes which leverage earlier developed display technologies and incorporated integrated systems and intelligent interfaces. (\$8.0M)

(U) FY 1997 Program:

- Initiate development of next generation reflective and emissive mobile display technologies and laser based projection systems for command and control applications. (\$13.0M)
- Continue development of equipment and components to meet display cost and performance goals. This will include efforts in field emission display materials, organic light emitting materials, reflective liquid crystal materials, phosphor technology development, and support for domestic display manufacturing infrastructure. (\$22.0M)
- Continue development of system prototypes which leverage earlier developed display technologies and incorporate integrated systems and intelligent interfaces. (\$10.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		September 1996																				
R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E, Project IC-03																						
(U) <u>FY 1998 Program:</u> - Continue development of next generation reflective and emissive mobile display technologies and systems for command and control applications, including laser based projection. (\$13.0M) - Continue development of equipment and components to meet display cost and performance goals. This will include efforts in printing and microreplication, field emission display materials, organic light emitting materials, phosphor technology development, and support for the domestic display manufacturing infrastructure. (\$20.0M) - Continue development of system prototypes which leverage earlier developed display technologies, particularly for mobile displays and incorporate integrated systems and intelligent interfaces. (\$10.0M) (U) <u>FY 1999 Program:</u> - Complete development of next generation reflective and emissive mobile display technologies and continue development of displays for command and control applications, including laser projection displays. (\$12.0M) - Continue development of equipment and components to meet display cost and performance goals. This will include efforts in printing and microreplication, field emission display materials, organic light emitting materials, phosphor technology development and support for the domestic display manufacturing infrastructure. (\$20.0M) - Complete first generation integrated display systems and system prototypes for mobile applications. - Continue development of large screen command and control system prototypes. (\$13.0M) (U) <u>Program Change Summary:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>48.0</td> <td>45.0</td> <td>45.0</td> <td>45.0</td> </tr> <tr> <td>Appropriated</td> <td>48.7</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>44.4</td> <td>45.0</td> <td>43.0</td> <td>45.0</td> </tr> </tbody> </table> (U) <u>Change Summary Explanation:</u> FY1996 Decrease reflects reprogramming action in support of Bosnia and internal reprioritization of programs. FY1998 Decrease reflects revised program requirements.				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	48.0	45.0	45.0	45.0	Appropriated	48.7	N/A	N/A	N/A	Current Budget	44.4	45.0	43.0	45.0
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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Integrated Command and Control Technology, PE 0602708E, Project IC-03	
(U) Other Program Funding Summary Cost: N/A			
(U) Schedule Profile: N/A			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY			R-1 ITEM DESCRIPTION								
RDT&E, Defensewide BA 2 Applied Research			Materials and Electronics Technology, PE 0602712E								
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Materials and Electronics Technology	228,446	214,128	191,711	236,846	274,525	290,308	336,592	373,799	Continuing	Continuing	
Materials Processing Technology MPT-01	117,372	111,428	80,476	90,297	111,350	120,927	146,127	169,327	Continuing	Continuing	
Microelectronic Device Technology MPT-02	54,399	66,193	71,331	95,660	96,222	98,881	110,972	120,972	Continuing	Continuing	
Cryogenic Electronics MPT-06	29,042	9,835	13,190	13,203	12,546	15,000	20,000	25,000	Continuing	Continuing	
Military Medical/Trauma Care Technology MPT-07	27,633	26,672	26,714	37,686	54,467	55,500	59,500	58,500	Continuing	Continuing	

(U) Mission Description: This program element is budgeted in the Applied Research Budget Activity because its objective is to develop technology related to those materials, electronics, and medical devices that make possible a wide range of new military capabilities.

(U) The Materials Processing Technology project (MPT-01) concentrates on the development of novel materials, materials processing techniques, and fabrication strategies for advanced structural and functional materials and components which will lower the cost, increase the performance, and enable new missions for military platforms and systems. Areas of concentration include exploitation of emerging processing approaches and mathematical models to tailor the properties and performance of structural materials and devices. This emphasis includes lightweight personnel protection, mesoscale machines for miniature devices, and ultra lightweight materials. The project also focuses on smart materials, sensors and actuators, functional materials and devices, and advanced magnetic materials for non-volatile, radiation hardened magnetic memories. Other areas of concentration include new materials concepts for portable power, protective coating materials to eliminate environmental hazards, infrared artificial dilectrics, and development of bio-interface materials and methods.

(U) The Microelectronics Device Technologies project (MPT-02) develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics and infrared devices. Areas of emphasis include high-performance analog-to-digital converters, military optical processors, novel optoelectronic

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM DESCRIPTION Materials and Electronics Technology, PE 0602712E		
devices and components, high temperature electronic devices, and high power electronics. This project includes a significant effort to develop advanced materials and device technology beyond the classical scaling limits of silicon device technology. (U) In the Cryogenic Electronics project (MPT-06), thin film electromagnetic material have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military applications. Thin-film high temperature superconducting components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance while reducing size and power requirements. Highly dependable and inexpensive cryocoolers (including thermoelectric coolers) are being developed for these applications, and new efforts will explore techniques to improve cryogenic performance of all solid state thermoelectric coolers as well as the overall cryogenic performance in applications ranging from communications to computing. (U) Military Medical/Trauma Care Technology project (MPT-07) is an initiative to significantly improve far-forward battlefield trauma care. The Advanced Biomedical Technology portion focuses on the human factors of advanced technology concepts in a front-line battlefield environment through development of body-worn monitors, field-portable digital imaging equipment, and battlefield surgical simulator. The Health Care Information segment concentrates on development of physician, medic, and community information associates for utilization by both medics during combat care scenarios and physicians during patient visits.			

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DATE
September 1996APPROPRIATION/BUDGET ACTIVITY
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BA 2 Applied ResearchR-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Materials Processing Technology MPT-01	117,372	111,428	80,476	93,297	111,350	120,927	146,127	169,327	Continuing	Continuing

(U) Mission Description: Among the major goals of this project are to develop novel materials, materials processing techniques, and fabrication strategies for advanced structural and functional materials and components which will lower the cost, increase the performance and/or enable new missions for military platforms and systems. One important area of concentration is the exploitation of emerging processing approaches and mathematical models to tailor the properties and performance of structural materials and devices. Thrusts in this area include new concepts for lightweight personnel protection, mesoscale machines for miniature devices, and ultra lightweight materials for lowering the weight and increasing the performance of aircraft and spacecraft structures. Smart materials, sensors and actuators for the control of the aerodynamic and hydrodynamic behavior of military systems are being developed and demonstrated in order to increase performance and lower detectability of aircraft, helicopters and submarines. Another major thrust is the development of functional materials and devices and advanced magnetic materials for non-volatile, radiation hardened magnetic memories with very high density, short access time, infinite cycle ability and low power. New materials and concepts for increasing the availability of portable power to the soldier are also being investigated as are substitute protective coating materials which eliminate environmental hazards. Infrared Artificial Dielectrics (IRADs) will be a new class of infrared materials having an emissivity that can be fully engineered for different spectral bands. For example, it may be possible for IRADs to camouflage hot objects from passive infrared sensors operating in the common 8-to-12 micron band.

(U) Other areas of concentration seek to 1) develop bio-interface materials and methods for preventing pathogens from entering the warfighter's body, and 2) once in the body, prevent them from causing disease. Approaches include advanced biomaterial barriers and elimination techniques to prevent pathogen entry and augmenting the warfighter's immune response to pathogens.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Structural Materials and Devices. (\$33.0M)
- Demonstrated full-scale rapid densification of carbon-carbon composite components.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01	September 1996
- Demonstrated a five-fold improvement in the life of the roll reaction control (RRC) valve bearings on the AV-8B Harrier aircraft due to the upgrade of the metal bearings with ceramic hybrid bearings. - Validated the Resonant Ultrasonic Inspection technique for ceramic rolling elements through beta site testing at a commercial ball bearing finisher. - Demonstrated production of voided and foamed aluminum and titanium core materials for ultra lightweight panels. - Demonstrated low cost aluminum-beryllium aerospace fabrication processes. - Demonstrated reduced mean-time-between-failure (MTBF) associated with the upgrade of glass optical domes to spinel domes used in the Angle Rate Bombing Set (ARBS) of the AV-8B Harrier aircraft. - Demonstrated the use of X-ray tomography and developed software to generate computer aided design (CAD) files from solid objects compatible with the requirements of solid freeform fabrication. - Developed the machine capability to produce silicon nitride components using the fused deposition method with silicon nitride powder loaded wax filaments. - Demonstrated the capability to fabricate molds for slip casting structural ceramics and for producing low cost resin transfer molding tooling using 3-D printing technology. - Designed an advanced polarization preserving fiber optic connector. - Developed a chemical vapor deposition (CVD) process for the fabrication of particulate and chopped fiber reinforced composites with a 10X increase in composite growth rate over normal CVD processing; - demonstrated the utility of the fabricated composites for the die casting of copper alloys. - Developed feedback control methods for plasma sprayed metal matrix composites. - Developed new casting practices which will reduce the emissions of foundaries with focus on characterization of emissions in current casting processes, core and mold making technology, metal melting treatments and handling, sand reclamation, and emissions control. • Smart Materials and Actuators. (\$20.8M) - Demonstrated application of smart materials to reconfigurable machines and tooling hardware. - Analyzed smart materials applications for submarines. - Demonstrated material sensor and activator components manufacturability utilizing piezoelectric ceramics and electrostrictors. - Completed wind tunnel testing of first iteration shape adaptive F-18 wing model. • Functional Materials and Devices. (\$40.3M) - Demonstrated prototype multichip modules (MCM) with laminate technology roll to roll processing. - Demonstrated a prototype MCM for a missile guidance section using a bare die on a laminate substrate and electronically validated performance.			

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September 1996

APPROPRIATION/BUDGET ACTIVITY

RD&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Materials and Electronics Technology,
PE 0602712E, Project MPT-01

- Developed magnetoresistive materials with improved electrical resistance properties.
- Developed simulation codes for the physics of vapor deposition and validated on industrial processes.
- Demonstrated a process to produce elastomeric electrorheological materials for acoustic wave filtering applications.
- Demonstrated large area, high deposition rate chemical vapor deposition (CVD) of diamond substrates.
- Identified processing approaches for manufacturing high thermal conductivity (>10W/K-cm), low-cost (<\$1/carat) diamond for thermal management of defense electronics.
- Initiated the demonstration of thermal management diamond in specific defense applications (e.g., high power transmit-receive modules, electronic warfare (EW) systems).
- Developed stable contacts for high temperature, high power semiconductors.
- Demonstrated high yield large area processing of thin film high temperature superconducting devices.
- Developed giant magneto resistive (GMR) films with enhanced electrical characteristics and enhanced magneto-resistance ratio at low magnetic fields for faster response and higher sensitivity of devices.
- A model magnetic memory cell design was completed.
- Energy and Environmental Sciences. (\$15.5M)
 - Designed and initiated construction of a hydrothermal oxidation system for shipboard excess hazardous material disposal.
 - Demonstrated more environmentally sound production processes for printed wiring boards.
 - Sensors and control models for the intelligent processing of materials were designed to improve the reliability of thermal barrier coatings for turbine engine airfoils and were demonstrated on a production scale reactor.
 - Initiated studies of advanced erosion/corrosion resistant thin film coatings.
 - Process parameters for the manufacture of copper-indium diselenide (CIS) photovoltaic solar cells were established and demonstrated in production scale efficiencies of over 8% (photons in to electrons out).
 - Bio Detection & Identification; BW Information Technologies; BW Immediate Response. (\$7.8M)
 - Developed integration technology to insert up-converting phosphors into existing biological warfare agent sensors.
 - Demonstrated feasibility of an aflatoxin biosensor.
 - Initiated design phase of microfabricated polymer bilayer air-fluid sampling inlet.
 - Initiated studies on performance characteristics of biological sensors in multiple environments.
 - Initiated research to identify, purify, and crystallize target enzymes for inhibition of spore germination.
 - Developed reference architecture for smart messages system.

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	September 1996	

(U) FY 1997 Program:

- Structural Materials and Devices. (\$32.0M)
 - Demonstrate a 2X increase in mean-time-between-failures (MTBF) associated with the replacement of carbon engine starter oil face seals on aircraft with ceramic face seals.
 - Demonstrate novel low cost processing approaches for ceramic composites for use in gas turbine engines.
 - Demonstrate a versatile process for lowering the cost of hot isostatic pressing of superalloy powders.
 - Demonstrate production of titanium components using laser sintering techniques.
 - Demonstrate production of cast aluminum-beryllium components.
 - Demonstrate the application of new processing approaches (e.g., solid freeform fabrication (SFF)) for controlling the dimensional tolerances, microstructural properties and affordability required for mesoscale machines.
 - Demonstrate secondary processing and joining of ultra lightweight panels.
 - Demonstrate the capability to produce ceramic components with complex geometry and dimensional tolerances and mechanical properties comparable to mass manufactured advanced ceramics using Jet Printer technology (3-D printing).
 - Develop a new solid freeform build method for ceramic components based on layer-by-layer photolithography utilizing either large area liquid crystal display or a light emitting diode display technology for electronically programmable photomasks.
 - Test reconfigurable machines and tools in shop floor beta test sites.
 - Determine the performance characteristics of low cost, damage tolerant fibrous monolith components in engine environments.
 - Demonstrate control of plasma sprayed metal-matrix processing and extend process control models to physical vapor deposition of metal coated fibers.
- Smart Materials and Devices. (\$23.3M)
 - Demonstrate fabrication process for microintegrated smart materials.
 - Demonstrate vibration reduction by a factor of ten in machine tools via specially designed sensor/actuator elements to enhance machining tolerances.
 - Determine the economic viability of Templated Grain Growth (TGG), a process by which solid phase epitaxy of crystallographically oriented seeds on near net shaped polycrystalline components is used for growth of single crystal-like oxides.
 - Construct fully integrated hydro-acoustic noise suppression tile.
 - Conduct wind tunnel test of second generation shape adaptive F-18 wing model.
 - Demonstrate vibration suppression in subscale helicopter blades.

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BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Materials and Electronics Technology,
PE 0602712E, Project MPT-01

- Functional Materials and Devices. (\$38.3M)
 - Complete development of a plasma/ion etch numerical simulation.
 - Demonstrate predictive capability of high-pressure, low-order, chemical vapor deposition models and demonstrate feedback control to a desired wafer state.
 - Demonstrate intelligent processing of large area chemical vapor deposition (CVD) of diamond with production costs of \$1/carat.
 - Demonstrate the advantages of thermal management diamond in the performance of defense electronic systems or subsystems.
 - Grow single crystal boules for three inch diameter silicon carbide semiconductor wafers by scaling up the reactor and developing larger seed crystals.
 - Demonstrate high temperature superconducting technology with greater than fifteen square inch format and greater than eighty percent yield.
 - Demonstrate large area deposition of giant magneto-resistive (GMR) materials.
 - Fully characterize spin transistor and other spin polarized transport devices for use in ultra-high density memory applications.
 - Demonstrate prototype GMR magnetic memory cell and spin transistor memory cell using magnetic multilayers.
 - Initiate effort to develop candidate polymers using advanced lithography techniques for infrared artificial dielectrics (IRADS).
- Energy and Environmental Sciences. (\$17.8M)
 - Demonstrate a hydrothermal oxidation pilot plant for the destruction of shipboard excess hazardous materials.
 - Demonstrate novel recycling/reclamation techniques for disposal of scrap polymer matrix composites.
 - Demonstrate intelligent processing of thermal barrier coatings yielding reliable coatings which increase turbine engine inlet temperatures by up to 200 degrees F, with a commensurate increase of 10-15% in thrust.
 - Develop advanced erosion/corrosion resistant thin film coatings for military applications.
 - Demonstrate high yield, pilot scale production (1.5 megawatt/year) of high efficiency (10%) copper-indium diselenide (CIS) solar cells on flexible substrates; test in a military environment.

(U) FY 1998 Program:

- Structural Materials and Devices. (\$30.1M)
 - Demonstrate low cost titanium and superalloy component fabrication processes.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01	
- Demonstrate uniformly bonded face sheet attachment on ultra lightweight foamed metal structure. - Demonstrate a 5x reduction in prototyping time (print-to-part) for ceramic and metal gas turbine engine components utilizing solid freeform manufacturing. - Demonstrate laser workcell at a beta test site. - Establish approaches for breakthrough gains in personnel protection performance (e.g., >100% from current capabilities for 7.62 mm armor piercing (AP)) through the application of innovative materials, materials processing and phenomenological modeling of multicomponent materials systems. - Build a high precision silicon nitride roll gimbal and pitch shaft for an infrared (IR) seeker utilizing Shaped Deposition Manufacturing (SDM), which combines additive and subtractive processing. - Select and begin a specific mesoscale machine demonstration of interest to DoD (miniature air sampler, catalytic air purifier, etc.) - Smart Materials and Actuators. (\$20.6M) - Demonstrate full sized smart material active helicopter blade structures and acoustic noise suppression structure on roto test stand. - Evaluate actuation potential of magnetoelastic and magneto-shape memory transducer materials. - Evaluate high performance electroceramic actuator fabrication processes. - Demonstrate applicability of smart shape adaptive wing to vortex destabilization concept. - Design, build, test and evaluate high power laminated actuator stacks for smart defense structures utilizing Computer Aided Manufacturing-Laminated Engineering Materials (CAM-LEM) solid freeform fabrication (SFF) capability. - Functional Materials and Devices. (\$15.5M) - Demonstrate a prototype giant magneto-resistive (GMR) magnetic memory array and spin transistor memory cell array using magnetic multilayers. - Design and build a very high sensitivity magnetometer. - Continue polymer development using advanced lithography techniques for infrared artificial dielectrics (IRADS). - Energy and Environmental Sciences. (\$14.3M) - Demonstrate the utility of advanced erosion/corrosion resistant thin film coatings at a military site. - Extend concepts of intelligent processing of thermal barrier coatings to complex multilayer systems capable of an additional 200 degrees F in turbine inlet temperature (10-15% additional thrust) without sacrificing reliability. - Develop balance-of-plant and packaging for a direct oxidation fuel cell replacement for military standard batteries.			

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01	
(U) <u>FY 1999 Program:</u> - Demonstrate that full scale, intelligent processing of copper-indium diselenide (CIS) solar cells yields both performance and cost (<\$1/Watt) suitable for use of flexible photovoltaics in military operations. - Structural Materials and Devices. (\$31.5M) - Fabricate and test materials and materials systems concepts designed to significantly improve personnel protection performance (e.g., >100% from current capabilities for 7.62 mm armor piercing (AP)), dramatically increasing protection for the individual soldier. - Demonstrate solid freeform fabrication of titanium forging blanks. - Demonstrate spray forming of superalloy forging billets. - Demonstrate the use of Solid Freeform Manufacturing to upgrade distressed turbine vanes in man-rated gas turbine engines with ceramic composite components of high reliability. - Demonstrate the construction and performance of a prototype mesoscale machine. - Smart Materials and Actuators. (\$21.6M) - Evaluate aluminum-beryllium (Al-Be) F-15 rudder span. - Demonstrate vortex wake reduction for submarines using smart materials. - Demonstrate submarine acoustic noise reduction using smart material tiles. - Functional Materials and Devices. (\$19.3M) - Demonstrate high speed, radiation hard, medium density, non-volatile magnetic memory utilizing magnetic multilayers. - Demonstrate very high sensitivity magnetometer and gradiometer for localization of magnetic anomalies. - Expand the Solid Freeform Fabrication program to demonstrate a new process for the fabrication of silicon carbide (SiC) devices using rapid tool-less vapor deposition processes. - Complete polymer development for infrared artificial dielectrics (IRADS). - Energy and Environmental Sciences. (\$17.9M) - Demonstrate a low temperature, packaged direct oxidation fuel cell for solder applications. - Demonstrate alternative energy sources for solder microclimate cooling and for portable battery chargers. - Complete demonstration and insertion of advanced erosion/corrosion resistant thin film coatings in military systems.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research			R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-01			
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		122.7	110.2	137.4	142.5
	Appropriated		126.0	N/A	N/A	N/A
	Current Budget		117.4	111.4	80.5	90.3
(U)	<u>Change Summary Explanation:</u>					
	FY 1996	Decrease reflects inflation savings, (\$-2.5 million) termination of polymer matrix composite effort (\$-4.1 million) and minor program repricing (\$-5.9 million).				
	FY 1997	Increase reflects minor program repricing.				
	FY 1998-99	Decrease reflects transfer of biological warfare defense program to PE 0602XXE, termination of the polymer matrix composite effort, and repricing of the planned requirements for this project.				
(U)	<u>Other Program Funding Summary Cost:</u> N/A					
(U)	<u>Schedule Profile:</u> N/A					

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

2-1 ITEM NOMENCLATURE

Materials and Electronics Technology,
PE 0602712E

COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Microelectronic Device Technologies MPT-02	54,399	66,193	71,331	95,660	96,222	98,881	110,972	120,972	Continuing	Continuing

(U) Mission Description: This project develops advanced electronic and optoelectronic devices, semiconductor process tools and methodologies, materials for optoelectronics, and infrared devices. Areas of emphasis include: high performance analog-to-digital converters (ADCs), military optical processors, novel optoelectronic devices and components, high temperature electronic devices and high power electronics. This microelectronics development project develops and demonstrates advanced microelectronics technology for DoD critical needs. Technologies developed in this project are performance driven and exceed commercial capabilities. This project includes a significant effort to develop advanced material and device technology beyond the classical scaling limits of silicon device technology.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Developed heterojunction bipolar transistor process, device, and design technologies for application in high-speed analog-to-digital converters, digital-to-analog converters, multiplexers, and demultiplexers. (\$7.2M)
- Delivered the first-generation of hardware and software for advanced image processing. (\$6.3M)
- Completed development of advanced electronic neural network technologies for target tracking and recognition applications. (\$6.5M)
- Developed critical materials, processes, and device technologies for .25µm silicon-on-insulator semiconductor fabrication. (\$8.5M)
- Developed optoelectronics technologies to enable cost-effective fabrication and integration of module subassemblies for digital optoelectronic processors, bus and backplanes, and serial/parallel input/outputs. (\$25.3M)
- Initiated efforts to design radio frequency photonic components for transmission of millimeter waves and microwaves. (\$.6M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-02	September 1996
(U) <u>FY 1997 Program:</u> • Complete hardware/software integration for advanced vision system, and demonstrate image recognition. (\$3.5M) • Demonstrate functionality and operation of high performance optoelectronic, digital processor prototype and develop advanced optoelectronic fabrication approaches and subassembly component technologies. (\$18.7M) • Develop component and fabrication technologies for radio frequency photonic components for application in millimeter wave and microwave transmission. (\$2.4M) • Improve silicon-on-insulator (SOI) materials and device fabrication methodologies to enable a low power, radiation tolerant, 0.18µm technology generation. (\$10.4M) • Initiate efforts to develop advanced digital-based radar processor components based on high speed semiconductor technologies, such as heterojunction bipolar transistors (HBT). (\$6.0M) • Demonstrate operation of semiconductor switches, based on silicon-carbide materials, capable of sustained handling of high electric power. (\$4.7M) • Develop high speed mixed signal packaging environment and integration approaches for Analog to Digital Converter (ADC) processor elements. (\$3.0M) • Extend HBT device technology to enable 75 dB spur-free dynamic range (SFDR) ADC processor performance. (\$5.0M) • Develop common complementary metal oxide semiconductor/silicon-on-insulator (CMOS/SOI) materials requirements to support low power electronics and radiation hardened performance requirements. (\$2.7M) • Initiate efforts to extend high performance mixed signal device technology to geometries below 0.18 micron. (\$4.8M) (U) <u>FY 1998 Program:</u> • Advanced Microelectronics Materials and Device Technology - Develop scaled devices and integration approaches to operation below 50nm CMOS. (\$14.2M) • Advanced Microelectronics Materials and Device Technology - Develop large area material growth with atomic layer precision, quantum level device modeling and material optimization to support advanced device requirements. (\$11.3M) • Advanced Microelectronics Process and Integration Technology - Develop shallow junction doping techniques with low thermal excursion and low damage processes, compatible with the required atomic layer materials. (\$10.8M)		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

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APPROPRIATION/BUDGET ACTIVITY

RDTE, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Materials and Electronics Technology,
PE 0602712E, Project MPT-02

- Advanced Microelectronics Process and Integration Technology - Develop in-situ process sensors to optimize process end points and to provide real time manufacturing feedback control and model development. This will result in the optimized integration of extreme scaled device technology on atomic layer material. (\$10.5M)
- Optoelectronics - Demonstrate critical optical elements and emitter based smart pixel arrays for a high payoff 3-D based optoelectronic engine for military battlefield information systems which can significantly impact: reconfigurable switching, 2-D image decompression/compression, and high speed parallel memory access. (\$11.5M)
- Digital Radar - Continue efforts to develop advanced digital-based processor components based on high speed semiconductor technologies, such as heterojunction bipolar transistors. (\$10.0M)
- A/D Converters - Develop integrated CAD tool set for high speed designs and demonstrate high speed analog-to-digital prototype. (\$3.0M)

(U) FY 1999 Program:

- Advanced Microelectronics Materials and Device Technology - Develop novel material and process approaches to address quantum level noise immunity in circuits with extreme scaled devices. (\$20.8M)
- Advanced Microelectronics Materials and Device Technology - Develop low noise high speed clock distribution and packing techniques for Trillion Transistor cells. (\$18.8M)
- Advanced Microelectronics Process and Integration Technology - Demonstrate full flow process of extreme scaled device technology on atomic layer material at an integration level of a trillion transistors. (\$24.2M)
- Advanced Microelectronics Process and Integration Technology - Develop feedback process control systems which integrate design and manufacturing to decoupling manufacturing cost from production volumes. (\$12.4M)
- Optoelectronics - Verify capability of optoelectronic engine to outperform conventional electronic systems by factor of greater than X 100 for specific computation intensive military signal processing problems such as STAP (Space Time Adaptive Processing) eg: for acoustic/digital radar signatures processing. (\$8.5M)
- Digital Radar - Develop Advanced digital processor components. (\$10.0M)
- A/D Converters - Complete prototype demonstration. (\$1.0M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-02			
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998
	President's Budget		62.2	71.8	87.2
	Appropriated		60.7	N/A	N/A
	Current Budget		54.4	66.2	71.3
(U)	<u>Change Summary Explanation:</u>				
	FY 1996 Decrease due to Bosnia reprogramming action (\$-1.2 million); SBR transfer to PE 0605502E (\$-.8 million), and program restructuring (-4.3 million).				
	FY 1997-98 Decrease due to a reprioritization of DoD resources.				
	FY 1999 Increase due to minor program repricing.				
(U)	<u>Other Program Funding Summary Cost:</u> N/A				
(U)	<u>Schedule Profile:</u> N/A				

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
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R-1 ITEM MONUMENTATION

Materials and Electronics Technology,
PE 0602712E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Cryogenic Electronics MPT-06	29,042	9,835	13,190	13,203	12,546	15,000	20,000	25,000	Continuing	Continuing

(U) Mission Description: Thin film electromagnetic materials have reached a stage of development where specific applications can be identified in electronic devices and circuitry for military systems. Films are deposited and patterned to form electromagnetic components in ways that are similar to, and compatible with, the processes of conventional semiconductor manufacturing. Such electromagnetic components, as well as complementary metal oxide semiconductors (CMOS), work best at lower temperatures, so that cryogenic packaging generally will be required for highest performance. Thin-film high temperature superconducting (HTS) components packaged with cryogenic devices are being applied to radars, electronic warfare suites, and communications systems to enhance performance by more than an order of magnitude while reducing size and power requirements. Particular demonstrations include an upgraded ship-defense radar (SPQ-9B) with 100X greater detectability of missiles in littoral clutter, and a switchable filterbank with 24 individually tuned high-performance filters to suppress Electronic Warfare (EW) saturation in radar warning receivers. Highly dependable and inexpensive cryocoolers (including thermoelectric cryocoolers) are being developed for these applications, and new efforts will explore techniques to improve the performance of all solid state thermoelectric coolers as well as the overall cryogenic performance in applications ranging from communications to computing.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- High Temperature Superconductors/Analog and Digital Applications (\$13.7M): In this final year of the HTS Program, components were evaluated for integration into military avionics.
 - Continued integration of 24-element filterbank with refrigerator for application to F-15 aircraft.
 - Evaluated cryo-radar with HTS stabilized oscillator (STALO), at the Naval Research Laboratory (NRL) Chesapeake Bay Facility.
 - Completed funding for Consortium for Superconducting Electronics.
 - Continued development of a high-performance 8x8 asynchronous transfer mode (ATM) cryogenic switch in a wide area network.
 - Developed simultaneously switchable and tunable high temperature superconducting (HTS) filters, preserving low insertion loss and high quality factors.
 - Examined applicability of 2nd generation HTS filters to interference reduction in communications sets, particularly SINGARS radios.

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APPROPRIATION/BUDGET ACTIVITY
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R-1 ITEM NOMENCLATURE

Materials and Electronics Technology,
PE 0602712E, Project MPT-06

- Developed a Broadband Waveform Generator incorporating high temperature superconducting (HTS) Josephson Junction array for advanced radar applications.
- Developed small HTS magnets for energy storage and mine countermeasures.
- Cryogenics Technologies. (\$15.3M)
- Developed small/inexpensive reliable cryocoolers.
- Developed electronic devices and components optimized for cooled operation.
- Initiated applications demonstrations with integrated cryocoolers and temperature-optimized components.
- Militarized several small low-cost cryocoolers for insertion into radar and Electronic Countermeasures (ECM) systems.
- Developed a miniaturized cryopackage for a High Stability Cryo-stabilized oscillator (STALO) for Airborne Radars.

(U) FY 1997 Program:

- Cryogenics Technologies. (\$9.8M)
- Continue fabrication of cryo-radar, using HTS components and upgraded conventional components such as driver and active array, for final demonstration in FY 1998 with a simulated Naval scenario.
- Upgrade HTS switchable filter sets with tunable filters, for simpler construction and operation in aircraft Electronic Countermeasures (ECM) suites.
- Evaluate results of cryo-crossbar switch and asynchronous transfer mode (ATM) efforts. Determine most appropriate insertion for digital systems employing HTS devices as well as cryo-complementary metal oxide semiconductors (CMOS).
- Determine most important communications applications for cryo-components.
- Evaluate advanced thermoelectric materials with significantly improved figure of merit including quantum well and multilayer structures.

(U) FY 1998 Program:

- Cryogenics Technologies. (\$9.2M)
- Demonstrate, at an appropriate facility, a fully functional Cryo-Radar, with 108 dB dynamic range, 20 dB greater than present performance, showing capability to detect targets over that range and an ability to address the defense of surface ships to attacking missiles.
- Demonstrate the ability of cryo-filterbanks to provide Electronic Counter-Countermeasures (ECCM) for aircraft receivers, in a scenario to be developed by the Air Force.
- Demonstrate an improved analog to digital (A/D) converter employing cryogenic components.

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APPROPRIATION/BUDGET ACTIVITY
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R-1 ITEM NOMENCLATURE
Materials and Electronics Technology,
PE 0602712E, Project MPT-06

- Demonstrate low-cost (less than \$2500), highly reliable (greater than 30,000 hr) Sterling cycle cryocooler that delivers 5 watts at 80K with less than 200 watts of total power.
- Thermoelectric Materials and Devices. (\$4.0M)
- Demonstrate new thermoelectric coolers using novel new materials that will provide a reduction in temperature greater than 50°C for a single stage.

(U) FY 1999 Program:

- Cryogenics Technologies. (\$8.2M)
 - Insert cryogenic packages in communication transceivers which mitigate electromagnetic interference effects.
- Demonstrate digital waveform generation and signal processing using superconducting quantum devices.
- Demonstrate pulse tube or Sterling cycle cryocooler costing less than \$1,500 in quantities of 1,000 with greater than 40,000 hr mean time before failure that delivers 5 watts of cooling at 70K with an input power of 150 watts or less.
- Thermoelectric Materials and Devices. (\$5.0M)
 - Demonstrate thermoelectric coolers that can achieve 100°C cooling in less than three stages as compared to the current seven stages.
 - Demonstrate potential benefit of efficient power generation from thermoelectric devices operating at high temperature (>500°C).

(U) Program Change Summary: (In Millions)

	FY 1996	FY 1997	FY 1998	FY 1999
President's Budget	12.0	9.8	11.2	10.2
Appropriated	30.9	N/A	N/A	N/A
Current Budget	29.0	9.8	13.2	13.2

(U) Change Summary Explanation:

FY 1996 Decrease reflects minor repricing.
FY 1998-99 Increases reflect expansion of cryocooler effort to include advanced thermoelectric materials.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Materials and Electronics Technology, PE 0602712E, Project MPT-06
(U) Other Program Funding Summary Cost: N/A		
(U) Schedule Profile: N/A		

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R-1 ITEM NOMENCLATURE
Materials & Electronics Technology,
PE 0602712E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Military Medical/Trauma Care Technology MPT-07	27,633	26,672	26,714	37,686	54,407	55,500	59,500	58,500	Continuing	Continuing

(U) **Mission Description:** The objective of this project is to revolutionize far-forward battlefield trauma care. The project recognizes that planned downsizing of U.S. forces creates new pressures to ensure force readiness, skill mix, and effective joint doctrine at a time when battlefield casualties carry both strategic importance and tactical relevance. A review of combat casualty care has shown: (1) that 90% of combat deaths occur in the zone of close combat prior to medical or surgical intervention; (2) that fratricide continues at casualty rates as high as 20%-30%; (3) that casualty location is a continuing battlefield problem; and (4) that less than 5% of U.S. Army active-duty physicians have treated combat casualties.

(U) The DARPA Combat Casualty Care program has two major segments: (1) Advanced Biomedical Technology and (2) Healthcare Information Infrastructure. The first segment exploits DARPA's unique leadership role in the electronics and information sciences to project advanced medical and surgical care into the far-forward battlefield area to effect early, successful, clinical intervention. In one thrust, this program will develop lightweight personnel status monitors (PSMs) permitting remote non-invasive clinical diagnosis, casualty localization, and friend or foe identification. The PSM, which would be worn by all soldiers as part of their combat uniforms, is further augmented with low power, secure, wireless communications and a Global Positioning Satellite system (GPS). The PSM would monitor the soldiers' clinical vital signs continuously, but would remain otherwise passive unless either queried by an operational commander or the soldiers' vital signs departed from established clinical norms.

(U) In a second thrust, this program will develop the technology base for early far-forward medical/surgical intervention. Hemorrhage will be controlled by projecting the expertise of a surgeon with remote telepresence surgery. To preserve critical organ system function, reverse systemic shock, and prevent hypoxia there will be development of automatically controlled devices to provide immediate mechanical or pharmacologic therapy. Once pharmacologic or early surgical stabilization has been achieved, the patient will be evacuated in a critical care life support for trauma and transport pod (LSTAT) which will function like an autonomous single-patient hospital intensive care unit.

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(U) In a third thrust, workers will develop and exploit advanced simulation technology to improve the training of battlefield health care providers and to ensure skill currency. The objectives of this effort are to provide for the virtual representation of human structure and function; ensure near-seamless transition from training to clinical practice; and to permit simulation of combat-casualty medical care within the framework of operational battlefield requirements. The broader impact of whole-body virtual simulation on undergraduate and continuing medical education programs will allow military medical students to integrate traditionally separate academic disciplines and dramatically reduce the need for human cadavers or live animal wounding. Virtual prototyping is provided for medical environments such as mobile operating rooms, critical care life support for trauma and transport pod (LSTAT) and instruments/equipment inserted by casualty care simulations. New technologies for presenting information and training scenarios will be developed using human interface technologies. (U) A fourth thrust will develop high-fidelity diagnostic imaging, particularly in biomedical applications of Computed Tomography (CT), ultrasound, infrared (IR), and conventional X-rays. For example the particular problem that is encountered in ultrasound imaging is that the medium (i.e., human) tissue is inhomogeneous and scatters the signal, which blurs the image. The processes for developing high-resolution imaging will build upon the emerging technology of adaptive acoustics, the displays of which are intuitive and easily interpreted by the combat medic and physician. (U) In the other segment of the Combat Casualty Care program, the development of an advanced healthcare information infrastructure supports the entire trauma care technology base. Medical information must flow seamlessly and transparently on all levels of patient care. For this to occur, a platform-independent medical record system, such as the electronic theater medical record (ETMR), will ensure immediate continuity, distribution, and accessibility of medical information from the forward battlefield to the rear echelon support in U.S. based medical centers. This information will be achieved in multimedia heterogeneous databases of laboratory studies, radiologic and pathologic images, inpatient medical records, and be available over a world wide telecommunication system for real-time interactive collaboration among physicians. In addition, the infrastructure will provide a clinical associate system which is an intelligent system that assists physicians, nurses, corpsmen and paramedics in assessing and treating patients. (U) This work does not duplicate any efforts of the Military Services or the National Institutes of Health. A Memorandum of Agreement exists between the Army Medical Department and DARPA.			

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R-1 ITEM NOMENCLATURE

Materials & Electronics Technology,
PE 0602712E, Project MPT-07

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Advanced Biomedical Technology. (\$16.3M)
 - Developed a specialty version of the Personnel Status Monitor (Ranger Overwatch PSM) with temperature, heart rate and motion sensors for insertion into Ranger training exercises.
 - Completed first prototype limb trauma simulator and delivered to U.S. Army Special Operations Command (USASOC) Medical Training facility.
 - Completed design and feasibility study to incorporate trauma simulator into the medic training on the virtual battlefield at the Dismounted Warrior Battle Lab (DWBL).
 - Completed 7 degrees of freedom (DOF) end-effectors and wireless communication packages for Remote Telepresence Surgery System.
 - Completed and delivered first prototype of life support for trauma and transport (LSTAT) (one for each service).
- 3-D Ultrasound Technologies. (\$2.8M)
 - Developed test and evaluation battlefield/trauma ultrasonic imaging technology (using a 2D array equivalent) for 3D interpretation of body structures for insertion into Bosnia as a battlefield tele-ultrasound unit.
 - Continued development of Synthetic Aperture Radar processing techniques to determine those features which are pertinent to the ultrasonic imaging problem. Began testing algorithms which could mitigate the contribution of multiple scattering sites to image degradation.
- Healthcare Information Infrastructure. (\$6.2M)
 - Integrated models of combat doctrine and knowledge-based decision support tools (combat casualty protocols and guidelines) in support of combat medics and physicians.
 - Demonstrated hands-free capture of patient data under battlefield conditions.
 - Demonstrated integration of battlefield electronic patient record with peacetime care systems.
- Bio Detection and Identification. (\$2.3M)
 - Initiated characterization of immune response to sonicate inoculation in bacterial, viral and bio-engineered threat species.
 - Continued development of ionization source and curved-field reflection for tiny mass spectrometer.
 - Preliminary exploration of approaches to transect and characterize the induced genetic changes in stem cells or their derivative lineages for the purpose of potential defense against biological weapons.

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(U) <u>FY 1997 Program:</u> - Advanced Biomedical Technology. (\$12.8M) - Incorporate miniaturized Global Positioning Satellite (GPS) chip into Personnel Status Monitors (PSMs) for the transmission of vital sign and situational awareness data to battalion level command. Integrate PSM into full echelon casualty data for Joint Task Force (JTF) reference. - Incorporate full haptic interface (sense of touch) into limb trauma simulator, phase one of organ system surgical simulation, and integrate medic simulation into Dismounted Warrior Battle Labs (DWBL). - Develop interchangeable surgical tools for remote telepresence surgery and explore methodology for motion compensation (e.g., beating heart); insertion of beta version of Life Support for Trauma and Transport (LSTAT). - Extend the development of portable digital X-ray to 20 x 20 cm detector array, for field use and insert beta prototype of 3D ultrasound imaging into field test. 3-D Ultrasound Technologies. (\$4.6M) - Continue to develop and implement the techniques of adaptive acoustics to ultrasonic imaging, utilizing 2-D sensor arrays and image processing. - Healthcare Information Infrastructure. (\$7.5M) - Extend combat casualty protocol based care to disease (non-battle) injuries. - Demonstrate integration of combat casualty care data with Joint Task Force reference architecture for Global Combat Control System (GCCS) compliant data services.			
(U) <u>FY 1998 Program:</u> - Advanced Biomedical Technology. (\$13.8M) - Complete miniaturization and field testing of PSM system, developing and integrating the sensate liner of microsensors into the system. Integrate and transition into 21st Century Land Warrior Program and USA Rangers. - Complete and deliver Telepresence Surgery system mounted in the Army Medical Department (AMEDD) Center and School chosen armored ambulance, with enhanced 6 degrees of freedom (DOF) manipulators, and operated wireless (advanced control theory to resolve latency (lag time) to remote sites). - Integrate micro-miniaturized components (ventilation, oxygen generator, monitors, power units) into beta version LSTAT with canopy. Demonstrate 3rd generation design of LSTAT which is NATO compatible. - Develop 3rd generation virtual simulation of battlefield injuries to solid organs as well as extremities with full physiologic responses such as bleeding and muscle twitching; integrate wound simulators into medic representation on virtual battlefield at Dismounted Warrior Battle Labs (DWBL).			

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07																						
• 3-D Ultrasound. (\$7.4M) - Continue to develop 2-D array ultrasound transducer. - Continue digital signal processing (DSP) for high-resolution, low signal-to-noise (S/N) ultrasound (US) image. • Surgical Robotics. (\$5.5M) - Develop advanced interface design and micro-dexterity enhancement and effectors to telesurgical system. - Initiate and develop technologies to solve latency issues involved with satellite transmission.																							
(U) <u>FY 1999 Program:</u> • Advanced Biomedical Technology. (\$10.0M) - Continue development of enhanced dexterity micro manipulators. - Continue exploration of unconventional actuators (artificial muscles, MEMS, etc.) - Complete transition of telepresence surgery and casualty simulation technologies to the services. • 3-D Ultrasound Technologies. (\$7.9M) - Complete ultrasound enhancements for scattering, deabberation, and beam forming. - Demonstration of field-portable ultrasonic images. • Surgical Robotics. (\$19.8M) - Continue development of advanced interface design and micro-dexterity enhancement and effectors to telesurgical system. - Continue resolution of latency (lag time) to remote sites. - Develop system for motion compensation (e.g., surgery or moving platform or upon the beating heart).																							
(U) <u>Program Change Summary:</u> (In Millions) <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;"><u>FY 1996</u></th> <th style="text-align: center;"><u>FY 1997</u></th> <th style="text-align: center;"><u>FY 1998</u></th> <th style="text-align: center;"><u>FY 1999</u></th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td style="text-align: center;">29.1</td> <td style="text-align: center;">26.7</td> <td style="text-align: center;">31.2</td> <td style="text-align: center;">37.7</td> </tr> <tr> <td>Appropriated</td> <td style="text-align: center;">24.3</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> <td style="text-align: center;">N/A</td> </tr> <tr> <td>Current Budget</td> <td style="text-align: center;">27.6</td> <td style="text-align: center;">26.7</td> <td style="text-align: center;">26.7</td> <td style="text-align: center;">37.7</td> </tr> </tbody> </table>					<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>	President's Budget	29.1	26.7	31.2	37.7	Appropriated	24.3	N/A	N/A	N/A	Current Budget	27.6	26.7	26.7	37.7
	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>																			
President's Budget	29.1	26.7	31.2	37.7																			
Appropriated	24.3	N/A	N/A	N/A																			
Current Budget	27.6	26.7	26.7	37.7																			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research	R-1 ITEM NOMENCLATURE Materials & Electronics Technology, PE 0602712E, Project MPT-07	
(U) <u>Change Summary Explanation:</u> FY 1996 Increase reflects Bio Detection and Identification (\$2.3 million), minor repricing (\$1.4 million), inflation savings (\$-.1 million), and Small Business Innovative Research (SBIR) transfer to PE 0605502E (\$-.3 million). FY 1998 Decrease reflects minor program repricing. (U) <u>Other Program Funding Summary Cost:</u> N/A (U) <u>Schedule Profile:</u> N/A		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 2 Applied Research

R-1 ITEM NOMENCLATURE

Biological Warfare Defense
PE 0602XXXE, Project BW-01

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Biological Warfare Defense Program BW-01	0	0	32,300	34,300	20,000	20,000	20,000	10,000	Continuing	Continuing

(U) Mission Description: This program element funds high-risk projects that support revolutionary new approaches to biological warfare defense. Today, there is a tremendous mismatch between the magnitude of the biological warfare threat faced by the DoD worldwide, and its ability to adequately respond. The widespread availability of bacterial, viral and toxin stocks, minimal developmental cost and scientific expertise required, and abundance of unsophisticated weaponization potentials comprise a sinister threat. The single largest concern, however, is from the exploitation of modern genetic engineering by adversaries to synthesize "super pathogens". Dramatic recent developments in biotechnology, which this program will leverage, promise to eliminate this mismatch.

(U) Efforts include developing barriers to block entry of pathogens into the human body, therapeutics to stop pathogen virulence and to modulate host immune response, medical diagnostics for the most virulent pathogens and their molecular mechanisms, and biological and chemically-specific detectors. Program development strategies will include collaborations with the pharmaceutical, biotechnology, government, and academic centers of excellence. The program has received approval as a stand alone effort in the FY 1996 DoD Authorization Act and this program element leverages activities previously funded in PE 0602712E, Project MPT-01 in FY 1996.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments: N/A

(U) FY 1997 Program: N/A

(U) FY 1998 Program:

- Pathogen Countermeasures. (\$32.3M)
 - Optimize the detection of specific pathogens by stem cells (in cell culture).
 - Determine the impact of modified red blood cells on coagulation and immune systems.
 - Define animal models in which to test the efficacy of modified red blood cells to defend against pathogen.
 - Establish a portfolio of strategies to:
 - * inhibit the expression of disease-causing (virulence) factors by pathogens.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 2 Applied Research		R-1 ITEM NOMENCLATURE Biological Warfare Defense PE 0602XXXE, Project BW-01																					
(U) <u>FY 1999 Program:</u> * Pathogen Countermeasures. (\$34.3M) - Develop a modified stem cell which can both detect and produce a prophylactic/therapeutic response to a pathogen (in cell culture). - Define animal models in which to test the efficacy of modified stem cells to prevent disease. - Demonstrate in laboratory animals the efficacy of modified red blood cells to eliminate pathogens from the blood for the purpose of potential defense against biological warfare agents. - Demonstrate selected strategies (in cell culture) to: * inhibit the expression of disease-causing (virulence) factors by pathogens. * disrupt the disease-causing (virulence) communications between pathogens. * modulate the body's response to the presence of a pathogen.																							
(U) <u>Program Change Summary:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Appropriated</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>0</td> <td>0</td> <td>32.3</td> <td>34.3</td> </tr> </tbody> </table>					FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	0	0	0	0	Appropriated	N/A	N/A	N/A	N/A	Current Budget	0	0	32.3	34.3
	FY 1996	FY 1997	FY 1998	FY 1999																			
President's Budget	0	0	0	0																			
Appropriated	N/A	N/A	N/A	N/A																			
Current Budget	0	0	32.3	34.3																			
(U) <u>Change Summary Explanation:</u> FY 1998-99 Increase is attributable to establishment of a new PE for Biological Warfare Defense.																							
(U) <u>Other Program Funding Summary Cost:</u> N/A																							
(U) <u>Schedule Profile:</u> N/A																							

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)						DATE		September 1996		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM MONITORING Experimental Evaluation of Major Innovative Technologies, PE 0603226E						
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Experimental Evaluation of Major Innovative Technologies	589,076	635,634	698,241	682,021	699,462	712,914	736,414	713,214	Continuing	Continuing
Command & Control Information Systems EE-21	41,960	50,927	61,208	66,300	80,369	91,234	100,234	99,034	Continuing	Continuing
Airspace Surveillance Technologies EE-27	3,000	0	24,900	26,800	18,100	11,000	6,000	27,000	Continuing	Continuing
Guidance Technology Program EE-34	11,876	11,499	27,661	29,600	29,212	28,000	34,200	52,000	Continuing	Continuing
Advanced Ship/Sensor Systems EE-36	24,239	15,886	22,943	46,144	83,478	89,696	109,696	119,696	Continuing	Continuing
Advanced Simulation EE-37	61,065	47,340	33,492	21,698	0	0	0	0	0	N/A
Unmanned Undersea Vehicle Systems EE-39	15,091	0	0	0	0	0	0	0	0	N/A
Critical Mobile Targets Systems EE-40	114,461	0	0	0	0	0	0	0	0	N/A
Air Defense Initiative EE-41	24,281	21,377	0	0	0	0	0	0	0	N/A
Global Grid Communications EE-45	42,807	45,190	41,882	43,916	44,750	49,549	54,549	49,549	Continuing	Continuing
Defense Simulation Internet EE-46	25,612	37,119	2,880	1,500	1,500	1,500	0	0	0	N/A

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development					R-1 ITEM MONITORING Experimental Evaluation of Major Innovative Technologies, PE 0603226E						
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Fast Ship/Future Ship EE-47	0	16,000	48,000	50,000	36,000	22,000	0	0	0	N/A	
Combat Hybrid Power System EE-48	0	15,400	25,000	28,500	18,000	17,000	4,000	0	0	N/A	
Tier III Minus UAV EE-49	23,201	14,749	5,000	0	0	0	0	0	0	N/A	
Sensors & Exploitation Systems EE-50	0	68,139	83,220	85,755	94,200	111,487	135,287	135,287	Continuing	Continuing	
Small Unit Operations EE-51	20,636	54,066	51,580	68,398	71,413	77,800	88,000	40,000	Continuing	Continuing	
Information Integration Systems EE-53	0	64,904	104,424	115,300	115,000	121,000	118,800	110,000	Continuing	Continuing	
Classified Programs EE-CLS	180,247	173,038	166,051	98,110	107,440	92,648	85,648	80,648	Continuing	Continuing	
(U) <u>Mission Description:</u> This program element is budgeted in the Advanced Technology Development Budget Activity because its purpose is to demonstrate and evaluate advanced research and development concepts. Funding for fifteen projects are requested in FY 1998 within this program element such as Command and Control Information Systems, Information Integration, Small Unit Operations, and Global Grid Communications projects. A number of advanced concept technology demonstrations are funded within these activities. A discussion of the most significant projects follows.											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, IE 0603226E	
(U) The Command and Control Information Systems project is developing the technologies necessary to facilitate joint campaign planning and control throughout the battlespace. The primary program in this project is the Joint Forces Air Component Command System, that will improve air combat coordination and targeting from initial planning through Air Task orders. (U) A new project, Aerospace Surveillance Technologies, will pursue non-traditional approaches to surveillance ranging from digital terrain mapping to passive radar tagging. (U) Advanced Simulation efforts will provide a distributed, scalable seamless warfighting environment at the weapon level of detail that will ultimately provide a massive synthetic theater of war capable of supporting such requirements as readiness training, doctrine refinement, requirements analysis, battle management simulation, and contingency planning. Communications and data infrastructures, range instrumentation and computer image generation are just a few of the developmental activities funded in the Advanced Simulation project. Funding for the Synthetic Theater of War ACTD is also included in this project. (U) The Global Grid Communications project will develop and demonstrate advanced communications technologies needed for defense and intelligence operations for the 21st century. The ultimate goal is deployment of a gigabit network that will be interoperable with commercial, optical and secure wireless networks. (U) The Advanced Ship-Sensor Systems project develops and demonstrates advancements in a wide range of technologies used in ship sensor, signal processing mechanical systems and advanced maritime platforms to significantly enhance the capabilities of naval and maritime forces. (U) The Sensor and Exploitation Systems programs (EE-50) are addressing imagery data collection processing capabilities by developing a Semi-Automated Imagery Processing advanced concept technology demonstration to enhance battlefield situational awareness, as well as developing sensor assets and evaluating the exploitation of sensor products.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E		
(U) Four projects initiated in FY 1997 continue in FY 1998: 1) Fast Ship/Future Ship (EE-47) is a joint project with the Navy to develop the Arsenal Ship to enhance naval battle support; 2) Combat Hybrid Power Systems (EE-48) efforts will develop electric power management and control technologies for use in hybrid electric/diesel powered combat and scout vehicles; 3) Small Unit Operations (EE-51) will explore and develop the technologies to expand the capability of squad-level warfighters to control large battlespaces, remotely engage enemy targets, and operate across a wide spectrum of conflict situations; and 4) Information Integration Systems (EE-53) will develop enhanced means to evaluate and compress the massive data streams provided by modern surveillance systems so that the information required by battlefield combatants is available on a near real time basis. (U) Finally, this program element also includes efforts in advanced Guidance/Targeting technologies and the Defense Simulation Internet. FY 1998 marks the final year of funding for the Tier III Minus UAV program.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
RDT&E, Defensewide				Experimental Evaluation of Major Innovative Technologies, PE 0603226E							
BA 3 Advanced Technology Development											
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
41,960	50,927	61,208	66,300	80,369	91,234	100,234	99,034	Continuing	Continuing		
Command Control Information Systems EE-21											
(U) <u>Mission Description:</u> Recent military operations, e.g., Desert Storm and Haiti, demonstrated that current theater command, control, communications, intelligence/information systems, planning and rehearsal systems, and non-lethal weapons capabilities lack the ability to support effective operations in diverse new arenas and scenarios ranging from desert heavy battle to urban areas with large civilian populations. Current capabilities do not provide critical interoperable wide-area communications and fail to provide real-time situational awareness, decentralized battle planning, rehearsal and execution capability, and flexible interfaces. The goals of the programs in this project, described individually below, are to enhance information processing, dissemination and presentation capabilities by inclusion of information concerning enemy and friendly forces, providing a joint situational awareness picture and improved planning and execution support capability (through the Joint Forces Air Component Commander (JFACC) Initiatives, Advanced Cooperative Collection Management (ACCM) Program, Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) and the Advanced Joint Planning (AJP) ACTD; and providing multi-media information interfaces to on-the-move users (through the Speakeasy program). Integration of collection management, planning and battlefield awareness programs is an important element of our strategy for achieving battlefield dominance through information systems. (U) The Joint Forces Air Component Commander (JFACC) Program seeks to revolutionize command and control (C2) of joint and coalition air forces through the incremental development, integration, evaluation, demonstration and transition of technology and systems which will enable new operational concepts for planning and execution that will significantly improve the responsiveness, efficiency and effectiveness of air operations. Key aspects of the program are: continuous near-real-time planning and execution with all tasks tied to a central strategy; collaboration among distributed elements to achieve a high degree of integration through the echelons and across operations, intelligence and logistics; and end-to-end management of C2 operations including advanced capabilities for strategy development, target systems analysis, campaign assessment and resource planning. Key technologies include: Centrally managed, multi-stage, concurrent plan generation; planning agents; intelligent resource scheduling techniques; dynamic resource reallocation algorithms; adaptive cueing tools; automated information routers; information tailoring and visualization tools and advanced collaborative and workflow management tools. These technologies will be applied to requirements that include:											

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NCNENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21

Continuous mission planning processes which quickly anticipate and react to changes in threat situation, resource availability and synchronization needs; full integration of intelligence and operational activities to support strike operations and prioritized target nomination; empowerment of cross functional product teams to quickly respond to changes; and proper battlefield knowledge to support activities and decisions at multiple echelons. JFACC technologies will be extended to maritime and land component C2 systems supporting joint force operations and associated planning tools will be made interoperable with related DARPA and Service programs (e.g. Advanced Logistics, Advanced Cooperative Collection Management (ACCM) and Battlefield Awareness and Data Dissemination). Program execution features a multi-phased, develop-demonstrate-transition approach, including close coordination with the Air Force and the Theater Battle Management Core Systems (TBMCS) development program which will serve as a near term precursor to the more revolutionary JFACC program.

(U) With the growing dependence on information systems and the pressing need to be able to get the right information to the right person at the right time, it becomes critical to protect information and assure the availability of associated services -- particularly in a stressed environment. The Information Assurance program will build on the initial work of the JFACC program to provide: Advanced capabilities for protection of information and services; a more robust information architecture; and automated tools for management and restoral of information service. This program will provide a set of common products, tools and architectural solutions that can be integrated for use by all DARPA programs as they proceed with their development.

(U) A new generation of collection systems will provide dramatically increased volumes of higher fidelity data to the operational decision maker. The challenge will be to dynamically manage and synchronize this advanced collection architecture with the processing, exploitation, and dissemination capabilities to provide the critical information to the decision maker in the constantly changing operational situation. The conventional requirements management, tasking, collection, processing, and exploitation process is unable to support the dynamics of a constantly changing operational environment. The Advanced Cooperative Collection Management (ACCM) Program will expand on efforts begun under the JFACC program and develop Continuous Asset Planning, Automatic Tasking, and Multi-asset Synchronization capabilities which will provide the collection management tools required to dynamically optimize/synchronize, schedule, and task the spaceborne, airborne and ground based collection, processing, exploitation and dissemination architecture. Collection Management (CM)-Link will optimize the architecture's capability to effectively support multiple operational users simultaneously by provided all echelons:

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A common NRT view of the collection environment; current status of collection, processing, exploitation, and dissemination operations; faster than real-time simulations in support of trade-off decisions; and the ability to conduct real-time multi-echelon coordination and shared decision making. ACCM is coordinating closely with the DIA Collection Management ACTD which will be a recipient of DARPA technology as it matures. (U) The objective of the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) is to deliver a synchronized, consistent description of the battlespace, allowing the field commander to design or adapt his command and control system to mission needs for effective application of force. The description of the battlespace provided to the warfighters under this ACTD will be tailored to their mission needs by intelligent selection of information to be broadcast and intelligent request (pull) and filtering at the warfighter workstation so that needed information is available. The ACTD focuses on the dissemination of the data required to present a consistent description of the battlespace and will provide the required infrastructure, information management capabilities, user applications and interfaces to intelligently manipulate data products, apply commercial direct broadcast technology for wide-band, low-cost dissemination of multi-media information and provide tactical internet services for two-way communications. A set of applications will be included in the ACTD to support the warfighter in the extraction of information about threats and other important aspects of the battlespace from nearby and remote real-time sensor data streams, intelligence sources and stored databases. BADD will be evaluated through participation in exercises, demonstrations and ongoing pilot services, and applications will be extended to other CINC users in addition to the CINC-sponsor of the ACTD, Atlantic Command. (U) Emerging technologies in Command and Control promise significant enhancements in operational readiness, planning and crisis response. The Advanced Joint Planning (AJP) ACTD seeks to evolve selected advanced planning tools, in a distributed collaborative environment at US Atlantic Command (USACOM), to evaluate the potential for enhancing Battle Staff Command and Control capabilities. Based on the evaluation results of this selected subset of planning tools, a full set of tools will be integrated into the USACOM Battle Staff Planning System. This "leave behind" system will form the model for upgrades to other CINC's Planning Systems. (U) Pacific Disaster Center (PDC) will help reduce the impact of various disasters by uniting Federal, State and local disaster agencies, utilizing the world's most advanced remote-sensing resources to reduce the loss of life and property from hurricanes, typhoons, volcanic eruptions, earthquakes, tsunamis and other disasters occurring in that area.			

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This will be done by bringing timely, critical information directly to Federal, State and local agencies responsible for disaster management. The PDC will provide a prototype for continuous, 24 hour monitoring for near real-time warnings of disasters and will obtain data and produce data products as events develop, to assess severity and guide emergency response and civil relief efforts. (U) Speakeasy will demonstrate a software-programmable communication system in a tactical environment. Speakeasy, which operates over the 2 Mhz to 2 Ghz band, provides the capability to implement wireless communications concepts to meet service requirements. Speakeasy is an open architecture-based, software-programmable communications terminal supporting simultaneous operation on a minimum of six radio frequency waveforms (four programmable channels in addition to ones for the global positioning system and cellular). The program is transitioning to the Services in FY 1998 after an operational demonstration of the system during the Task Force XXI exercise in FY 1997. (U) The Small Satellites Program will explore advanced satellite architectures to satisfy direct tactical-battlefield surveillance needs. Innovative commercial technology and standards will be employed in a search for low-cost solutions to this important problem. This study will investigate various levels of satellite complexity to understand the functional relationship between system cost and the number of satellites in a constellation. Subsystems such as attitude control, prime power, on-board processing, and data storage will be tailored or eliminated to reduce satellite weight and cost while maintaining acceptable performance. Options such as direct-to-theater downlinking will be examined for their ability to address the tactical surveillance problem while reducing costs compared to current systems and concepts. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> Continued development, test and integration of components of the LAC that were applicable to joint air campaign planning to the JFACC Program (EE-21) and transitioned them into that project. Delivered and transitioned UNIX version of Army Deep Operations System to Army and Marines. Continued development of advanced capabilities, with emphasis on interoperability, for incorporation into new and existing Air Force systems. Enhanced distributed situation object technology and targeting functions to support multimedia databases and target systems analysis. (This program was funded in Project EE-40 in FY 1996.)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21
September 1996		
(U) <u>FY 1997 Program:</u> - Joint Forces Air Component Commander (JFACC): Demonstrate prototype components of the continuous planning process: Air operations resource allocation and scheduling tools, campaign assessment process, workflow management control of the planning process, ISR and logistics planner, target system analysis toolset with advanced security and management features to assure necessary supporting information services in a stressed operational environment. (\$24.6M) - Battlefield Awareness and Data Dissemination (BADD) ACTD: Demonstrated an initial capability that includes Warfighter Associate functions with local databases, filtering on tags, profiles, requests, static/dynamic visualization and video interaction; and Information Dissemination Manager functions with repository, object tagging, and video/data broadcast. Phase II of the program was initiated. BADD is also funded in part under EE-40 (Critical Mobile Targets-Warbreaker) in FY 1996 and the ACTD under Atlantic Command sponsorship will be consolidated into EE-53 (Information Integration Systems) in FY 1997. (\$7.1M) - Advanced Joint Planning (AJP) ACTD: Evaluated metrics of installed planning tools. Based on the results from previously installed planning tools, integrated and demonstrated additional planning tools which resulted in a completed integration of planning tools at United States Atlantic Command (USACOM). Expanded the functionality of systems to crisis response employing map based planning; and evaluated the installed planning tools and associated metrics under operational conditions for future design incorporation. Developed integration and test environment for evaluation of operational effectiveness of commander's planning tools. (\$17.0M) - Demonstration of interoperability between off-island military resources and island civil forces in response to a hurricane threat. (\$5.9M) - Speakeasy: Continued the development of advanced technologies for the Speakeasy multiband, multimode modules in preparation for first incremental capability demonstration in December 1996. This capability was utilized in the Task Force XXI Advanced Warfighting Experiment (AWE) by the 1st Brigade 4th Infantry Division. (\$9.0M) - Strategic Packaging for Single Chip Modules and MCMs developed revolutionary new low cost packaging technology for high pin-count chips and multi-chip modules. (\$1.9M) - Small Satellites (Congressional addition to the FY 1996 President's Budget): Initiated satellite architecture requirements study exploiting commercial satellite buses, low-cost radar designs and low-cost space launch vehicles. (\$1.0M)		

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21	
• Battlefield Awareness and Data Dissemination (BADD): Provide enhanced information management and command and control information system capabilities to the Joint Broadcast System installed for European Command. The BADD ACTD, under the sponsorship of Atlantic Command, was funded in under EE-40 (Critical Mobile Targets-Warbreaker) in FY 1996 and is funded under EE-53 (Information Integration Systems) in FY 1997 and beyond. (\$5.0M) • Advanced Joint Planning ACTD: Based on prior year evaluation, complete the design, accomplish modifications and installation of a "leave behind" operational system, which can then be replicated for other CINCs. (\$14.5M) • Speakeasy: Continue development of hardware and software technology for the Speakeasy demonstration radio and participate in Task Force XXI AWE. Transition program to the Services to complete development in FY 1998 and FY 1999. (\$5.8M) (U) FY 1998 Program: • JFACC: Demonstrate and evaluate the basic technology/application building blocks and system architecture for the "JFACC After Next" Concept (Phase 2). Develop Phase 3 capabilities - an initial integrated campaign management and continuous planning and execution ability. Develop the combined benefit of target systems analysis and campaign assessment leading to an increase in mission cost effectiveness by a factor of three. Develop initial transition of JFACC capabilities to maritime environment and demonstrate interoperability with TBM Core Systems and the DII. (\$37.2M). • Information Assurance: Demonstrate automated capabilities to identify and prioritize near-term mechanisms and strategies for resilient boundary protection, access control and integrity safeguards in systems and networks. (\$5.0M) • Expand the Advanced Cooperative Collection Management (ACCM) functionality beyond the JFACC ISR Planner to include information needs management and dynamic, multi-asset allocation. Begin technology transitions into DoD collection management migration systems. Demonstrate emerging ACCM functionality with Service transition partners and integrate fully with the DIA ACTD on Collection Management. (\$10.6M) • Battlefield Awareness and Data Dissemination (BADD): Complete enhanced information management and command and control information system upgrades to the Joint Broadcast System installed for European Command and transition operations to DISA. (\$6.0M) • Complete the transition and support to the operational Advanced Joint Planning System to USACOM. (\$2.4M)			

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-21	September 1996																				
(U) <u>FY 1999 Program:</u> - JFACC: Demonstrate, evaluate and initiate transition of Phase 3 capabilities to Warfighters. Develop Phase 4 capabilities - a robust integrated campaign management and continuous planning and execution capability that achieves 70% of all responsiveness, resource efficiency, campaign effectiveness and process flexibility goals. Develop initial transition of JFACC capabilities to ground forces component and full DII compatibility. (\$42.1M) - Information Assurance: Demonstrate automated capabilities to limit system access, protect data, manage replication and recovery, detect and respond to intrusions, and reconstitute/reconfigure information services to reflect dynamic operational priorities. (\$10.0M) - ACCM: Demonstrate initial proof-of-concept of Continuous Asset Planning, Automatic Tasking, Multi-Asset Synchronization and CM-Link in the Roving Sands 99 exercise. (\$14.2M)																						
(U) <u>Program Change Summary:</u> (In Millions) <table border="0"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td align="right">61.4</td> <td align="right">47.8</td> <td align="right">57.3</td> <td align="right">62.1</td> </tr> <tr> <td>Appropriated</td> <td align="right">55.0</td> <td align="right">N/A</td> <td align="right">N/A</td> <td align="right">N/A</td> </tr> <tr> <td>Current Budget</td> <td align="right">42.0</td> <td align="right">50.9</td> <td align="right">61.2</td> <td align="right">66.3</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	61.4	47.8	57.3	62.1	Appropriated	55.0	N/A	N/A	N/A	Current Budget	42.0	50.9	61.2	66.3
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	61.4	47.8	57.3	62.1																		
Appropriated	55.0	N/A	N/A	N/A																		
Current Budget	42.0	50.9	61.2	66.3																		
(U) <u>Change Summary Explanation:</u> FY 1996 Decrease reflects net effect of: Funding of the Battlefield Awareness and Data Dissemination (BADD) ACTD and transfer of the Military Operations in a Built-up Area (MOBA) to Project EE-51, (\$-8.0 million); and a reduction to the Speakeasy program (\$-5.0 million). FY 1998-99 Increase reflects funding of the Advanced Cooperative Collection Management (ACCM) Program.																						
(U) <u>Other Program Funding Summary Cost:</u> N/A																						

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 06032226E, Project EE-21	
(U) <u>Schedule Profile:</u>			
Plan	Milestones		
Jun 96	Demonstrated baseline LAC functionality within USAF Combat Integration Center (CIC) at Roving Sands 96.		
Jul 96	Expand the AJP-ACTD functionality of systems to crisis response.		
Aug 96	Deliver initial BADD capability to 4th Infantry Division.		
Sep 96	Evaluate the installed AJP-ACTD planning tools and associated metrics under operational conditions.		
Dec 96	Demonstrate Speakeasy Model Year 1 initial capability in preparation for Task Force XXI Advanced Warfighting Experiment (AWE).		
Jan 97	Demonstrate JFACC Phase 1 - initial objectives-based targeting module for JFACC.		
Mar 97	Support Task Force XXI Advanced Warfighting Experiment.		
Apr 97	Deliver initial BADD information management capability to EUROM.		
Sep 97	Complete the design, accomplish modifications and installation of "leave behind" AJP-ACTD operational systems.		
Aug 98	Complete BADD information management upgrades in EUROM and transition to DISA.		
Sep 98	Demonstrate continuous asset planning and automatic tasking with U-2, Dark Star, and Global Hawk.		
Sep 98	Demonstrate automated capabilities to limit system access, protect data, manage replication and recovery, detect and respond to intrusions, and reconstitute/reconfigure information services.		
Dec 98	Demonstrate JFACC Phase 2 - prototype JFACC planning and execution infrastructure/tools.		
Apr 99	Demonstrate proof-of-concept A ² CM capabilities in Roving Sands 99.		
Dec 99	Demonstrate JFACC Phase 3 - integrated campaign management and continuous planning and execution capability.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET CATEGORY
RDT&E, Defense

BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Aerospace Surveillance Technology EE-27	3,000	0*	24,900	26,800	18,100	11,000	6,000	27,000	Continuing	Continuing

* Tagging concepts and elements of the sensor/sensor processing capabilities (hyperspectral detection and tactical synthetic aperture radar) matured under small unit operations (EE-51) will be used in the conceptual design and analysis of the programs listed under this project.

(U) **Mission Description:** This project funds space and airborne sensor efforts whose purpose is to improve the accuracy and timeliness of our surveillance systems for improved battlefield awareness. Timely surveillance of enemy territory under all weather conditions is critical to providing our forces the tactical information needed to succeed in future wars. This operational surveillance capability must perform during enemy efforts to deny and deceive the sensor systems, and operate, at times, in a covert manner. This project will exploit recent advances in signal processing, large constellation satellite architectures, low-power high-performance computing, and low-cost micro-electronics to develop advanced surveillance systems.

(U) The Tactical Radar Program will develop technologies to meet the stressing needs associated with mobile target detection; i.e. one meter or better resolution with a revisit time of order ten minutes. This program will pursue innovative spacecraft and radar designs that minimize complexity and cost; e.g., by employing complex radar waveforms that address range ambiguities. Battlefield Visualization (BV) and geo-referenced Precision Guided Munitions (PGM) call for high-density, high-accuracy Digital Terrain Elevation Data (DTED). Affordable methods of obtaining this data from single and multiple satellites will also be explored.

(U) The Passive Radar Tag for Covert Communications will provide a covert capability to remotely extract data from unattended ground sensors and Special Operation Forces (SOF) in real-time by airborne sensors such as the Joint Surveillance Target Attack Radar (JSTARS) or Advanced Synthetic Aperture Radar System (ASARS) surveillance radar systems. Miniature prototypes have been developed for other radars such as the APS-137 and APS-145 used on the E-2C and P-3. The tags will use special wake-up circuitry, surface acoustic wave delay lines, and modulation techniques to detect, delay, and modify radar pulses from these radars such that the return pulse received by the radar will include unique identification numbers and data messages from the tag. Covertiness will be obtained by the choice of modulation and the amplitude of the returned signal. The interrogating radars will be modified to detect, identify, and display the tag message. Variants of the tag will be produced to be compatible with air delivered internetted

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-27

ground sensors and with man portable tags used by SOf units. Low cost tags (<\$300) will be developed for cost effective and covert, friendly situational awareness. Other variants will be used to precisely register synthetic aperture radar imagery and to enhance communications of geolocation and other data between widely dispersed operating units.

(U) The Spectral Reconnaissance System will develop the next generation airborne reconnaissance system based on spectral imaging sensors. Such a system will enhance the ability to conduct wide area search for high value targets from both manned and unmanned airborne platforms. The program will develop a hyperspectral cueing and detection sensor and integrate this with a high image quality multispectral system. This system will be demonstrated on a Unmanned Air Vehicle (UAV) platform.

(U) In FY 1996, the Congress funded a Large Millimeter Wave Telescope as a potential joint United States/Mexico program to build and operate an adaptive, high precision, wide bandwidth, 50-meter aperture millimeter wave radio telescope. The sites being considered in Mexico offer low humidity and the ability to view both northern and southern skies. This telescope is being designed for a 5 microradian pointing accuracy, which, if achieved, would better the current state-of-the-art for radio telescopes.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Developed baseline optical design for the Large Millimeter (MM) Wave Telescope Program. Completed preliminary design review for all antenna systems and radome for the Large MM Wave Telescope Program (\$3.0M)

(U) FY 1997 Program: N/A

(U) FY 1998 Program:

- Perform concept designs for the Tactical Radar Program. Develop and mature critical technology areas to include orbital configurations that when combined with innovative system concepts, can provide the required coverage frequency and ground resolution, complex radar waveforms that will address range ambiguities, and innovative system designs that minimize cost by reducing spacecraft complexity. (\$8.6M)
- The Passive Radio Frequency (RF) Tags for the Covert Communications program will perform concept analyses

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
EA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-27

for multiple concepts of operation to include remote communications of sensor data from unattended ground sensors, data communications from Special Operations Forces (SOF), geo-registration of Synthetic Aperture Radar (SAR)/Moving Target Indicator (MTI) imagery, and communications of geo-location and other data between dispersed operating units. System design for each operational concept will be conducted, and fabrication of brassboard RF tags, modifications to airborne SAR/MIT processors and ground stations will be completed. (\$9.3M)

- The Spectral Reconnaissance System will develop a Long Wavelength Infra-red (LWIR) hyperspectral cueing sensor for UAV application and a multispectral imaging sensor. These sensors will include both the hardware and software necessary for integration as an airborne wide area surveillance system. (\$7.0M)

(U) FY 1999 Program:

- Complete concept designs for the Tactical Radar program. Complete development and maturation of critical technology areas Initiate design and fabrication phase of program. Perform tests of new SAR waveforms and techniques using existing airborne SAR platform. (\$10.1M)
- The Passive Radio Frequency (RF) Tags for the Covert Communications program will test multiple brassboard RF tags and the modified airborne Synthetic Aperture Radar (SAR) and Moving Target Indicator (MTI) radar systems. Ground and flight tests with several airborne platforms will be performed to validate performance. Design and fabrication of miniaturized tags will be performed and a test and evaluation plan developed. (\$9.0M)
- The Spectral Reconnaissance System will test both the spectral queuing sensor and the high resolution multispectral imaging sensor. After performance verification, the two sensors will be integrated together as a wide area surveillance system. This system will be demonstrated on a manned platform and then integrated onto a Unmanned Air Vehicle (UAV) system. (\$7.7M).

(U) Program Change Summary: (In Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget

0 0 0 0

Appropriated

3.0 N/A N/A N/A

Current Budget

3.0 0 24.9 26.8

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide EA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-27	September 1996																				
(U) <u>Change Summary Explanation:</u> FY 1998-99 Addition of the following programs: Tactical Radar, Passive Radar Tags for Covert Communications, and Spectral Reconnaissance System.																						
(U) <u>Other Program Funding Summary Cost: (In Millions)</u> <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>Passive Radar Tags</td> <td>0.5</td> <td>2.5</td> <td>3.0</td> <td>-</td> </tr> <tr> <td>Source</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>DARO</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	Passive Radar Tags	0.5	2.5	3.0	-	Source					DARO				
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Source																						
DARO																						
(U) <u>Schedule Profile:</u> <u>Plan Milestones</u> Tactical Radar Dec 97 Complete system level trades analysis. Jan 98 Begin concept development. Jan 98 Start development of less than mature critical technology areas. Dec 99 Complete concept designs. Sep 98 Complete development of critical technology areas. Nov 98 Initiate design and fabrication of tactical radar system. Jun 99 Conduct airborne tests. Radar Tags Jan 98 Concept Analysis. May 98 System Design. Sep 98 Fabricate brassboard RF Tags. Sep 98 Modify airborne Synthetic Aperture Radar (SAR) processors and ground stations. Nov 98 Test brassboard Radio Frequency (RF) Tags. Nov 98 Test airborne SAR processors and ground stations. Jan 99 Performance flight test RF Tags to verify system operation. Sep 99 Fabricate miniaturized RF Tags.																						

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-27	
Sep 99 Develop system test plan. Spectral Reconnaissance System Oct 98 Release solicitation for Phase I contracts. Feb 98 Award of contracts. May 98 Preliminary Design Review for both systems. Aug 98 Critical Design Review for Phase I efforts. Jan 99 Systems ready for test. May 99 Integration begins.			

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DATE September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM MONITORING

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Guidance Technology EE-34	11,876	11,499	27,661	29,600	29,212	28,000	34,200	52,000	Continuing	Continuing

(U) **Mission Description:** Fire-and-forget stand-off weapons need precise targeting information if critical fixed and mobile targets are to be eliminated effectively and with minimal collateral damage and minimum cost-per-kill. This requires that: (1) military surveillance and targeting systems geolocate targets accurately in the same coordinate system (i.e. WGS-84) in which the weapon system navigates; (2) the surveillance, targeting and weapon systems have precision navigation and guidance systems on-board; and (3) navigation and target location systems cooperate day/night and in adverse weather. In addition, future systems designed to accomplish precision strike missions must be significantly more affordable. The achievement of these characteristics in an integrated system is the goal of this program. The advanced navigation and guidance technologies being developed in support of this goal are called the Global Positioning System (GPS) Guidance Package (GGP). GGP technologies are applicable for both new or retrofit guidance/navigation packages to a variety of airborne platforms, ground vehicles, surface-to-surface standoff weapons and air-to-surface weapons. Additional thrusts are intended to increase the robustness of precision GPS navigation and to apply the technologies to the Advanced Tactical Targeting Technology Program.

(U) GGP tightly integrates a miniature GPS receiver and an all solid state, low cost, navigation-grade, interferometric fiber optic gyroscope (IFOG) based miniature inertial measurement unit (MIMU) with an advanced navigation computer into a low cost (\$15,000), precision navigation system. GGP Phase I addressed the technology issues involved in: (1) miniaturizing navigation grade inertial measurement units (IMUs) into a compact, manufacturable configuration; and (2) developing a multi-channel-on-chip, high dynamics GPS receiver. A Memorandum of Agreement (MOA) has been signed and implemented to demonstrate a Phase I unit on an Army Fire Support Team Vehicle (FIST-V). Successful demonstrations were conducted at Redstone Arsenal in June 1995 using a M981 FIST-V. GGP Phase 2 requirements place more stressing demands on performance of MIMU components and call for further reductions in size, power and weight. An MOA has been signed with the Navy designating GGP Phase 2 as the Navy's Advanced Integrated Navigation and Control Package. Another MOA was signed with the Program Executive Officer, Tactical Missiles, Army Missile Command. Potential applications include the Multiple Launch Rocket System. A third MOA is in coordination with the Project Manager, Bradley Fighting Vehicle Systems, Army Tank and Automotive Command. Potential application is the Bradley Fire Support Team Vehicle.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM MONITORING Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-34	

(U) The thrusts within the GPS Guidance Package (GGP) Program will also increase the robustness of GPS receivers by increasing their ability to operate effectively in presence of enemy jamming or countermeasures. The all-in-view Miniature GPS Receiver (MGR) chipset will be upgraded to demonstrate direct precision GPS code acquisition by employing a fast acquisition correlator engine and high performance clock. Operation with precision GPS code signals increases the MGRs robustness to jamming. The program will provide for the design, development, implementation and demonstration of a low cost, all digitally controlled GPS adaptive phased array receiver antenna; coherent precision matched analog antenna components; and antenna recalibration for stressing military environments. These technologies also increase MGR robustness to jamming. Finally, the GGP Program will develop and demonstrate a low power, long endurance MGR. This will increase MGR battery endurance, and thus availability of accurate navigation, from hours to days for dismounted troops.

(U) The Advanced Tactical Targeting Technology (AT3) will demonstrate a passive tactical targeting system for the lethal suppression of enemy air defenses (SEAD). AT3's objectives are to develop passive targeting technologies with precision time standards, wideband low cost multichip module based radio frequency (RF) receivers and threat association algorithms and to demonstrate an affordable tactical targeting system solution. Two airborne architectures will be considered. One will employ AT3 systems on an opportunistically diverse mix of platforms netted together by communications links. The other will employ a single strike aircraft with two or more dedicated miniature air-launched radar decoys, each carrying an AT3 and communication system. The SEAD mission must now be accomplished in the face of new electronic order of battle (EOCB) and new engagement tactics by enemy air defenders such as frequent threat emitter shutdowns. Today's targeting systems fail to provide timely information to target the growing mobile threat. Far more comprehensive, near real time, cockpit battlefield awareness must be provided. This includes synchronization of multi-platform information, long range emitter identification and target geolocation within seconds. An order of magnitude improvement in rapid target geolocation accuracy is needed against mobile surface to air missiles. Emerging DARPA technologies can combine to provide an affordable lethal SEAD tactical targeting capability. These include leveraging the GPS Guidance Package and cesium clock technologies for precision time and location. Low cost, light weight RF wideband digital receiver, processor and adaptive antenna functions can be implemented in advanced technology multichip modules.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Continued Global Positioning System (GPS) Guidance Package (GGP) Phase 2 designs. (\$10.6M)

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM DESCRIPTION

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-34

- Conducted integration of Phase 1 GGP units on a Navy testbed (F/A-18) aircraft. (\$1.3M)

(U) FY 1997 Program:

- Complete GGP Phase 2 designs and begin fabrication of two competitive GGP units. (\$10.4M)
- Complete evaluation of Phase 1 units on the Navy testbed aircraft. (\$.1M)
- Investigate and evaluate applications of the Miniature GPS Receiver (MGR) and other relevant technologies for concepts to suppress enemy air defenses. (\$1.0M)

(U) FY 1998 Program:

- Continue fabrication and begin integration of GGP hardware and software. (\$10.0M)
- Design circuits and power management techniques for the direct precision GPS code, low power, robust MGR. (\$5.1M)
- Design the GPS adaptive antenna array, signal processing and control functions for the MGR. (\$4.1M)
- Initiate Advanced Tactical Targeting Technology (AT3) design and development. (\$8.5M)

(U) FY 1999 Program:

- Perform final integration and testing of GGP units; deliver eight units. (\$4.6M)
- Complete design and begin fabrication of the robust MGR. (\$5.0M)
- Conduct final design reviews for adaptive GPS receiver antenna and signal processing. (\$2.9M)
- Conduct final design reviews for robust GPS receiver antenna and signal processing. (\$.8M)
- Fabricate robust GPS receiver antenna. (\$4.3M)
- Complete AT3 design and conduct breadboard component demonstrations. (\$12.0M)

(U) Program Change Summary: (In Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget

26.2 10.5 15.0 16.6

Appropriated

12.1 N/A N/A N/A

Current Budget

11.9 11.5 27.7 29.6

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(U) <u>Change Summary Explanation:</u> FY 1996-97 Reflects minor repricing. FY 1998-99 Reflects program repricing to accommodate additional efforts for more robust MGR receiver guidance and for the Advanced Tactical Targeting Technology Program.																									
(U) <u>Other Program Funding Summary Cost:</u> (In Millions) <table border="0"> <tr> <td>PE 0305154D</td> <td>FY 1996</td> <td>FY 1997</td> <td>FY 1998</td> <td>FY 1999</td> <td>FY 2000</td> <td>FY 2001</td> <td>FY 2002</td> <td>FY 2003</td> </tr> <tr> <td>Robust Guidance</td> <td align="right">0.4</td> <td align="right">1.6</td> <td align="right">2.8</td> <td align="right">3.0</td> <td align="right">3.0</td> <td align="right">2.0</td> <td align="right">2.0</td> <td align="right">1.0</td> </tr> </table>				PE 0305154D	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Robust Guidance	0.4	1.6	2.8	3.0	3.0	2.0	2.0	1.0				
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COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Advanced Ship-Sensor Systems EE-36	24,239	15,886	22,943	46,144	83,478	89,696	109,696	119,696	Continuing	Continuing	
*In FY 1997, this project consolidates programs under PE 0603226E, Project EE-39 and PE 0603569E, Project AS-01. Project EE-39 (33,901) (8,897) Project AS-01 (31,400) (31,910)											
(U) Mission Description: The objectives of this project are to develop and demonstrate advanced systems concepts and to pursue critical enabling technologies for maritime systems that will counter the threat created by the world-wide spread of increasingly sophisticated military technology. The evolving threat of quiet diesel submarines, the proliferation of sophisticated submarine and weapons capabilities, and the growing stockpile of underwater mines available to third world countries necessitates the development of far-term solutions for increasing ship affordability and enhancing our operating capabilities in the littoral. This project will provide advanced technologies to enhance the capabilities of naval forces to more effectively operate "...forward from the sea" in a broader range of tactical environments. (U) The Advanced Ship-Sensor Systems Program includes Sensor and Sonar Technology, Advanced Ship Mechanical Systems, and Advanced Maritime Platforms. In the Sonar Technology area, applications of advanced object detection, classification, and localization technologies using High Performance Computing (HPC) are demonstrated. Active and passive sonar techniques are applied, using advanced sources and sonar systems built from distributed elements or concentrated arrays. Advanced signal processing techniques to integrate real-time information and background intelligence into the operational situation are included. These applications will result in enhanced Anti-Submarine Warfare (ASW) capability against diesel-electric submarines operating in shallow water. In the Advanced Ship Mechanical Systems area, technologies such as precision active structural controls, actuator and sensor systems and high speed digital signal processing are being developed. These technologies will result in reduced ship acoustic signatures, high performance/high reliability propulsion systems, a safer/more survivable ship, and increased ship system affordability. Advanced Maritime Platforms efforts focus on the technologies for innovative ships and ship systems to provide the multi-mission, sustained presence capability required for joint operations associated with future regional conflicts. The advanced ASW program addresses coordinated source and receiver concepts to substantially increase the range for reliable detection and classification of quiet submarines. A particular focus is waveform design for optimal noise rejection and enhancement of target echoes.											

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(U) In FY 1997, this project incorporates the following programs formerly budgeted under the Advanced Submarine Technology Project (AS-01) and the Unmanned Undersea Vehicle (UUV) Project (EE-39). Innovative technologies to significantly enhance submarine stealth and survivability including hydrodynamic control, advanced materials/structures, and structural acoustics efforts to reduce ship observables will continue to be developed and demonstrated. They form the basis for efforts addressing affordability through improvements in structural acoustic design capabilities, innovative machinery mounting systems and high reliability propulsion systems. The Supercavitation Technology Program will continue to address the physics of launching and propelling underwater bodies at velocities approaching the speed of sound in water. UUV technologies brought forward involve development of a Synthetic Aperture Sonar (SAS) system to increase underwater search rates for mine detection and classification. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> • Completed development of multistatic active processing and impulsive sources for shallow water tactical sonars. Completed assessment of potential of multistatic active adaptive technology. Completed system integration and end-to-end testing for fleet Anti-Submarine Warfare (ASW) demonstration of multistatic active tactical processor and other components. (\$9.0M) • Accelerated autonomous ASW detection effort and extend to multi-targets and broader application to fleet systems. Deployed and evaluated initial (one class) autonomous submarine detection and classification package. (\$3.5M) • Exploited available wide-swath, mine SAS sea test data, investigated potential improvements which can be realized by incorporating state-of-the-art motion compensation. (\$.5M) • Explored stand-alone, low-frequency, acoustic source options for insonification of high interest, littoral waters to support high probability ASW search of these areas. (\$.5M) • Evaluated enhanced torpedo attack phase performance to be realized from fiber optic weapon link to launch platform and initiate planning for feasibility demonstration. (\$.4M) • Performed studies to develop technology options for future surface ships including the initial support activities related to a joint Navy/DARPA program for arsenal ship development. This work led to activities performed under Project EE-47 starting in FY 1997. (\$1.0M)		

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APPROPRIATION/SUBJECT ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-36	
• The following activities were funded by Congressional additions to the FY 1996 President's Budget: - Completed design and assemble off-board autonomous detection and classification package in preparation for demonstration in sea test. (\$2.9M) - Conducted simulation and modeling of information exchange and potential improvements among fleet platforms, ASW sensors and other sources to establish a basis for pursuing performance technical enhancement opportunities. (\$2.0M) - Developed a design and system architecture for an autonomous deployable sensor package suitable for long term monitoring of disposal sites for the Deep Ocean Relocation Program. (\$2.5M) - Developed design concepts for improved survivability of naval combatants-damage control without direct crew participation. Developed and demonstrated proof-of-concept sensors/sensor network to remotely monitor, assess, and control casualty conditions throughout the ship. (\$1.9M) (U) FY 1997 Program: • Complete final at-sea ASW demonstration of environmentally adaptive shallow water active sonar technology in conjunction with single/few platform scene generation capability. (\$1.2M) • Conduct tests to determine the effectiveness of supercavitating high speed bodies against fixed targets. (\$.8M) • Complete development of autonomous ASW multi-target detection technology. (\$.8M) • Fabricate and integrate a prototype active transmission vibration isolation mount. (\$3.1M) • Initiate development of a large scale Electromagnetic Turbulence Control application for at-sea demonstration of drag reduction, maneuvering control, and signature control. (\$2.0M) • Initiate development of the Netted Acquisition and Targeting (NAT) for littoral surveillance to include an acoustic source, as well as signal processing for enhanced detection and attack performance. (\$4.5M) • Design and initiate the fabrication of a prototype acoustic mine detection and classification system for a large (10 sqm/hr) area coverage rate. (\$1.0M) • Develop space-time adaptive processing techniques and perform ocean tests to enhance long range active coherence and towed array detection performance. (\$2.5M)		

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(U) FY 1998 Program: - Continue development, plan, and test proof of concept Anti-Submarine Warfare (ASW) Netted Acquisition and Targeting (NAT) system at sea, incorporating a wide frequency band, autonomous, long duration, leave behind acoustic source, signal processing for enhanced detection and attack performance, and acoustic space-time adaptive processing. (\$7.5M) - Complete fabrication and conduct at-sea testing of a prototype acoustic mine detection and classification system for a large (10 sqnm/hr) area coverage rate. (\$3.5M) - Initiate development of a system for signal exploitation and environmentally adaptive waveform generation. (\$6.0M) - Develop advanced submarine hydrodynamics and structural designs that are focused toward reducing submarine target strength against active sensor detection. (\$.5M) - Design, fabricate and test large scale magneto-rheological fluid (MRF) based mounts for acoustic and shock isolation. (\$3.6M) - Commence design work for at-sea demonstration of Electromagnetic Turbulence Control (EMTC) or other flow enhancements, exploiting potential drag reduction technologies leading to an improved flowfield for a submarine. (\$1.8M)	(U) FY 1999 Program: - Upgrade system and demonstrate detection-to-attack performance of a prototype ASW NAT system, incorporating: full wide frequency band, autonomous, long duration, leave behind acoustic source, autonomous diesel electric detection, signal processing for enhanced attack performance, and acoustic space-time adaptive processing. (\$12.1M) - Upgrade system and conduct an at-sea demonstration test of a prototype acoustic mine detection and classification system for a large (10 sqnm/hr) area coverage rate. (\$6.2M) - Continue development of and conduct at-sea testing of a signal exploitation and environmentally adaptive waveform generation system. (\$7.7M) - Develop detailed design and test planning for the at-sea demonstration of Electromagnetic Turbulence Control (EMTC) or other flow enhancements in a large scale test vehicle. (\$15.0M) - Continue development and demonstrate advanced submarine hydrodynamics and structural designs that are focused toward reducing submarine target strength against active sonar detection. (\$5.1M)
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RDTE&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE September 1996

APPROPRIATION/BUDGET ACTIVITY

**RDTE&E, Defensewide
BA 3 Advanced Technology Development**

R-1 ITEM DESCRIPTION

**Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-36**

(U)	Program Change Summary:	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		16.5	18.8	21.3	62.1
	Appropriated		25.4	N/A	N/A	N/A
	Current Budget		24.3	15.9	22.9	46.1

(U) Change Summary Explanation:

FY 1996 Reflects Bosnia reprogramming (\$-.8 million), transfer of sensor systems to the Small Unit Operations, Project EE-51, (\$-.8 million), and Arsenal Ship studies (\$+1.0 million) and minor repricing (\$-.5 million).

FY 1997 Reflects repricing of the acoustic mine detection system and the vibration isolation mount effort.

FY 1998 Minor program repricing.

FY 1999 Reduction reflects transfer of funds to Project EE-47 for support of the Arsenal Ship Program and restructuring of the following: fabrication and test of a supercavitating gun and high speed torpedo demonstrator, multiple target autonomous detection technology, and synthetic aperture sonar technology enhancement effort.

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile:

Plan Milestones

4QFY96 Conduct an at-sea demonstration of multistatic active adaptive processing for shallow water tactical sonars.

4QFY96 Conduct proof of concept test for acoustic mine detection and classification system.

4QFY96 Complete Large-Scale Demonstration of advanced Aeroderivative Engine active control technology.

4QFY96 Conduct at-sea demonstration of an autonomous submarine detection and classification system.

4QFY96 Complete preliminary design for a Mobile Offshore Base (MOB) concept.

4QFY96 Demonstrate simulation and visualization techniques of dredged material isolation process.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)			DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE		
RDT&E, Defensewide		Experimental Evaluation of Major Innovative Technologies,		
BA 3 Advanced Technology Development		PE 0603226E, Project EE-36		
4QFY96	Complete design concept for survivable naval combatant.			
1QFY97	Complete active transmission vibration isolation mount prototype test.			
3QFY97	Conduct functional demonstration of off-board detection and classification sensor.			
3QFY97	Conduct laboratory demonstration of signal processing for enhanced detection and attack performance.			
3QFY97	Complete development of coded waveform processing techniques and perform ocean tests to enhance long range active coherence and towed array detection performance.			
3QFY97	Demonstrate sensors/sensor network proof-of-concept for remote monitoring, assessment, and control of shipboard casualties.			
4QFY97	Complete prototype active transmission vibration isolation mount integration.			
4QFY97	Conduct laboratory test of power generation and conversion for an autonomous acoustic source.			
4QFY97	Conduct design of acoustic mine detection and classification system.			
1QFY98	Complete airframe shake test of active transmission vibration isolation mount.			
2QFY98	Conduct Anti-Submarine Warfare (ASW) Netted Acquisition and Targeting (NAT) system proof of concept test.			
4QFY98	Conduct initial at-sea test of prototype acoustic mine detection and classification system.			
4QFY99	Complete acoustic and shock tests of magneto-rheological fluid (MRF) mounts on Navy supplied large-scale testbed.			
3QFY99	Conduct at-sea test of signal exploitation and environmentally adaptive waveform generation system.			
4QFY99	Conduct at-sea test of prototype NAT.			

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM DESCRIPTION

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226X

COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Advanced Simulation EE-37	61,065	47,240	33,492	21,698	0	0	0	0	0	N/A

(U) **Mission Description:** The strategic environment in which the United States operates will require Joint Forces to operate across the full spectrum of conflict. At the same time, resources will continue to shrink, requiring the Department to search for the most cost effective means to perform the full spectrum of defense functions. To support the National Military Strategy, the Advanced Distributed Simulation (ADS) program is developing advanced simulation technologies to construct a seamless synthetic battlespace that will permit high fidelity simulation across the full spectrum of conflict and will enable fundamental changes in how defense functions are accomplished. The ultimate goal is to create simulation technologies capable of representing Joint Forces from the level of operations other than war up to an MRC level of combat, and supporting the following functions: Joint/Service readiness training and mission rehearsal; Joint/Service doctrine development and refinement; requirements analysis; design and prototyping; and operational/tactical planning. Specific technology efforts being undertaken as part of this project include large scale simulation system design interfaces to real world C4I systems advanced distributed networking and after action review technologies. As technologies mature, they are integrated, tested and demonstrated in exercises of varying size, complexity and utility. These technologies will transition to service and joint simulation developers, e.g. JSIMS, WARSIM, NASM, JSIMS Maritime component, as well as to STOW's international partner, the United Kingdom, etc.

(U) The Synthetic Environment component concentrates on the creation of large scale synthetic environments including representation of dynamic terrain and targets, weather and environmental phenomena, as well as seasonal and diurnal variations. The Synthetic Forces component creates a scalable, computer-generated joint military force that is representative and behaviorally credible. This simulation includes models of command nodes, various intelligence sensors and their related platforms. The high fidelity of the computer generated forces provides the capability to resolve battle outcomes at the weapon system level of detail. The system design and integration component develops the overall DoD High Level Architecture (HLA) occupant system architecture, interfaces to C4I systems, communication networking, distributed exercise management, data collection and, after action reviewed technologies. This architecture supports the capability to initialize, manage, and analyze large scale distributed joint as well as combined exercises. The Networking and Information Transfer Technology Development Program investigates and develops the technologies necessary to take full advantage of capabilities offered by the next generation communication networks. These technologies facilitate efficient and cost effective utilization of evolving network infrastructure

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while supporting the requirement to represent 100,000 entities interoperating over the network, in either perceptible real time or faster than real time.

(U) The Synthetic Theater of War (STOW) program has been designated an Advanced Concept Technology Demonstration (ACTD) with USACOM as the user. STOW is developing a HLA compliant prototype simulation system which enables creation of a seamless synthetic battlespace to support joint and combined training as mission rehearsal activities. The STOW prototype will play in USACOM's JTF level exercise Unified Endeavor in Nov 1997 and in subsequent USACOM exercises during FY 1998 and FY 1999. STOW technologies and user experience with these technologies will transition to JSIMS, WARSIM and other service simulation systems.

(U) The Operational Simulation Technology Program has been divided into two programs. The Advanced Simulation Technology Thrust (ASTT) develops simulation technology supporting the next generation of DoD simulation systems. Detailed coordination has been established with JSIMS, WARSIM and other service simulation developments. This program will extend core simulation technology research into areas not currently under develop by the Synthetic Theater of War Program such as advanced synthetic environments modeling, multi-resolution modeling, and scaling. The ASTT program will act as a bridge to future DoD simulation developments such as the Joint Simulation System (JSIMS). The other facet of the Operational Simulation Program will integrate Advanced Distributed Simulation and ASTT developed technologies into an operational planning systems to provide course of action analysis. This is a cooperative program with the Command and Control Division, Information System Office.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Developed and demonstrated improved network technologies supporting interaction of 10,000 entities within the HLA compliant simulation operating system. Tested and integrated NSA developed, ATM based, network security devices. (\$3.4M)
- Improved and demonstrated the technology necessary to create a synthetic battlespace to include increased fidelity of terrain and environmental effects (e.g. fog, smoke, haze); continued development of terrain and environmental data bases to support STOW 1997. Initiated efforts to transition to a HLA compliant system. (\$6.1M)
- Developed synthetic, artificially intelligent, command entities; expanded development of synthetic forces to include representations of additional battlespace entities for all services. Improved functionality and

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APPROPRIATION/BUDGET ACTIVITY

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R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-37

Interoperability of existing synthetic forces. Developed and tested a set of standard interface specifications capable of accommodating a variety of technical architectures which represent service unique command and control features. Initiated efforts to transition to a HLA compliant subsystem architecture. (\$23.2M)

- Developed a STOW simulation operating system, tested and integrated technologies, and continued development of the STOW Advanced Concept Technical Demonstration (ACTD) prototype simulation for the STOW-97 ACTD. (\$19.9M)
- Continued development of advanced simulation technologies to include initial use of automatic code generation to create synthetic forces from high level specifications; and initiated development of semi-automated scenario setup. Faster than real time simulation, and improved efficiencies for generating simulations Program focus directed towards JSIMS, WARSIM and other service simulations. (\$4.3M)
- Demonstrated the capability to utilize concurrent engineering tools for land vehicle design, link to synthetic battlefield environments, and the requirements to design through virtual prototypes. (\$4.2M)

(U) FY 1997 Program:

- Continue to develop and transition HLA compliant synthetic environment technology. Continue development of environmental technologies capable of supporting an environmentally robust battlespace to include interactive terrain, battlefield obscuration, diurnal effects. Develop technology for simulating the full range of dynamic terrain effects, e.g. cratering, building positions, fighting. (\$6.1M)
- Continue to develop and transition a broad range of synthetic forces representing combat elements; integrate with the DoD HLA a distributed command and control structure portraying in simulation the influence of one command level on the actions of the subordinate synthetic formations. Continue to develop and demonstrate increasingly more sophisticated behaviors representing an extended set of battlespace reactions such as situational awareness, reaction to the environment and tactical planning. Continue to re-architect synthetic forces to a HLA compliant design. (\$15.2M)
- Demonstrate a prototype Joint Synthetic Theater of War simulation system supporting a seamless land/sea/air warfighting synthetic environment capable of representing up to 50,000 entities with a high degree of realism, supporting Service and Joint operational training while retaining the arbitration of battle outcomes at the entity level of detail. Integrate and test expanded HLA compliant network and information transfer various technologies and network security devices. Transition technologies and simulation components to JSIMS, WARSIM and other service simulations. (\$12.9M)

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• Continue to develop simulation technologies capable of supporting a major regional contingency simulation (e.g. JSIMS, WARSIMS, et.al.). Technology efforts include: Multi-fidelity synthetic environments and multi-resolution modeling of synthetic forces, adaptive behaviors and rapid behavior development for synthetic forces, scaleability to 20K platform objects in real time, improved synthetic environments network performance, and data collection techniques for use in a multi-cast environment. (\$11.1M) • Create and demonstrate an integrated simulation capability, utilizing STOW technologies and simulation components, to support rapid course-of-action analysis for a single service planning system, using automated, faster than real time (FTRT) battle simulation, with both friendly forces and reactive OPFOR to enable rapid review of courses of action developed as part of mission planning. (\$2.0M)			
(U)	<u>FY 1998 Program:</u> - Continue to develop and demonstrate, in a series of USACOM sponsored exercises, the prototype STOW simulation. Optimize warfighter capabilities to employ high fidelity, platform level simulations for increased readiness. Make improvements as identified by USACOM. Integrate new/improved synthetic environments, synthetic forces, and networking technologies. (\$13.5M) - Continue to develop advanced simulation technologies to support JSIMS, WARSIM and other service simulations. Technology efforts include: Adaptive multi-skilled Synthetic Forces; Scaleability greater than 20,000 objects; distributed multi cast data collection on large amounts on data; rapid generation of computer generated forces and alternative methods of SAF generation; single synthetic environments database abstraction to accommodate multiple simulation requirements; initial multi-resolution modeling techniques. (\$18.0M) - Continue to develop course of action analysis capability based on advanced simulation technologies. Expand analysis capability to multiple joint planning systems. (\$2.0M)		
(U)	<u>FY 1999 Program:</u> - Continue to develop, demonstrate, and transition prototype technologies supporting a DoD High Level Simulation Architecture Compliant Joint Synthetic Theater of War Simulation System. Demonstrations will continue to focus on the representation of a seamless land/sea/air warfighting synthetic environment with an ever increasing degree of realism, supporting service and joint operational training and retaining the arbitration of battle outcomes at the platform level. (\$13.7M) - Continue to develop advanced simulation technologies to support JSIMS and WARSIM and other service simulations. Technology efforts include demonstration of: Scaleability to 100K objects in the simulation,		

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R-1 ITEM NOMENCLATURE

RDT&E, Defensewide

Experimental Evaluation of Major
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PE 0603226E, Project EE-37

BA 3 Advanced Technology Development

goal based reasoning for synthetic command entities, advanced multi-resolution modeling techniques, and improved terrain data base correlations. Complete transition of all technologies to JSIMS, et al. (\$8.0M)

(U) Program Change Summary: (In Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget	79.1	48.4	42.3	44.7
Appropriated	66.1	N/A	N/A	N/A
Current Budget	61.1	47.3	33.5	21.7

(U) Change Summary Explanation:

FY 1996 Reflects inflation savings (\$-6 million), reductions to the core simulation technologies development program (\$-3.5 million), and transfer of SBIR set aside to PE 0605502E (\$-.9 million).
FY 1997-99 Reflects repricing of current technology initiatives and reductions in keeping with JCS direction to reduce simulation activities.

(U) Other Program Funding Summary: Cost: N/A(U) Schedule Profile:

Plan Milestones
Sep 96 Demonstrate and assess the capability of concurrent-engineering tools for land vehicles design using engineering work stations, the driving simulator, and the synthetic battlefield.
Sep 96 Demonstrate advanced network technologies to include dynamic multi-casting.
Jan 97 Conduct technical Engineering Demonstration #2 of integrated STOW Technologies.
Oct 97 IAW CIN USACOM, demonstrate the STOW 97 prototypes ability to support the joint and combined rehearsal of tactically significant military operations.
Nov 97 Demonstrate 10-20,000 objections operating in a distributed simulation exercise with Battalion and Navy CFOR entities and rapid behavior modification capability.
Nov 98 Demonstrate initial coarse of action capability based on simulation interconnection.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM MONITORING Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-37	
Nov 98	Demonstrate initial multi-resolution modeling capability. Demonstrate scalability to 50,000 objects on a single large MRC size synthetic environment supporting multiple fidelity requirements. Demonstrate the ability of ground forces to move across a multi-resolution seam without a visible indication of boundary crossing.		
Nov 99	Demonstrate and transition technology developed under the ASTF program to other DoD simulation development agents. Complete development and demonstrate: scalability up to 100,000 objects, Command Forces to Division level; alternative CFOR approaches; techniques to correlate disparate databases; and the ability to display data during after action review at multiple resolutions from multiple sources.		

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COST (In Millions)		FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Air Defense Initiative EE-41		24,881	21,377	0	0	0	0	0	0	0	N/A
(U) Mission Description: Air Defense Initiative (ADI) programs form a critical part of the Defense Advanced Research Project Agency's (DARPA) program to ensure defense against cruise missiles and manned aircraft. The programs also complement systems being pursued by other program offices to counter theater ballistic missile threats. The rapid evolution and spread of cruise missile systems and technologies require new approaches and technologies to ensure effective and efficient countering of future airbreathing threats to assets in regional theaters. (U) The DARPA Mountain Top Program provided a cost effective ground-based radar system for the advancement and evaluation of concepts and technologies required for future airborne surveillance radars. In FY 1996, the Mountain Top Project was divided into the Radar Surveillance Technology Experimental Radar (RSTER) hardware program segment and the signal processing and analysis effort. The RSTER system continues to serve as the focal point for the Mountain Top Program and program activities continue to concentrate on joint testing and integration to effect a successful RSTER system transition to the Services, specifically, the Navy E-2 Program Office, PMA-231, by FY 1998. (U) Advanced Signal Processing Program includes the Common Research Environment for Space Time Adaptive Processing (STAP) Technology (CREST), Algorithm Development Tool (ADT) set designs, signal processing and analysis, and algorithm development and evaluation. Specific efforts are focused on the Navy E-2C Hawkeye and the Air Force E-3 Airborne Warning and Control System (AWACS). (U) The DARPA Simulation (Transition Support) Program conducts integrated analysis, modeling, simulated exercise, and demonstration efforts to develop Advanced Air Combat Concepts (A2C2) using DARPA technologies and to facilitate technology transition to the Services. Examples of these concepts include advanced fire control support for the Air Force and Navy fighters as well as air directed surface-to-air missile (ADSAM) operations of Army and Navy systems. Analysis and modeling efforts will be performed to develop and refine employment architectures and concepts of operations (CONOPS) utilizing DARPA technologies. Primary vehicles for these efforts will be in-house analyses, contracted studies, support for the Joint Staff (J-8) led Joint Cruise Missile Defense (JCMD) Study, and seminar wargames used to create and assess robust warfighting concepts supported by DARPA technologies. Field demonstration scenarios will be derived from the analysis and modeling effort, combined with simulated exercises to facilitate operator involvement early in the process.											

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R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41		
(U) The AIRMS Program is a large, precision infrared sensor flown on a modified Boeing 720B aircraft that is collecting high quality, long range infrared imagery for advanced air defense applications. The program ends after FY 1996. (U) The Crown Royal program mission is to develop and test techniques for spoofing surveillance radars. Off-board intelligent jamming techniques will be evaluated which blind the surveillance radar to the presence of an incoming threat. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> • The Mountain Top Program's RSTER system was employed as the surveillance sensor for the Navy's Cruise Missile Defense (CMD) Advanced Concept Technology Demonstration (ACTD) Phase I Live Fire Demonstration at the Kokee site at PMRF. DARPA initiated action to formally transfer custody of the RSTER asset to the Navy in support of the E-2C Radar Modernization Program (RMP). (\$5.0) • The Advanced Signal Processing E-2 and E-3 program offices commenced requirements definition with the selected Service program offices and support activities for direct insertion of cost effective STAP and related adaptive algorithm solutions for air defense. Rome Laboratory released version 1.0 of the Algorithm Development Tool (ADT) RLSTAP - Rome Laboratory, Space Time Adaptive Processing. The Maui High Performance Computing Center hosted the virtual STAP Algorithm Development Support Environment, including the Common Research Environment for STAP Technology (CREST) and demonstrated remote link capabilities. (\$6.6) • The Simulation (Transition Support) Program conducted architecture studies related to cruise missile defense (CMD) and monitored and supported outside activities of particular interest to DARPA; the J-8 Joint CMD Study, Service architectures, simulation exercises, small wargaming exercises and cost analysis efforts were emphasized. Architecture work continued in three primary areas: assessing advanced fire control benefits for fighters, Navy ADSAM architectures, and aerostat architecture analysis. DARPA continued to monitor and support DoD efforts pertaining to transition of DARPA technologies to the Services, including participation with the following activities: J-8's JCMD Study, a war game sponsored by DARPA/STO and OSD Net Assessment, simulated exercises, and a Navy Warfare Analysis Laboratory Exercise. (\$4.1M) • The AIRMS flight test program focused on collecting data that will not only further our research into advanced processing techniques but will also support other programs. The AIRMS final data collection campaign completed, having collected data against Low Observable aircraft at ranges greater than 500 KM,		

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	Cruise missiles at ranges in excess of 110 KM, and TBM's tracked at 350 KM. Over 1 Terabyte of data was cataloged, archived and is on-line at NAWC-CL. In addition, numerous performance models were validated (rework/phenomenology/IRST operational performance), advanced 3-D signal processing was demonstrated, and program work was successfully transitioned into numerous other infrared technology programs. Technology transfer of the signal processing activities for the Navy Shipboard IRST program, the AWACS EAGLE program, and the Navy F-14D IRST program was completed. (\$4.2M) - The Crown Royal program developed algorithms for selectively blinding hostile surveillance radars. (\$4.9M) (U) <u>FY 1997 Program:</u> - The Mountain Top Program will finalize the Memorandum of Agreement between DARPA and the Navy and effect transfer of custody of the RSTER asset to the E-2C Program Office, PHA-231. DARPA's Mountain Top program will terminate in FY 1997 with the transfer of custody of the RSTER asset to the Navy. (\$5.0) - The Advanced Signal Processing Program will employ the virtual STAP Algorithm Development Support Environment at MHPCC to design and develop advanced STAP algorithms compatible with the E-2 and E-3 AEW radar systems. The program will be completed in FY 1997 with the successful transition of insertion-ready STAP algorithms for the E-2 and E-3. (\$8.8M) - The Signal Intelligence (SIGINT) Program for FY 1997 will focus on development of innovative ideas to meet future collection requirements and identify insertion points for DARPA funded technology. (\$1.0) - The Simulation (Transition Support) Program for FY 1997 will focus on the development planning for an F-16 Silent Fighter Demonstration, an F-18 Demonstration of advanced sensor support for Navy fighters, an Advanced Combat ID demonstration, a Joint Strike Fighter (JSF) Architecture study, continued test planning and support for JACSSF advanced sensor utility for fighter operations, joint testing and support of the Navy WALEX (CONOPS), and the development of a joint architecture for DARPA advanced sensor deployments. Continued modeling and analysis will be performed and enhancements of system/sensor models will be implemented and employed to enable Service recognition and acceptance of the new DARPA advanced sensor suites. (\$6.6M) (U) <u>FY 1998 Program:</u> N/A (U) <u>FY 1999 Program:</u> N/A	

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APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE		
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(U)	<u>Program Change Summary:</u> (In Millions)	FY 1996	FY 1997	FY 1998
	President's Budget	25.6	21.3	N/A
	Appropriated	25.6	0	N/A
	Current Budget	24.9	21.4	N/A
(U)	<u>Change Summary Explanation:</u>			
(U)	FY 1996-97	Reflects minor repricing		
(U)	<u>Other Program Funding Summary Cost:</u> N/A			
(U)	<u>Schedule Profile:</u>			
	Plan Milestones			
	Mountain Top Program			
	Oct 96	MOA between DARPA and Navy signed.		
	Oct 96	Completion of DARPA Mountain Top Program.		
	Advanced Signal Processing Program			
	Oct 96	STAP Algorithm Development Support Environment remote access established.		
	Dec 96	E-2 and E-3 sensor system algorithm requirements defined.		
	Aug 97	Complete test and evaluation of candidate algorithms.		
	Sep 97	Transition algorithms to E-2 and E-3.		
	Sep 97	Completion of DARPA Advanced Signal Processing Program.		
	Signal Intelligence			
	Jun 97	Demonstration System Definition complete.		
	Oct 98	Begin experimental field testing.		

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RDT&E, Defensewide		Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-41	
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Simulation (Transition Support) Program Feb 96 Fighter/Navy/Surveillance Analysis Apr 96 Seminar Wargame Jun 96 J-8 JCMD IPR Sep 96 TACSSF Exercise Jan 97 Joint Test Mar 97 F-16 Field Demonstration May 97 Service Exercise Sep 97 Joint Architecture Assessment AIRMS Program - Program transitioned in FY 1997 Crown Royal Jun 96 Developed and tested algorithms for blinding hostile radars. Sep 96 Developed a demonstration plan.			

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COST (In thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Global Grid Communic... EE-45	42,807	45,190	41,882	43,916	44,750	49,549	54,549	49,549	Continuing	Continuing

(U) Mission Description: This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and demonstrated to be applicable to advanced, high performance networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technologies developed elsewhere.

(U) The key elements are: 1) Applications such as intelligent decision aids, that enable a geographically distributed planning staff to develop and analyze a course of action; 2) Advanced services such as scalable file systems, databases, and distributed computing support that are integrated with high performance computing, and free applications from the necessity to work down to the raw data transport level; 3) Demonstration networks that validate the research and development and enable early application development and technology transition into DoD efforts such as Defense Information System Networks; 4) Develop network controls pertaining to management, and security software technologies to enable sensor-to-shooter applications combining all network media; and 5) Develop advanced optoelectronic network component technology and network architecture for scalable and modular networks. The aggregate network bandwidth will be in the range of terabits per second and the network will handle multi-media service for both digital and analog signals.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Demonstrated evolving software development practices and the migration of software applications and information services to higher bandwidth networks in an operational exercise involving multiple JTFS. (\$17.0M)
- Demonstrated integration on a CONUS/International scale of all networks and demonstrate end-to-end secure transmission and signaling at gigabit rates. (\$4.9M)
- Demonstrated high bandwidth operation of critical multi-wavelength components. (\$7.3M)

(U) Mission Description: This program develops and demonstrates advanced communications technologies needed for defense and intelligence operations for the 21st century. The program will develop advanced information processing concepts to support a geographically dispersed staff for crisis management. Services for an enhanced information infrastructure to support command and control will be developed and demonstrated to be applicable to advanced, high performance networks. This program will demonstrate that commercial communications resources and technologies can be integrated with advanced optical components developed in this program as well as DoD tactical and satellite technologies developed elsewhere.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM DESCRIPTION	
RDT&E, Defensewide		Experimental Evaluation of Major Innovative Technologies,	
BA 3 Advanced Technology Development		PE 0603226E, Project EE-45	
• Field tested local area network application of multi-wavelength analog and digital signal transmission. (\$8.7M) • Developed multi-wavelength network management software and control algorithms. (\$4.9M)			
(U) <u>FY 1997 Program:</u>			
• Identify control and protocol issues for operation of multi-wavelength networks. (\$4.2M) • Demonstrate advance integrated optoelectronic network component operations. (\$9.3M) • Complete multi-wavelength network architecture and control planning; and initiate field-trial network deployment for long-distance and wide area applications. (\$14.5M) • Demonstrate integration with advanced virtual testbeds; large scale planning demonstrations; and deployable JTF C3 (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces). (\$17.2M)			
(U) <u>FY 1998 Program:</u>			
• Demonstrate multi-wavelength network management and control in local area testbeds. (\$8.0M) • Demonstrate 40 billion bit per second cross-connect switching and 32 channel transceiver chip. (\$10.4M) • Continue analysis and report on economics of multi-wavelength network architecture and technology for local area optical networks. (\$7.1M) • Continue integration with advanced virtual testbeds and design and conduct assessments of information services needed to extend the Joint Task Force (JTF) Infrastructure from the planning phase into the execution dynamic replanning phase. Develop Java-compatible Object Web Tools for generic plan editing, and demonstrate persistent brief development tools. (\$16.4M)			
(U) <u>FY 1999 Program:</u>			
• Demonstrate full operations, multi-wavelength, experimental, system network including interoperability among testbeds distributed across several geographic domains. (\$15.2M) • Develop software applications and servers, and expand the JTF reference architecture to include execution and dynamic replanning. Demonstrate information logistics services for optimization of time-value of information delivery and demonstrate rapid development of specialized plan viewers for multiple echelons. (\$22.0M) • Complete multi-wavelength network architecture for local area optical networks. (\$6.7M)			

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DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-45(U) Program Change Summary: (in Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget

45.2

42.0

43.4

33.9

Appropriated

43.4

N/A

N/A

N/A

Current Budget

42.8

45.2

41.9

43.9

(U) Change Summary Explanation:

FY 1996 Decrease reflects Bosnia reprogramming action (\$-.6 million).

FY 1997-99 Changes reflect repricing of JTF program.

(U) Other Program Funding Summary Cost: N/A(U) Schedule Profile:Planned Milestones

May 96 Demonstrate network combining crypt, commercial communications, and defense secure wireless, satellite.

May 97 Demonstrate integration with advanced optical testbeds. Conduct large scale planning demonstrations.
Jul 97 Complete first phase of deployable JTF C3 development (mobile C3, plan rehearsal and refinement during deployment, intelligent interfaces).

May 98 Complete large-area demonstration of optical network and advanced network management.

Sep 98 Demonstrate initial execution and dynamic replanning functionality.

Jun 99 Demonstrate 20 gigabit per second, multi-channel, multi-media, large-area network.

Jul 99 Demonstrate advanced execution and dynamic replanning functionality.

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 3 Advanced Technology Development

R-1 ITEM MONITORING

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Defense Simulation Internet (DSI) EE-46	25,612	37,119	2,880	1,500	1,500	1,500	0	0	0	N/A

(U) Mission Description: The goal of the Defense Simulation Internet (DSI) program is to research, develop and test at scale (worldwide), a network infrastructure capable of enabling distributed, real-time, multi-media (video, voice, shared data and work spaces) simulation that will seamlessly integrate all simulation, modeling, command and control functions from early design to battle rehearsal enroute to the conflict. The DSI meets DoD security requirements by using a commercial-off-the-shelf (COTS) encryption device (INES). The communications needs of the distributed, real-time, multi-media modeling and simulation community cannot be met with any other available technology. Commercial vendors are pursuing some of the required technologies, but development is too slow and unfocused to accommodate the immediacy of the Department of Defense's simulation requirements. The DSI program provides focus for the commercial development of the technologies needed by the simulation community for distributed work environments worldwide. Over 100 nodes currently extend the DSI to each of the Services, most of the Commanders-in-Chief (CINCs), some of our allies and other Government affiliated sites. These locations constitute the network's user sites; they provide valuable feedback on the technologies and methodologies being pursued and critical capability for both ongoing and major modeling and simulation events. A key mission of the DSI is to provide real time infrastructure for the Synthetic Theater of War (STOW) 97.

(U) The DSI will transition to the Defense Information Systems Agency (DISA) Defense Information Systems Network (DISN) by the end of FY 1997 and be operated on a reimbursable basis. It will be jointly managed by DISA and DARPA through the Advanced Information Technology Systems Joint Program Office. The transition of the DSI into the DISN provides affordability through consolidation of the costs required to operate multiple networks while continuing to support modeling and simulation requirements.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Provided network operations and user services. The DSI became a virtual network of DISN during the 3Q FY 1996, containing an estimated 30% more user sites. Operations included the 24 hours per day/7 days per week

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM DESCRIPTION

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-46

NOC, network security, exercise/event planning and management, and the 24 hours per day/7 days per week CSC Help Desk. (\$8.4M)

- Procured telecommunication circuits: International circuits (T1 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade select high use Synthetic Theater of War (STOW) sites to T3 tail circuit 4Q FY96. (\$10.2M)

- Upgrade network: Initiated upgrade which provides ATM switches and end-to-end encryption for the wide area network interface to the sites and the edge devices which provide the local area interface with the workstation for STOW 97 (30 Sites). Upgraded to commercial standard desktop VTC. Integrate systems management to provide control of end node workstations. (\$5.5M)

- Transition management: Provided programmatic integration management and engineering support through the DARPA/DISA (Advanced Information Technology Systems (AITS)) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. (\$1.5M)

(U) FY 1997 Program:

- Provide network operations and user services. As a subnet of DISN, it is expected that by the end of FY 1997 the subnet work will contain an estimated 30% more user sites. Operations include the 24 hours per day/7 days per week NOC, network security, exercise/event planning, management and the 24 hours per day/7 days per week CSC Help Desk. Provide STOW Exercise support. (\$9.0M)
- Procure telecommunication circuits: International circuits (T3 backbone), CONUS Phase II Backbone (T3) Tail Circuits (T1), upgrade high use STOW sites to high capacity tail circuits. (\$13.9M)
- Upgrade network: Complete deployment of service upgrade which provides ATM switches, end-to-end encryption and the edge devices to sites which require this upgraded capability (70 Sites). Automate network management to provide real-time management of high speed high bandwidth requirements. Provide resource reservation at the application level. Complete migration of Defense Simulation Internet (DSI) network operations and maintenance to Defense Information Systems Network (DISN). (\$11.7M)
- Transition management: Provide programmatic integration management and engineering support through the DARPA/DISA (Advanced Information Technology Systems (AITS)) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. (\$2.5M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		3-1 ITEM NOMENCLATURE	
RDT&E, Defensewide		Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46	
BA 3 Advanced Technology Development			
(U) <u>FY 1998 Program:</u>			
Transition management: Provide programmatic integration management and engineering support through the ARPA/DISA Advanced Information Technology Systems (AITS) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. (\$2.9M)			
(U) <u>FY 1999 Program:</u>			
Transition management: Provide programmatic integration management and engineering support through the ARPA/DISA Advanced Information Technology Systems (AITS) Joint Program Office (ADJPO) to identify and evaluate advanced technology candidates, offer pilot services, and transition LES technology to DISA. (\$1.5M)			
(U)	<u>Program Change Summary:</u>	(In Millions)	
		<u>FY 1996</u>	<u>FY 1997</u>
		<u>FY 1998</u>	<u>FY 1999</u>
	President's Budget	27.5	39.7
			0
	Appropriated	26.5	N/A
			N/A
	Current Budget	25.6	37.1
			1.5
(U)	<u>Change Summary Explanation:</u>		
	FY 1996 Decrease reflects Bosnia reprogramming source (\$-.3 million) and transfer of funds to the SBIR program element 0605502E.		
	FY 1997-98 Decreases reflect minor repricing.		
	FY 1999 Increase required to provide DARPA transition management for the DSI.		
(U)	<u>Other Program Funding Summary Cost:</u> N/A		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-46																					
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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM NCMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E							
COST (In Thousands)		FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Arsenal Ship/Fast Ship EE-47		0	16,000	48,000	50,000	36,000	22,000	0	0	0	N/A
(U) Mission Description: In the Arsenal Ship/Fast Ship Project, DARPA will identify and develop high leverage technologies and acquisition improvements to support future surface ships with an emphasis on littoral missions. The objectives of this new project have far-reaching implications for the future of surface ships for the US Navy. The project is currently structured in two parts: (U) Arsenal Ship is a high priority joint Navy/DARPA program to acquire a new capability for delivery of large quantities of ordnance (approximately 500 Vertical Launch System (VLS) cells) in support of land and littoral engagements. Key to both arsenal ship's affordability and operational flexibility is off-board integration of all but the most rudimentary C4I. The ships are to be theater assets that will operate under the authority of the joint Commanders-In-Chief (CINC's) and will receive their targeting along with command and decision information from other assets. Early in arsenal ship's life this control will be exercised through an Aegis platform, though as other assets mature, control will transition to aircraft such as AWACS or an E-2 with Cooperative Engagement Capability (CEC) and eventually to the Marine or Army shooter on the ground. Thus, the Arsenal Ship will not be fitted with long range surveillance or fire control sensors, but will be remotely controlled via robust data links. The data links will be secure, redundant and anti-jam in order to provide high reliability in the connectivity of the Arsenal Ships in high jamming operational scenarios. The overall program is an attempt to leverage the significant joint investment in Link 16 and CEC. The Arsenal Ship's survivability will be primarily achieved through passive design techniques. While active systems are not ruled out, they must be consistent with overall cost and manning goals. These design goals will allow the Arsenal Ship to have a very small crew (potentially, none at all) which will be a key ingredient in minimizing its life cycle costs. (U) This demonstration program is a non-ACAT (Acquisition Category) program to design the arsenal ships and to construct and test an arsenal ship demonstrator (ASD) to evaluate this new capability while minimizing the risks in acquisition of approximately six ships (to include conversion of the arsenal ship demonstrator to a fleet operational unit).											

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-47	September 1996																				
(U) As a result of studies that DARPA has performed, it is very clear that we should expect significant re-trenching from overseas deployments by US forces. This, coupled with the growing unaffordability of maritime pre-positioned logistics, will require that future forces be deployable from CONUS. The large travel distances suggest major payoffs for achieving speeds in excess of 50 or 60 knots and, in fact speeds of 75 knots or greater show major payoffs. We will explore the potential for sealift deliveries at speeds up to 100 knots to determine the breakpoints for cost and feasibility.																						
(U) <u>Program Accomplishments and Plans:</u>																						
(U) FY 1996 Accomplishments: N/A																						
(U) FY 1997 Program: - Select two industry teams from Phase I arsenal ship concept studies to begin Phase II development of functional baseline. (\$15.0M) - Perform initial evaluation of hydrodynamics for high speed regime. (\$1.0M)																						
(U) FY 1998 Program: - Complete arsenal ship Phase II functional designs by two industry teams and downselect to one team for detail design and construction of the arsenal ship demonstrator. (\$47.0M) - Assess hydrodynamic potentials for further exploitation. (\$1.0M)																						
(U) FY 1999 Program: Continue Phase III construction of arsenal ship demonstrator. (\$50.0M)																						
(U) <u>Program Change Summary: (In Millions)</u> <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>0</td> <td>16.4</td> <td>65.0</td> <td>40.0</td> </tr> <tr> <td>Appropriated</td> <td>0</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>0</td> <td>16.0</td> <td>48.0</td> <td>50.0</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	0	16.4	65.0	40.0	Appropriated	0	N/A	N/A	N/A	Current Budget	0	16.0	48.0	50.0
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	0	16.4	65.0	40.0																		
Appropriated	0	N/A	N/A	N/A																		
Current Budget	0	16.0	48.0	50.0																		

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DATE September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-47

(U) Change Summary Explanation:

FY 1997 Minor repricing.
FY 1998-99 Realignment of funding profile with joint Navy/DARPA arsenal ship memorandum of agreement.

(U) Other Program Funding Summary Cost:

	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Navy Funding PE 64310N	3.0	25.0	141.0	70.0	80.0	11.0	0	0	0	350.0

(U) Schedule Profile:

Plan Milestones

Jan 97 Award two industry teams Phase II arsenal ship contracts.
Jun 97 Complete initial 100 knot speed feasibility evaluation.
Jan 98 Award one industry team Phase III contract to start Arsenal Ship Demonstrator (ASD) detail design/construction.
Feb 98 Assess application potential for high speed ship concepts.
Feb 99 ASD keel laid.
Aug 00 ASD launched.
Oct 00 Begin ASD Demonstration/Testing Phase.

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Combat Hybrid Power System EE-48	0*	15,400	25,000	28,500	18,000	17,000	4,000	0	0	N/A

*The Integrated Product and Process Development Program (EE-37) is developing concurrent engineering/virtual prototyping technology that will be used in the conceptual design and analysis of the Combat Hybrid Power System.

(U) **Mission Description:** The Combat Hybrid Power System project is developing key power management technologies to enable Cavalry/Scout and combat vehicles to fully satisfy mission requirements. Essential requirements for U.S. Cavalry/Scout Ground Unit Operations and Small Unit Operations are to acquire threat information, locate targets, communicate, reduce signatures, and be more mobile and survivable. Essential requirements for close combat units are simultaneous, sustained offensive mobility, overmatching lethality and survivability against heavy threat firepower. The platforms must be air deployable which dictates weight and volume constraints. The military is developing an array of subsystems to support these missions that include: advanced sensor suites and communication equipment, active suspension and electric propulsion systems, signature management suites, countermeasures, active defense, and electric weapons. These subsystems require either continuous or pulsed electric power and in each case a dedicated electrical power supply has been developed for each subsystem. Integration of multiple power supplies into a vehicle is not feasible due to space constraints, cost, and efficiency.

(U) The objective of the Combat Hybrid Power System program is to develop enabling technologies and conduct demonstrations of an integrated hybrid electric power system which provides power and energy management for all of the subsystems throughout the cavalry/scout vehicle and is scaleable to combat systems. The hybrid electric power system will consist of an engine/alternator, sized for average power demand, energy storage and power averaging components which provide both continuous and pulsed power, distribution network, subsystem control and power conditioning devices. Vehicles will be simulated to evaluate subsystem requirements, topologies, and military utility.

(U) The Reconnaissance, Surveillance, and Targeting (RST) Vehicle Technology program will design, develop, test, and transition to the services critical components and technology for a lightweight, highly maneuverable vehicle. The vehicle will host integrated precision geolocation, communication and RST sensor subsystems provided by DARPA's Small Unit Operations Program. The RST vehicle is the essential mobility aspect of the DARPA, U.S. Army, and Marine Corps futuristic concepts of the use of small unit operations.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-48	
Critical components and technologies include a high efficiency, reduced signature hybrid electric power system; an electric propulsion system; a semi-active electromechanical suspension to double cross country speed and provide platform stabilization; an advanced survivability suite; and the capability to operate as either a manned or unmanned platform. The Marine Corps will develop vehicle concepts and chassis, integrate the DARPA developed components, and conduct vehicle performance tests (PE 0603640M). Additional co-funding for semi-autonomous capability will be provided by the Office of Secretary of Defense Joint Robotics Program (PE 0603709D). (U) Hybrid electric power is an enabling technology for future combat vehicles if electrically powered subsystems are to be implemented. The vehicles will have greatly reduced noise and thermal signatures; and improved mobility, survivability, lethality, and fuel economy. By eliminating rigid connections between components, interior layout can be optimized, significantly reducing volumetric constraints. These advantages will result in deployable, affordable combat vehicles that meet mission requirements. The programs are closely coordinated with the U.S. Army, Navy, Marine Corps, the DARPA Electric Vehicle Program (EV-01), and the DARPA Small Unit Operations Program (EE-51). (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> - The Integrated Product and Process Development Program (EE-37) developed concurrent engineering/virtual prototyping technology that will be used in the conceptual design and analysis of the Combat Hybrid Power System. (\$4.2M funded under EE-37). (U) <u>FY 1997 Program:</u> - Establish subsystem requirements, evaluate military utility, and provide modeling support to hybrid electric power system technology development. (\$1.5M) - Complete detail design of hybrid electric power system demonstration. (\$1.4M) - Complete design and conduct proof of concept experiments of engine/alternator, power averaging, power conditioning, and power distribution and controller component options. Downselect for fabrication and demonstration. (\$12.5M) (U) <u>FY 1998 Program:</u> - Continue evaluation of military utility, support technology development, and transition technology to USMC and U.S. Army Advanced Technology Demonstrators. (\$1.1M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-48																				
September 1996																						
- Integrate hybrid electric power system subsystems for laboratory demonstration. (\$1.2M) - Complete technology development and fabrication of selected full-scale engine/alternator, power averaging, power conditioning, and power distribution and control components. (\$17.7M) - Design, develop, and test critical components for Reconnaissance, Surveillance, and Targeting (RST) vehicle hybrid electric power system, mobility subsystems, and survivability suite. (\$5.0M)																						
(U) <u>FY 1999 Program:</u> - Continue development of critical enabling technology for high risk power system components. (\$8.0M) - Complete evaluation of military utility using the future scout vehicle virtual prototype, support technology development, and transition technology to USMC and U.S. Army Advanced Technology Demonstrators. (\$1.0M) - Test and evaluate hybrid electric power system in a laboratory demonstration. (\$11.0M) - Fabricate and demonstrate critical RST vehicle subsystems including: power system, propulsion, suspension, survivability, and controls. (\$8.5M)																						
(U) <u>Program Change Summary:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>0</td> <td>15.0</td> <td>20.0</td> <td>20.0</td> </tr> <tr> <td>Appropriated</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>0</td> <td>15.4</td> <td>25.0</td> <td>28.5</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	0	15.0	20.0	20.0	Appropriated	N/A	N/A	N/A	N/A	Current Budget	0	15.4	25.0	28.5
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Current Budget	0	15.4	25.0	28.5																		
(U) <u>Change Summary Explanation:</u> FY 1997 Increase reflects minor repricing of requirements. FY 1998-99 Reflects addition of the RST vehicle to the program.																						
(U) <u>Other Program Funding Summary:</u> \$: <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>PE 0603640M</td> <td>1.5</td> <td>2.0</td> <td>2.5</td> <td>3.0</td> </tr> <tr> <td>PE 0603709D</td> <td>0</td> <td>0</td> <td>2.0</td> <td>2.0</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	PE 0603640M	1.5	2.0	2.5	3.0	PE 0603709D	0	0	2.0	2.0					
	FY 1996	FY 1997	FY 1998	FY 1999																		
PE 0603640M	1.5	2.0	2.5	3.0																		
PE 0603709D	0	0	2.0	2.0																		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-48	
(U) <u>Schedule Profile:</u> Plan Milestones Aug 97 Establish subsystem requirements, evaluate military utility, and support hybrid electric power system technology developments using integrated, hybrid electric powered combat vehicle virtual prototypes. Jan 98 Downselect components for final combat hybrid power system demonstration. Jun 98 Complete combat hybrid power system integration and test plan. Sep 98 Test Reconnaissance, Surveillance, and Targeting (RST) vehicle critical components and conduct critical design review. Sep 99 Demonstrate RST vehicle subsystems. Dec 99 Demonstrate power system for future scout vehicle and establish military utility for technology transition to the Services. Sep 00 Assemble subsystems and integrate into Marine Corps RST vehicle chassis. Mar 01 Demonstrate 5-ton RST vehicle system capabilities.			

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September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Tier III Minus UAV EE-49	23,701	14,749	5,000	0	0	0	0	0	0	N/A

(U) **Mission Description:** The objective of this program is to develop and demonstrate a Low Observable High Altitude Endurance Unmanned Air Vehicle (LO HAE UAV) system, including a ground segment, capable of providing the war fighter with the near real time ability to assess battlefield situations. This system will provide continuous, all weather, day/night, wide area reconnaissance and surveillance in direct support of the Joint Forces Commander. It will consist of aircraft, sensors, communications and interfaces to theater systems in support of tactical warfighters at various levels of command. The LO HAE UAV will provide wide area search (over 15,000 sq nm per mission) with either an Electro-Optical (EO) or Synthetic Aperture Radar (SAR) system at 1m resolution. In addition, it will provide 600 spot images per mission with either sensor at 0.3m resolution. The search and spot modes can be interleaved with attendant reductions in the overall coverage. The system will support a targeting accuracy of at least 20m circular error probability (CEP).

(U) The low observables capabilities of the system will allow it to operate in high threat environments where manned reconnaissance or other operational assets are not viable options.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Complete system integration and initiate Phase II flight test. (\$11.2M)
- Prepare Air Vehicle #2 for Flight Test. (\$12.0M)

(U) FY 1997 Program:

- Complete System Integration and Flight Test of Air Vehicle #2. (\$14.7M)

(U) FY 1998 Program:

- Prepare and Flight Test Air Vehicle #3. (\$5.0M)

(U) FY 1999 Program: N/A

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide JA 3 Advanced Technology Development		Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-49							
(U)	<u>Program Change Summary:</u> (in Millions) President's Budget Appropriated Current Budget	FY 1996 24.7 23.7 23.2	FY 1997 14.7 N/A 14.7	FY 1998 5.0 N/A 5.0	FY 1999 0 N/A 0				
(U)	<u>Change Summary Explanation:</u> FY 1996 Decrease reflects minor repricing.								
(U)	<u>Other Program Funding Summary Cost:</u> Related RDT&E PE 0305154D Defense Airborne Reconnaissance Program	FY 1993 56.3	FY 1994 63.4	FY 1995 18.0	FY 1996 6.0	FY 1997 5.0	FY 1998 10.0	FY 1999 23.0	Total Cost N/A
(U)	<u>Schedule Profile:</u> Plan Milestones Jun 96 Prepare Air Vehicle #2 for Flight Test. Oct 96 Commence fabrication of vehicles #3 and #4. Mar 97 Begin Taxi and Flight Test Air Vehicle #2. Jul 97 Complete Air Vehicle #3. Sep 97 Survivability Testing.								

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM MONITORING

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Sensor and Exploitation Systems EE-50	0	68,139	83,220	85,755	94,200	111,487	135,287	135,287	Continuing	Continuing

* Programs included in this project were previously funded under Project EE-40.

(U) **Mission Description:** This project represents a refocusing and transition of pertinent elements of the Critical Mobile Targets (WAR BREAKER) project (EE-40) into a concentrated effort to empower the battle commander with comprehensive battlespace awareness. The development efforts described herein embody key sensor demonstrations and the exploitation of sensor products. These efforts, in conjunction with those described in Project EE-53 (Information Integration Systems), seek to develop the systems needed to provide the warrior with situational awareness and battlefield dominance. The strategic goal of this project is to utilize diverse, complete, sensing of the battlefield environment, including sensors which can counter Camouflage, Concealment and Deception (CC&D), and provide near-real-time, semi-automatic, exploitation of wide-area moderate (and high) resolution imagery and provide semi-automated recognition and birth-to-death tracking of high value units and critical moving targets. These goals are being addressed by the Counter CC&D Program, the Semi-Automated Imagery Intelligence (IMINT) Processing (SAIP), Advanced Concept Technology Demonstration (ACTD), Moving and Stationary Target Acquisition and Recognition (MSTAR), Moving Target Exploitation (MTE), and Automatic Target Recognition (ATR) applications programs.

(U) The goal of the Counter CC&D Program is to provide significant enhancement of the military's capability to detect obscured targets hidden under natural and artificial camouflage. Specific goals include validation of Foliage Penetration (FOPEN) target detection capability (0.1 FA/sq.km max) with data from the P-3 Ultra-Wideband UHF Synthetic Aperture Radar (SAR) testbed and the DARPA-sponsored Swedish Carabas I Very High Frequency (VHF) SAR tests; and demonstrations of real-time processing of FOPEN high resolution SAR image formation, Radio-Frequency interference (RFI) suppression and Automatic Target Detection/Classification (ATD/C) algorithms. A FOPEN Airborne Demonstration Radar will be developed for demonstration on a manned platform providing inputs via narrowband tactical data links for ground image exploitation. The image exploitation processing of SAIP will be extended for FOPEN as well as Multi/Hyper Spectral Image (M/HSI) sensor input, geolocation and sensor fusion processing of images, and detection of time critical targets. The program will ultimately combine FOPEN Radar on an Endurance Unmanned Aerial Vehicle (UAV); with other airborne sensors (e.g., the Senior Year Electro-optical Reconnaissance System on the U-2, a HSI sensor on the Predator Medium Altitude Endurance UAV), and develop combined exploitation technologies for insertion into the DARO Common Imagery Ground/Surface System (CIGSS).

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50	
(U) The Semi-Automated IMINT Processing (SAIP) ACTD will develop, test and transition to the operational user, automated algorithms and semi-automated tools that enhance the warfighter's capability to: Process SAR, then EO/IR, and eventually multispectral imagery; conduct wide-area search for Ground Order of Battle and Missile Order of Battle targets; perform rapid site-monitoring and site modeling; and produce target reports in near real-time (< five minutes). SAIP will consist of baseline, enhanced, and transition systems. Goals for the baseline system are: automatic target cueing and classification for a limited set of vehicles (10 targets); object level change detection; force recognition to the company level; and interactive target recognition and terrain delimitation. Goals for the enhanced system are: Increasing the automatic target cueing and classification to 20 targets; site modeling and monitoring with EO; addition of SIGINT cueing; and rapid target insertion. Goals for the transition system are to add enhanced automatic target recognition (30 targets); flexible force recognition to the regiment level; site modeling and monitoring with SAR data; rapid target insertion and; on-the-fly training. SAIP will integrate program products that are being refocused and transitioned from the WAR BREAKER program. (U) The goal of the Moving and Stationary Target Acquisition and Recognition (MSTAR) program is to achieve a major advance in SAR Automatic Target Recognition (ATR) performance through fundamental and innovative technology developments and to transition this technology to fielded systems with ATR requirements. Other program goals include: Significant advances in interactive image exploitation environments and performance; the development of rapid target model construction and rapid ATR updating methods; the development of resource management systems for surveillance and exploitation, and the development and demonstration of ATR-based and single/multiple-scale SAR image formation-based methods for reducing HAE UAV data rates to SATCOM-supportable bandwidths; and the conduct of basic university research into ATR. (U) The goal of the Moving Target Exploitation (MTE) program is to achieve a major advance in computer-assisted tracking and target identification by providing previously unavailable capability to automatically detect, track, and classify high-valued ground-moving targets using all-weather airborne surveillance radar data. Three techniques are being investigated and evaluated: the discrimination of desired targets from other moving vehicles using high range resolution (HRR) moving target indication (MTI) range profiling and 1-D automatic target recognition (ATR); the imaging of specific moving targets via enhanced moving target imaging (MTIm) and inverse synthetic aperture radar (ISAR) processing; and the classification of moving targets using both 1-D and 2-D images and vehicle motion pattern characteristics. Specific applications are targeted for the Joint STARS, U-2, and Global Hawk (Tier II*) platforms.			

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APPROPRIATION/BUDGET ACTIVITY

80T&E, Defensewide

BA 3 Advanced Technology Development

P-1 ITEM MONITORING

Experimental Evaluation of Major Innovative Technologies,
PE 0603226E, Project EE-50

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments: N/A

(U) FY 1997 Program:

- Complete Foliage Penetration (FOPEN) Concept Development and verify the System Requirements for a FOPEN Airborne Demonstrator radar targeted for a Medium or High Altitude Endurance (MAE/HAE) Unmanned Aerial Vehicle. Complete critical technology demonstration of ultra-wideband antenna design, airborne real-time processing interface, radio-frequency interference suppression, and FOPEN automatic target detection/classification. Develop and prototype Image Exploitation algorithms for FOPEN an EO (HSI/MSI) sensors within the SAIP architecture. Develop a test and evaluation plan with measurement criteria, validation approach and risk assessment matrix by critical technologies to integrate with the DUSD(AT) proposed Counter CC&D ACTD. (\$13.9M)
- Transition of component modules into the SAIP ACTD will be completed and integration continued to achieve enhanced system objectives in continued collaboration with the Defense Airborne Reconnaissance Office (DARO). The site modeling and monitoring component will be integrated, additional Missile Order of Battle and Ground Order of Battle models and algorithms inserted, and the system ported to a High Performance Computer architecture. Tests will be done on system performance with ETRAC and national imagery and the enhanced SAIP system will be available to the Battlefield Awareness and Data Dissemination ACTD (EE-53) to serve as its imagery processor. A military utility evaluation will be conducted with U.S. Atlantic Command. (\$30.4M)
- The MSTAR 10 target recognition system with limited extended operating condition (EOC) capability will be integrated and evaluated, then matured into a 15 target system with increased ROC capability. Transition to SAIP ACTD of MSTAR modules will occur. Concepts and prototypes for interactive exploitation, rapid target insertion and rapid ATR updating will be developed and evaluated. A single scale ATR-based bandwidth compression will be completed and demonstrated in the SAIP exploitation van, and an initial multi-scale compression architecture will be developed and demonstrated in the lab, University research in basic automatic target recognition will continue, with techniques transferring to technology integration programs. (\$16.6M)

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
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R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-50

- The FY 1997 Moving Target Exploitation (MTE) program will complete the integration and evaluation of MTE technology components into the ground-based testbed and will demonstrate non-real-time moving target classification on recorded data. Enhanced tracking capabilities and tools for vehicle motion pattern analysis (MPA) will be added to complete the Phase I MTE testbed. The performance goal of the end-to-end MTE system is to detect and classify high-valued moving Transport Erector Launcher (TEL) targets with a probability of correct classification of 0.9 and associated probability of incorrect classification of 0.05. The MTE program, in coordination with USAF ESC/JS, will record MTE data using the Joint Surveillance, Target, and Attack Radar System (Joint STARS) in FY 1997, and this data will be processed in the ground-based Phase I testbed. In FY 1997, the MTE program will be expanded to include multiple platform operation; the Phase I testbed architecture will be expanded (Phase II) to process Moving Target Imagery (MTIm) data from the U-2 and Global Hawk platforms and to accommodate a more robust target set supporting more comprehensive battlespace awareness. (\$7.2M)

(U)

FY 1998 Program:

- Counter CC&D Program will develop a Foliage Penetration (FOPEN) Airborne Demonstrator radar for test and evaluation on a manned platform, providing inputs via narrowband tactical data links to the image exploitation capabilities in SAIP ground processing facility. The Image Exploitation techniques developed under SAIP will be extended (SAIP++) to include unique characteristics of VHF/UHF band FOPEN radar, high spatial resolution U2 SYERS MSI sensor, and high spectral resolution Predator HSI sensor, and multisensor correlation to improve the reliability of detection and discrimination of tactical targets under camouflage and foliage cover. (\$24.0M)
- Semi-Automated IMINT Processing (SAIP) integration and field testing will continue to achieve transition system objectives and to support U-2 ASARS-2, ASARS-2 upgrades, and Dark Star imagery. Transition to the operational customer, U.S. Atlantic Command, will begin. (\$26.0M)
- The MSTAR 15 target recognition system with increased EOC capability will be integrated and evaluated, then matured into a 20 target system with greater EOC capability. The system then will be fully characterized vs. the defined target set and full EOC dimensions. Transition of the MSTAR system to SAIP and Counter CC&D ACTDs will occur. Full prototypes for interactive exploitation for two analyst missions will be developed and evaluated. A rapid target insertion prototype system will be built and evaluated, creating 5 target models and rapid ATR training systems as a baseline. A resource management prototype will be built and evaluated. Development, integration and demonstrations will continue on a single scale compression and multiple scale bandwidth compression. Airborne and field demonstrations are planned. (\$18.9M)

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R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, Project EE-50

- The FY 1998 MTE program will demonstrate operational, near-real-time MTE performance against high-value moving targets by integrating the Phase I testbed on a Joint STARS platform. In parallel, the Phase II testbed will be completed, and the multiple platform technology components will be integrated and evaluated using simulated and recorded data. A coordinated, joint data collection with Joint STARS and U-2 platforms will be conducted providing instrumented multiple platform MTI data. Non-real-time, multiple-platform tracking, cueing, and moving target classification will be demonstrated using simulated and recorded data. (\$14.3M)

(U) FY 1999 Program:

- Counter CC&D Program will complete Airborne Demonstrator Flight Test and Evaluation on manned platform in conjunction with SAIP ground exploitation capabilities during tactically significant military exercises to verify performance capabilities of ATD/C of tactical targets in CC&D. Initiate integration of FOPEN and Hyperspectral sensors into a Medium or High altitude/endurance (HAE) UAV depending on suitability of sensor and UAV CONOPS. (\$25.0M)
- Complete transition of the SAIP system to OCONUS for military operations. (\$23.3M)
- The evaluation of the MSTAR 20 target/full EOC system will be completed, system technology will be transferred to the SAIP and STARLOS programs, and a two year effort to develop a high performance computing adaptation for an MSTAR real time demonstration system will begin. Development and evaluation of resource management, rapid target insertion, rapid ATR updating and interactive exploitation systems will continue, with key milestones occurring in FY 2000. (\$22.5M)
- The FY 1999 MTE program will finalize the system design for the multiple platform MTE and conduct a joint operational demonstration using the Joint STARS and U-2 platforms. (\$15.0M)

(U) Program Change Summary: (In Millions)

	FY 1996	FY 1997	FY 1998	FY 1999
President's Budget	0	69.2	93.5	82.8
Appropriated	N/A	N/A	N/A	N/A
Current Budget	0	68.1	83.2	85.8

President's Budget

Appropriated

Current Budget

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50	
(U)	<u>Change Summary Explanation:</u> FY 1997 Reflects minor repricing and program rephasing. FY 1998 Reflects reprogramming to EE-53 as part of the Dynamic Multi-User Information Fusion (DMIF) program. FY 1999 Reflects minor repricing and program.		
(U)	<u>Other Program Funding Summary Cost:</u> N/A		
(U)	<u>Schedule Profile:</u> Plan Milestones Oct 96 MSTAR 10 target recognition system demo with Initial EOCs; downselect of MSTAR developers to enter Phase 2. Nov 96 Demonstrate and test baseline SAIP system with ASARS-II at Edwards AFB. Nov 96 Demonstrate single-scale capability of data compression and screening in SAIP system. Dec 96 Ground demonstration of real time FOPEN ATD/C processor. Jan 97 Demonstrate and test baseline SAIP system with ASARS-II at Nellis AFB and NTC. Mar 97 Engineering evaluation of Baseline SAIP configuration at Task Force XXI. Apr 97 JSTARS data collection and system demonstration (MTE). May 97 FOPEN Airborne Demonstrator Requirements Decision. Jun 97 Demonstrate required MTE performance in JSTARS virtual testbed. Jun 97 Test SAIP with national product. Jun 97 Demonstrate MTE tracking and target classification in a Joint STARS tape input, ground-based Phase I testbed. Aug 97 Demonstrate multi-scale capability of data compression in lab environment. Aug 97 Demonstration of FOPEN VHF/UHF Antenna technology. Sep 97 SAIP operational user evaluation at TBD exercise. Nov 97 SAIP split-based CONUS configuration complete. Nov 97 Second major demonstration of MSTAR ATR: 15 targets with increased EOCs. Transition modules to SAIP. Jan 98 Laboratory Demo of FOPEN and HSI/MSI Image Exploitation on SAIP Architecture processors. Jan 98 Airborne demo of data compression/screening capability on U-2R.		

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-50
Jun 98 Operational demo of MTE system on JSTARS. Jun 98 Real-time operational MTE demonstration with Joint STARS. Jul 98 Complete integration of SAIP transition configuration. Jul 98 Initiate SAIP OCONUS deployment and operational support. Aug 98 Demonstrate required MTE performance in U-2 virtual testbed. Nov 98 Start Integration of FOPEN Airborne Demonstration Radar. Nov 98 Final MSTAR ATR demo: 20 targets, full range of EOCs; transition system to SAIP. Nov 98 Joint operational demonstration with Joint STARS. Jan 99 Ground demonstration of Image Exploitation of SYERS MSI and Predator HIS images on SAIP++ processor. Feb 99 Operational demonstration of MTE with the U-2. Apr 99 Operational demonstration of MTE with an HAE. Jun 99 Flight demonstration of FOPEN Radar with CIGSS Image Exploitation System. Sep 99 Complete SAIP transition. Sep 99 HAE demonstration (MTE).		

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COST (in Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Small Unit Operations EE-51	20,636	54,066	51,580	68,398	71,413	77,800	88,000	40,000	Continuing	Continuing	

* Related FY 1996 effort performed in projects ST-11 (\$3.5M) and TT-34 (\$11.7M).

(U) **Mission Description:** The objective of this program is to develop critical technologies which enable dispersed units to effectively perform warfighting operations traditionally accomplished with massed forces. With declining resources and a smaller military, the Services must be prepared to quickly project sufficient power to achieve United States objectives rapidly and effectively. The deployment of our forces will be restricted by lift assets and in-theater infrastructure; and they will operate under more complex rules of engagement. Adversaries who are not very powerful may possess sophisticated technology that will place our forces at risk. These risks are increased if our forces are massed to conduct traditional conventional operations. To fight effectively in the future, the Army and Marine Corps are developing concepts of operation (Army - Force XXI and Marine Corps - Sea Dragon) whose tactical implementation will vary, but with similarities that include lighter, more lethal, more flexible forces that are widely dispersed through out the battlefield. The objective is to enable these forces to quickly control a large battlespace with dispersed forces, control the operational tempo, engage enemy targets with remote fire, and operate effectively across the spectrum of conflict and in a variety of environments.

(U) The keys to success for these units are a vastly improved and highly integrated comprehensive awareness system, robust communications, and an integrated, scaleable common grid of the battlespace. While there are many technology developments underway that will assist the Services to accomplish their objectives, at the tactical level there are technology gaps that DARPA will help narrow under the Small Unit Operations program. Technology development efforts will focus on a comprehensive awareness capability that provides real-time, essential information for small units and individual warfighters; wireless communication technologies to permit exchange of voice, digital and video data with other systems; geolocation technologies that provide navigation information in built-up, forested and mountain environments; internetted tactical surveillance and targeting sensors to complement information requirements not satisfied by national, theater, and component sensor programs; and automated tasking and control technologies for air and ground systems. As these technologies mature they will be tested and evaluated. Engineering demonstrations with

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combatant participation will be conducted to assess program progress in a realistic environment which provides critical user feedback. After successful tests and evaluation, or further refinement of the technologies, they will be integrated and tested with operational units.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Developed upper level system architecture, conducted engineering analysis and evaluated advanced concepts/technologies for Small Unit Operations (SUO) applications. (\$3.0M)
- Completed communications, data stripping and information understanding analyses in support of comprehensive tactical awareness enhancements. Developed candidate communications network architectures. (\$1.7M)
- Upgraded and field demonstrated Sea Dragon Communications and Coordination (SDC2) in preparation for Sea Dragon/Force XXI Exercise in 1997. (\$7.8M)
- Initiated development of requisite technologies, including precision clocks, to provide precision geolocation for dismounted combatants in a variety of environments, including wooded, mountainous, urban and within buildings. (\$5.0M)
- Developed acoustic array sensors, initiate internettted sensor processing studies. (\$3.1M)

(U) FY 1997 Program:

- Assess advanced concepts and technologies for SUO applications. (\$2.1M)
- Conduct system integration and demonstrate SUO technologies at CINC and Warfighter exercises. (\$5.5M)
- Initiate technology developments for the comprehensive situation awareness system, focusing on tactical picture generation, tactical forecast, situation assessment functionality. (\$5.8M)
- Continue development of real-time tasking and control technology from previously funded in the Intelligent Systems and Software Project (ST-11). (\$7.0M)
- Initiate technology development for tactical communications capability. (\$7.8M)
- Complete SDC2 and participate in Joint Army and Marine Corps Exercise. (\$2.4M)
- Continue development of requisite technologies to provide precision geolocation. (\$6.7M)
- Develop and integrate sensing/surveillance technology into tactical sensing capabilities. (\$7.2M)
- Integrate multiple sensors and multi-sensor processing capabilities. (\$8.6M)
- Evaluate tagging concepts. (\$1.0M)

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(U) <u>FX 1998 Program:</u> - Assess advanced concepts and technologies for Small Unit Operations (SUO) applications. (\$1.1M) - Conduct system integration and demonstrate SUO technologies at Commander in Chief (CINC) and Warfighter exercises. (\$7.2M) - Continue technology developments for the comprehensive awareness system focusing on plan generation and support asset tasking functionality. (\$7.3M) - Continue to develop enabling technology for reactive planning and support asset tasking and control. (\$7.5M) - Continue technology development for tactical communications capability. (\$7.5M) - Continue development and evaluation of requisite technologies to provide precision geolocation. (\$8.4M) - Apply and integrate sensing/surveillance technology into tactical sensing developments. (\$1.5M) - Integrate multiple sensors and processing capabilities. (\$11.1M) (U) <u>FX 1999 Program:</u> - Assess advanced concepts and technologies for SUO applications. (\$1.1M) - Conduct system integration and demonstrate SUO technologies at CINC and Warfighter exercises. (\$7.5M) - Continue technology developments for the comprehensive awareness system focusing on plan generation and support asset tasking functionality. (\$10.9M) - Continue to develop enabling technology for reactive planning and support asset tasking and control. (\$5.4M) - Continue technology development for tactical communications capability. (\$10.9M) - Continue development and evaluation of requisite technologies to provide precision geolocation. (\$10.9M) - Develop and integrate sensing/surveillance technology into tactical sensing developments. (\$2.1M) - Integrate and demonstrate multiple sensors and processing capabilities. (\$14.2M) - Develop and integrate advanced concepts such as robotics, remote targeting/remote firing resupply/sustainment and multispectral deception. (\$5.4M)		

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BA 3 Advanced Technology Development					
(U)	<u>Program Change Summary:</u> (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget	0	52.7	51.6	39.9
	Appropriated	0	N/A	N/A	N/A
	Current Budget	20.6	54.1	51.6	68.4
(U)	<u>Change Summary Explanation:</u>				
	FY 1996 Funding transferred from Command & Control Information Systems Project ZE-21, Advanced Ship/Sensor Systems Project EE-36, Unmanned Undersea Vehicle Systems Project EE-39, Critical Mobile Targets Systems Project EE-40, Sensors and Exploitation System Project EE-50, Intelligent Systems and Software Project ST-11, and Advanced Land Systems Project TT-04.				
	FY 1997 Minor program repricing.				
	FY 1999 Increase reflects a better understanding of program requirements and a more comprehensive estimate of development costs.				
(U)	<u>Other Program Funding Summary Cost:</u>	N/A			
(U)	<u>Schedule Profile:</u>				
	<u>Plan Milestones</u>				
	Aug 96	Complete initial architecture and requirements definition for Brigade/Battalion and Combatant Warfighter's Tactical Associate.			
	Mar 97	Complete performance testing of multiple precision clock units in hybrid packages.			
	Mar 97	Complete Sea Dragon Communications and Coordination (SDC2) program and participate in Sea Dragon/Force XXI exercise. Demonstrate sniper, mortar, mine detection sensors at Force XXI EXFOR AWE.			
	Jul 97	Support Military Operations in Urban Terrain (MOUT) Advanced Concept Technology Demonstration (ACTD) with SVO technology.			
	Nov 97	Downselect final communications architecture.			
	Dec 97	Demonstrate feasibility of local tactical picture generation module.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, Project EE-51		
Mar 98 Demonstrate and characterize various breadboard precision geolocation technologies in restricted environments. Apr 98 Complete precision clock environmental and cell life testing. Sep 98 Demonstrate initial integration of reflective and reactive planning. Nov 98 Demonstrate and characterize various breadboard geolocation technologies. Sep 99 Demonstrate reflective and reactive planning and tasking modules.			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
RDT&E, Defensewide				Experimental Evaluation of Major Innovative Technologies, PE 0603226E							
BA 3 Advanced Technology Development											
COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Information Integration Systems											
EE-53	0*	64,504	104,424	115,300	115,000	121,000	118,800	110,000	Continuing	Continuing	
*Programs included in this project were previously funded under Project EE-21 and EE-40. (U) <u>Mission Description:</u> This project represents a refocusing and transition of pertinent elements of the Critical Mobile Targets (WAR BREAKER) project (EE-40) and Command and Control Information Systems Project (EE-21) into a concentrated effort to empower the battle commander with comprehensive battlespace awareness. The goal of this project is to take diverse inputs, including those planned as outputs from the Sensors and Exploitation Project (EE-50), and perform distributed and dynamic all-source correlation and fusion to produce an integrated, geospatially referenced, battlefield database and knowledge-base, and through the use of wideband dissemination and integrated sensor management allow multi-site, real-time, collaborative situation assessment and course-of-action evaluations. These goals are being addressed by the Dynamic Multi-User Information Fusion (DMUF) project, the Battlefield Awareness and Data Dissemination (BADD) ACTD and the Airborne Communications Node (ACN) project. (U) Dynamic Multi-User Information Fusion (DMUF) seeks to develop and insert a product line of fusion capabilities that amalgamate and focus diverse sensor observations and rectify disparate fusion products to provide the warfighter with a clear and actionable picture of the battlespace. This system will maintain birth-to-death tracking of high value targets; use distributed, collaborative, dynamic, and all-source correlation, fusion and situation assessment; exploit terrain limitations, enemy doctrine, and first-principle constraints on military operations to construct a hierarchical representation of all battlefield activity; and define a reference architecture to ensure multi-service software reuse and in-field modifiability, full uncertainty accounting, and Global Command and Control System (GCCS) Leading Edge Services (LES) compliance. (U) The Dynamic Database (DDB) program will expand on work begun under DMUF to develop the technology to maintain a Dynamic Situation Model by indexing all relevant information about the battlespace according to geospatial and other attributes, at the entity, terrain, and signal feature level. The database will be able to store selected imagery and annotations, 3D site models, battlefield entities and relations, 1.5D and 2.5D terrain parameter maps, and physical and signal features from imagery and terrain generation applications, all aligned and indexed for rapid, common access. Methods for updating and accessing the Dynamic Situation Model will be provided.											

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DATE

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Experimental Evaluation of Major
Innovative Technologies,
PE 0603226E, EE-53

The program will also develop the database services needed by users and applications, including DMIF and BADD, such as change detection, line-of-sight and terrain suitability calculations, trafficability analysis, and real-time generation of current terrain features such as lines of communications.

(U) The objective of the Battlefield Awareness and Data Dissemination (BADD) Advanced Concept Technology Demonstration (ACTD) is to deliver, install and evaluate an operational prototype system that delivers to warfighters a consistent operational picture of the joint/coalition battlefield, allow commanders to design/tailor their own information system, and provides access to key transmission mechanisms and worldwide data repositories. The description of the battlespace provided to the warfighters under this ACTD will be tailored to their mission needs by intelligent selection of information to be broadcast, intelligent processing of user requests (pull) and filtering at the warfighter workstation so that needed information is available. BADD will be evaluated through participation in exercises and demonstrations, and by insertion into ongoing pilot services, such as the Joint Broadcast Service installed in the European Theater in April 1996. EADD is also operating under a Memorandum of Agreement with the Global Broadcast Service Program Office to provide advanced information management capabilities and new applications for this system as part of the overall plan of transition of BADD developments to operations after test and evaluation in the ACTD.

(U) The objective of the Airborne Communications Node (ACN) program is to develop an open architecture, software reconfigurable, communication payload for deployment on the Global Hawk High-Altitude Endurance (HAE) Unmanned Aerial Vehicle (UAV). Global Hawk ACN will provide a self-deployed robust communications infrastructure which will enable range extension relays for line of sight radios and Joint Warfighter communication services for over-the-horizon communications, reachback connectivity to CINCs, high data rate communications to on-the-move users and gateways/bridges to dissimilar radios for seamless communications. The program will conclude with field demonstrations in FY 2000.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- See Projects EE-40 and EE-21 for FY 1996 program accomplishments.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53	
(U) FY 1997 Program: - Dynamic Multi-User Information Fusion (DMUF) program: Develop and demonstrate, with Service transition partners, adaptive fusion processes and services for providing tailored situation representations which facilitate technology insertions and functionality through a broad spectrum of operating environments. Initiate the construction of a simulated test environment for early assessment of user requirements and operational concepts, for performance evaluations and validation of fusion engines, and for easy integration with other developmental and Service information systems. Continue the insertion begun in FY 1996 of DMUF capabilities into the Combined Air Operation Center (CAOC) in Vicenza, Italy. Perform pilot experiments, system performance definition, and entity-level development for a Dynamic Database. Demonstrate a prototype stand alone, multi-source, inference-based fusion system for a limited target set at a major joint operations center, and migrate that system toward an open, agile, and robust architecture to promote interoperability with existing ops/intel battlefield information systems. (\$20.2M) - Battlefield Awareness and Data Dissemination (BADP) ACTD: Participate and be evaluated in Task Force XXI Army Warfighting Experiment. Demonstrate system capabilities in a series of demonstrations, including a joint demonstration (called the Joint Forces Integration Demonstration) involving Navy, Marine and Air Force elements. Capabilities and services to be evaluated include: Information Dissemination Manager node located in Washington, DC; Warfighter's Associate terminals in use by the Army and Marines at Fort Irvin, at 29 Palms by the Marines, and at Camp Pendleton/NRAH by the Navy and Marines; leased GBS commercial satellite communications interfaces; creation and dissemination of an operational picture of red and blue force status; and dissemination of integrated imagery, video, signals intelligence, terrain, weather, Global Command and Control System (GCCS) and Maneuver Control System (MCS) data. Enhance legacy systems focusing on improving the bandwidth utilization and expanding the user base to include additional major military commands. Efforts during this fiscal year culminate in the delivery of an operational capability supporting CONUS based users and enhancements to the current capability supporting OCONUS users. (\$32.4M) - Airborne Communications Node (ACN): Conduct technology development of advanced devices and antennas to facilitate the access of multiple hand held communications devices, start integration of several key enabling technologies (e.g. software radios, common hardware modules and high-speed fiber optic communication infrastructure), develop time, frequency and power management techniques, coupled with traditional EAC/EMI mitigation techniques and antenna design/placement, to enable simultaneous operation across the frequency spectrum from VHF to Ku bands. Initiate subsystem design and development of payload modules. Perform system-level data collections in support of multi-sensor information dissemination. (\$12.3M)			

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53	
(U) FY 1998 Program: - DMIF: Continue the development of the DMIF system to include high value target tracking and targeting, hierarchical force assessment, collaborative situation assessment, and direct support to operations and planning applications. Implement the standards and architecture designs needed to create a product line of flexible, open, and distributed battlespace awareness functionality which includes in FY 1998: MTL/multi-track correlator, GOB aggregator/projector, multi-application knowledge representation schemas, dynamic database, and adaptive fusion manager. Transfer entity-level dynamic database capabilities for the FY 1998 initiation of the Dynamic Database program and continue close coordination of these efforts. Demonstrate functionality at multi-service exercise and transition mature components to Service transition partners (Army ASAS/Air Force T3MCS) and DARPA ACTDs (BADD). (\$19.4M) - Dynamic Database Program: Expand entity-focused database efforts begun under DMIF by building an integrated prototype for consolidated terrain, signal feature, and entity level representation of a Dynamic Situation Model. Build on algorithms and capabilities previously developed under BADD, Semi-Automated IMINT Processing ACTD (funded under EE-50), Intelligent Integration of Information (funded under ST-11) and especially DMIF, including fusion services, integration of multiple information repositories, change detection and site monitoring, and database mediation, to create a united set of reusable software services that can be mediated for general purpose access by many applications, including DMIF, BADD, and SAIP. Provide an initial test article for integration into the Integrated Sensors Office testbed, and provide a baseline for scalable performance estimates. (\$9.8M) - BADD ACTD: Participate and be formally evaluated in an ACOM-conducted joint exercise (Unified Endeavor) increasing the level of automation previously provided to users and extending information management and dissemination support at the level of individual battalions/ships. Provide new information management capabilities to include creation of a 3D graphical depiction of a consistent operational picture by near-real-time integration of all relevant databases, identification and semi-automated resolution of differences. (\$47.0M) - ACN: Complete development of advanced device and antenna technology for multiple hand held communications devices and for development of EMC/EMI techniques and antennas that will allow simultaneous operation of radio frequency devices across the spectrum. Complete payload and unique subsystem design. Select and acquire equipment and modules. Fabricate and assemble payload systems and subsystems. Initiate Subsystem Integration and Test. Continue system-level data collections in support of multi-sensor information dissemination and concept-of-operation development. (\$38.2M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM MONITORING Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53 September 1996																				
(U) <u>FY 1999 Program:</u> - Continue the development of DMIF functionality to include agile models and distributed, collaborative situation assessment, including: expanded GOB, maneuver control, plan monitoring, SEAD, IPB, and course of action analysis. Extend DMIF architecture to create a product line of fusion systems that work flexibly and seamlessly with existing battlefield information systems within the full GCCS-LES environment. Incorporate DMI products into emerging systems such as BADD. (\$25.4M) - Extend the functionality of the Dynamic Database prototype system to incorporate mature access language, index structure, and search engine capabilities. Incorporate additional common data services, including visibility, alignment, and change detection computations and flexible trigger, pedigree, and information product definitions. Prepare for transition to migration systems, including by defining a comprehensive regression and performance test set, developing capabilities for uploading and accessing legacy data, and operating as an overlay on existing systems. (\$10.0M) - BADD ACTD: Continue frequent participation in operational exercises to validate the incremental additional of operational capabilities. Examples of increased information management functionality include the creation of the consistent operational picture by near-real-time integration of all relevant databases, and identification and automated resolution of differences. Provide capabilities to perform resource management of multiple communications paths. Evaluate this capability via participation in a joint demonstration using the Airborne Communications Node (ACN). (\$49.9M) - Complete demonstrations in system integration laboratory environment. Initiate ACN integration into global Hawk HAE UAV. Begin ACN field demonstrations. (\$30.0M)																						
(U) <u>Program Change Summary:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>0</td> <td>67.9</td> <td>90.4</td> <td>100.3</td> </tr> <tr> <td>Appropriated</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>0</td> <td>64.9</td> <td>104.4</td> <td>115.3</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	0	67.9	90.4	100.3	Appropriated	N/A	N/A	N/A	N/A	Current Budget	0	64.9	104.4	115.3
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	0	67.9	90.4	100.3																		
Appropriated	N/A	N/A	N/A	N/A																		
Current Budget	0	64.9	104.4	115.3																		
(U) <u>Change Summary Explanation:</u> FY 1997 Decrease reflects minor repricing.																						

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITTM NOMENCLATURE Experimental Evaluation of Major Innovative Technologies, PE 0603226E, EE-53	
FY 1998 Increase reflects restructuring of funds to realize the development of key new components for the Dynamic Multi-User Information Fusion (DMIF) Program. FY 1999 Increase reflects addition to the Airborne Communications Node (ACN) Program to enable manned aircraft demonstration and begin prototype procurement of Phase III Global Hawk units.		
(U) <u>Other Program Funding Summary Cost:</u>	N/A	
(U) <u>Schedule Profile:</u>	Plan Milestones Oct 96 Demonstrate BADD capability (joint exercise) - Joint Forces Integration Demonstration. Mar 97 Support Task Force XXI Advanced Warfighting Experiment. Apr 97 Complete definition of ACN antenna design and placement. Apr 97 Demonstrate Dynamic Multi-User Information Fusion (DMIF) capability at a major joint operations center. Apr 97 Demonstrate BADD capability (Roving Sands '97). Jul 97 Deliver DMIF-I to a MAJCOM. Sep 97 Complete DMIF testbed for system design, concept of operations and human computer interface development. Oct 97 Demonstrate BADD capability (JWID '97). Nov 97 Demonstrate DMIF enhanced capability at Division XXI (high value target tracking/projection, hierarchical force assessment). May 98 Demonstrate DDB prototype in conjunction with ISO testbed. Jun 98 Complete integration and lab demo of DMIF II and demonstrate interoperability with BADD. Jul 98 Complete ACN payload design, development, subsystem integration and test. Jul 98 Support operational exercise OCONUS and CONUS upgrade. Sep 98 Demonstrate DMIF enhanced capability in joint-level simulation (collaborate situation assessment and operations support). Sep 98 Deliver BADD pilot service to OCONUS with DMIF baseline capability. Oct 98 Demonstrate BADD capability (Unified Endeavor 98-1). Jan 99 Complete demonstration of ACN in systems integration laboratory environment.	

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Mar 99	Use Dynamic Situation Model from DDB for change detection, situation awareness, and dissemination in laboratory demonstration with SAIP, DMIF and BADD.		
Jun 99	DMIF demonstration of distributed comprehensive battlespace awareness in joint-level simulation with service migration systems (ASAS/TBMCS).		
Sep 99	Complete ACN payload integration into Global Hawk HAE UAV and conduct test.		
Oct 99	Demonstrate BADD capability (JWID '99).		
Sep 00	Complete BADD transition to DISA, GBS Joint Program Office (JPO) and the Services.		
Sep 00	Transition to DISA, ACOM and GBS PO, final operational service.		
Oct 00	Demonstrate BADD capability (JWID '99).		

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APPROPRIATION/BUDGET ACTIVITY					R-1 ITEM NOMENCLATURE						
RDT&E, Defensewide					Advanced Electronics Technologies,						
BA 3 Advanced Technology Development					PE 0603739E						
cost (In thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Advanced Electronics Technologies	388,931	332,168	291,176	316,285	330,392	287,812	277,240	280,672	Continuing	Continuing	
IR Focal Plane Array (IRFPA) MT-03	39,493	23,995	9,000	11,000	3,000	0	0	0	0	N/A	
Electronic Module Technology MT-04	93,376	62,377	62,006	94,090	125,160	125,312	127,240	132,425	Continuing	Continuing	
Tactical Information Systems MT-05	20,697	25,076	34,884	35,646	31,000	27,500	27,500	27,500	Continuing	Continuing	
Microwave and Analog Front End Technology (MAFET) MT-06	39,665	43,221	43,071	39,000	25,000	0	0	0	0	N/A	
Centers of Excellence MT-07	16,841	14,000	0	0	0	0	0	0	0	N/A	
Manufacturing Technology Applications MT-08	59,539	33,591	30,155	25,000	21,951	0	0	0	0	N/A	
Advanced Lithography MT-10	57,509	51,404	40,000	40,000	40,000	40,000	37,500	35,754	Continuing	Continuing	

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APPROPRIATION/BUDGET ACTIVITY					R-1 ITEM NOMENCLATURE						
RDT&E, Defensewide					Advanced Electronics Technologies,						
BA 3 Advanced Technology Development					PE 0603739E						
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Electronic Commerce Resource Centers MT-11	31,073	20,704	0	0	0	0	0	0	0	N/A	
Microelectromechanical Systems (MEMS) MT-12	30,738	57,800	72,060	71,549	69,281	60,000	50,000	50,000	Continuing	Continuing	
Advanced Micro Systems MT-13	0	0	0	0	15,000	35,000	35,000	35,000	Continuing	Continuing	
(U) Mission Description: The Advanced Electronics Technology program element is budgeted in the Advanced Technology Development Budget Activity because it seeks to design and demonstrate state-of-the-art manufacturing and process technologies for the production of various electronics and microelectronic devices, sensor systems, actuators, and gear drives that have both commercial and military applications. Introduction of advanced product design capability and flexible, scalable manufacturing techniques will enable the commercial sector to rapidly and cost-effectively satisfy military requirements and enhance the U.S. industrial base. (U) The IR Focal Plane Array project focuses on the establishment of a manufacturing capability for advanced infrared sensor arrays for major weapons systems. This industrial base will allow the systems to meet specification requirements at approximately 1% of the current cost. (U) The Electronic Module Technology project is a broad initiative to substantially decrease the cost and increase the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the design and fabrication of various types of digital, analog, and mixed signal modules consisting of electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards and emerging technologies such as high density Multichip Modules (MCMs). (U) The Tactical Information Systems project contains three major programs: Head Mounted Displays (HMD), Smart Modules, and Warfighter Visualization. The Head Mounted Display program is developing world-class miniature displays and integrating these displays into head and helmet mounted configurations for use by pilots, combat vehicle crews											

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E	
and individual warriors as well as for virtual environments and simulation. Smart Modules is a program to design and develop prototype modules, using core technologies that sense, think, and communicate, and integrate them into selected personal information products. Warfighter Visualization is a program to demonstrate the feasibility of combining real-time visual images of the environment with geospatially registered computer generated information for use by individual mounted and dismounted warfighters. (U) The Microwave and Analog Front End Technology (MAFET) project is the only DoD effort directed at significantly reducing non-recurring costs for military microwave/millimeter wave sensor systems through improved computer aided design capabilities. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave components. The MAFET program addresses the essential foundation for all DoD systems and programs making use of microwave and millimeter wave solid state technology. (U) The Centers of Excellence project finances demonstration, deployment of and training on advanced manufacturing technologies. The goal of this technology is to reduce unit and life-cycle costs while improving quality. (U) The goal of the Manufacturing Technology Applications project is to reduce the cost and acquisition leadtime of future military systems by integrating manufacturing process considerations during the product design phase, and by demonstrating high efficiency multi-product prototype factories. This project will also enable manufacturers to economically produce military variants of their commercial products in limited quantities through the introduction of flexible process technologies. (U) Advanced Lithography technology has enabled the dramatic growth of integrated circuit capability. Advances have led directly to improvements in electronic and computing systems performance in terms of speed, power, weight and reliability. (U) The mission of the Electronic Commerce Resource Centers project is the transfer of electronic commerce technologies to small- and medium-size enterprises through a network of regional deployment centers. This program will transition to the Defense Logistics Agency beginning in FY 1998.			

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		P-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E	
(U) The Microelectromechanical Systems (MEMS) project was previously included in MT-04, the Electronic Module Technology Project. This program is a broad and cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems. The microfluidic molecular systems program will address issues centered around the development of automated microsystems that integrate biochemical fluid handling capability along with electronics, opto-electronics and chip-based reaction and detection modules to perform tailored analysis sequences for monitoring of environmental conditions, health hazards, and physiological states.			
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APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE								
RDT&E, Defensewide		Advanced Electronics Technologies, PE 0603739E								
BA 3 Advanced Technology Development										
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
IR Focal Plane Array MT-03	39,493	23,995	9,000	11,000	3,000	0	0	0	0	N/A
(U) <u>Mission Description:</u> The Infrared Focal Plane Array project addresses the technology necessary to produce affordable, infrared (IR) sensor arrays, essential to major weapon systems. The focal plane array consists of a two dimensional detector array sensitive in a broad spectral range, integrated with unique signal processing to enhance performance and provide more efficient utilization of the information. The critical elements of the technology addressed in this program include the infrared material, detector array fabrication, read-out electronics, cryogenic packaging and testing, and module assembly. Processing and fabrication techniques focus on the production of affordable arrays, at low volume, in the configurations required by weapon systems. Performance enhancements in uncooled infrared and near-infrared sensors are also being addressed to provide an integrated, broadband two dimensional sensor array without the cryogenic package usually associated with infrared sensors. Elimination of the cryogenic package dramatically reduces the cost of the sensor module, and provides a sensor package compatible with a wide range of system applications, including navigation, targeting and manportable systems. The solid state integrated sensor also solves the problem of blooming in the presence of high intensity sources, which is encountered with current low light level visible and near infrared sensors. Arrays will be built in the configuration required for missile seekers; target acquisition and navigational platforms; search and track; and threat warning systems. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> - Completed development of standard electronic cells for rapid design and fabrication of infrared read-out circuits. (\$9.0M) - Demonstrated uncooled focal plane arrays hybridized to low noise analog readout circuits. (\$5.0M) - Demonstrated focal plane array fabrication using four inch diameter silicon wafers. (\$14.0M) - Verified computer aided design tool for infrared sensors; including cryogenic packaging. (\$11.5M) (U) <u>FY 1997 Program:</u> - Complete single-wafer IRFPA processing on six inch silicon wafers. (\$6.0M) - Demonstrate capability to fabricate uncooled infrared sensor with one million pixels. (\$5.5M) - Assess capability to fabricate thin film ferroelectric uncooled infrared sensor. (\$4.0M) - Evaluate imaging performance and anti-blooming of uncooled solid state sensor. (\$8.5M)										

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Advanced Electronics Technologies,
PE 0603739E, Project MT-03(U) FY 1998 Program:

- Demonstrate uncooled infrared array with thermal sensitivity of 0.05 degrees. (\$4.0M)
- Demonstrate low light level solid state imager with anti-blooming protection. (\$5.0M)

(U) FY 1995 Program:

- Fabricate and test integrated uncooled infrared array and solid state, low light level array with anti-blooming protection. (\$7.0M)
- Establish feasibility of a solid state imager with spectral response beyond night vision goggles. (\$4.0M)

(U) Program Change Summary:

(In Millions)

FY 1996

FY 1997

FY 1998

FY 1999

President's Budget

36.7

24.0

9.0

14.0

Appropriated

35.8

N/A

N/A

N/A

Current Budget

39.5

24.0

9.0

11.0

(U) Change Summary Explanation:

FY 1996 Increase is due to increased uncooled technology efforts.

FY 1999 Decrease is due to rephasing of program.

(U) Other Program Funding Summary Cost:

N/A

(U) Schedule Profile:Plan Milestones

Mar 97 Demonstrate gain stage integrated into the pixel unit cell.

Sep 97 Evaluation of high performance uncooled sensor array.

Sep 98 Evaluation of large area uncooled sensor with less than 0.05 degree thermal sensitivity.

Jan 00 Evaluation of integrated sensor with broad band infrared response.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development					R-1 ITEM DESCRIPTION Advanced Electronics Technologies, PE 0603739E						
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Electronic Module Technology MT-04	93,376	62,377	62,006	94,090	125,160	125,312	127,240	132,425	Continuing	Continuing	

(U) **Mission Description:** The Electronic Module Technology Project is a broad initiative to substantially decrease the cost and increase the performance of weapon systems through the timely insertion of state-of-the-art electronic modules. Electronic module technology addresses the design and fabrication of various types of digital, analog, and mixed signal modules consisting of electronic, electro-optical and micro-mechanical components. It includes traditional approaches such as printed circuit boards and emerging technologies such as high density Multichip Modules (MCMs).

(U) The project has four major objectives: (1) shorten the overall design, manufacture, test, and insertion cycle for advanced electronic subsystems; (2) advance the state-of-the-art in electronic interconnection and physical packaging technology to allow circuits to operate close to their intrinsic maximum speed with less overhead in terms of volume, weight and cost; (3) provide a robust manufacturing infrastructure for electronic modules; and (4) demonstrate the system level payoff of electronic module technology through advanced technology demonstrators (ATDs).

(U) The project has the following major elements: Application Specific Electronic Modules (ASEM); Multichip Integration (MCI); Rapid Prototyping of Application Specific Signal Processors (RASSP); Optical Micro-Networks (OMNET); Cooperative Adaptive Payloads (CAPS); Infrared Artificial Dielectrics (IRADS); and Design Support for mixed Technology Integration (Composite CAD). ASEM will reduce the non-recurring engineering time and cost for designing and inserting complex electronic modules. MCI will produce order of magnitude reductions in manufacturing cost and accelerate the acceptance and insertion of Multichip Integration technologies. RASSP is a major DARPA/tri-Service initiative which seeks to dramatically reduce the development time and life cycle cost of advanced signal processing capability. OMNET seeks to demonstrate new paradigms for integrating electronic, electromechanical, and electro-optical components to enable small, lightweight, battlefield information systems. CAPS is a new effort to integrate developments in MEMS, power sources, communications, and advanced microelectronics to design, construct and field multiple, high-performance, mobile, autonomous systems. Composite CAD seeks to enable the design of systems incorporating emerging micro-devices and manufacturing processes by developing the design technology (tools, methodology, and architectures) to support device and systems design of mixed-technology integrated systems.

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RD/T&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-04	
(U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> - Completed development of required microwave packaging approaches and interconnection circuitry; produced and demonstrated required multichip microwave assemblies. (\$10.0M) - Demonstrated complete end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) design framework with additional demonstration hardware and benchmark evaluations. Developed accelerated framework standards, improved Computer Aided Design (CAD) technology for system testing, and reuse libraries. Accelerated technology transfer activities. (\$32.2M) - Continued Application Specific Electronic Modules (ASEM) program to reach one month turn-around time and \$25K non-recurring engineering (NRE) cost for digital Multichip Modules (MCMs). Demonstrated high volume production technology for producing known-good die. (\$19.6M) - Continued Multichip Integration (MCI) program with the delivery of high volume/low cost laminate MCM technology and develop optimized modules and mixed signal applications. (\$20.1M) - Expanded the current effort in Seamless High Off-Chip Connectivity (SHOCC) to include a full scale demonstration of a high-performance microprocessor. This demonstration segmented the integrated circuit design into yield and performance-optimized active elements, fabricated these elements and assembled a fully-functional device on a passive substrate incorporating traces formerly within the chip. Mating of the active die to the substrate was through a high-density interposer. (\$10.0M) - Reprioritized design activities to focus on enabling highly integrated mixed-technology electronic systems which include digital, analog, MEMS and optics devices. (\$1.5M) (U) <u>FY 1997 Program:</u> - Complete and demonstrate final end-to-end RASSP signal processor design environment. Complete technology insertion demonstrations, benchmarking analysis, and technology transition activities. (\$7.5M) - Continue ASEM technology development and demonstrate new ASEM foundry capability for flexible production of modules with board-level integration. (\$11.8M) - Continue Multichip Integration program to demonstrate order of magnitude reductions in MCM manufacturing costs and MCM technology insertions. Continue insertion of MCM technology into dual-use products such as workstations, engine control and wireless communications. (\$22.6M) - Initiate OMNET program to demonstrate new paradigms for integrating electronic, electromechanical, and electro-optical components to enable small, lightweight, battlefield information systems. (\$11.5M)		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NONDECLASSURE Advanced Electronics Technologies, PE 0603739E, Project MT-04	
- Continue to refocus ASEM and MCM design technology to support the design of composite electronic systems from composable design tools (electronics composite CAD). Focus on multi-technology lumped behavior modeling capability. (\$4.3M) - Enable design of highly integrated MEMS devices coupled with electronics through the development of coupled energy modeling of 3D devices (MEMS and optics composite CAD). (\$4.7M)			
(U) FY 1998 Program:			
- Complete ASEM program to reduce non-recurring engineering cost for designing and inserting complex electronic modules. (\$4.0M) - Complete the Multichip Integration (MCI) program to demonstrate cost reductions in Multichip Modules (MCM) manufacturing costs and technology insertions. (\$14.3M) - Optical Micro-Networks (OMNET) - Downselect amongst heterogeneous integration technologies and demonstrate multi-functional integration of electronic, electro-mechanical and optoelectric components targeted to military information systems. (\$12.7M) - Cooperative Adaptive Payloads (CAPS) - Initiate effort to put together in one package low-weight (<2 kg), high-performance payloads including sensors, imagers, countermeasures, designators, communications, and munitions. (\$7.0M) - Composite CAD - Pull together composable design technology capability of electronics and MEMS to enable composite system. Develop models with parameters optimized for manufacturing variances. Initiate behavior modeling of mixed technology devices. (\$16.0M) - Far Reach - Explore technology for ultra-low power, high bandwidth, stealthy battlefield wireless communications capability. (\$8.0M)			
(U) FY 1999 Program:			
- OMNET - Demonstrate integrated optoelectronic transceivers and optical switches for reconfigurable interconnections of sensors to processors and the ability to distribute computation across military platforms 1-100 meters in length for future Electronic Warfare/digital radar and image processors. (\$18.0M) - CAPS - Construct the unit platforms, integrate commercial or demonstrated technology elements (e.g., imagers, MEMS, wireless systems), and field packs/herds of units to demonstrate multiple, cooperative functions. (\$19.0M) - Composite CAD - Continue to develop the mixed domain (kinematic, electric, electrostatic, and fluidic) analysis of micro-machined devices, systems of devices and corresponding electronic circuits to support the design of composite electronic sensors and systems. (\$18.0M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE	
RDT&E, Defensewide		Advanced Electronics Technologies,	
BA 3 Advanced Technology Development		PE 0603739E, Project MT-04	

- Far Reach - Continue development of spread-spectrum wireless communications for battlefield applications. (\$18.0M)
- Explore new effort on developing technology for ultra-small, low cost multi-cast digital radio. (\$11.0M)
- Develop small personal inertial and GPS based navigation chip for small unit operations. (\$10.0M)

(J)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		134.5	66.2	93.2	144.8
	Appropriated		136.7	N/A	N/A	N/A
	Current Budget		93.4	62.4	62.0	94.1

(U) Change Summary Explanation:

FY 1996 Decrease reflects: creation of a separate MT-12 MEMS Project for greater program visibility; Bosnia reprogramming funding source; and internal reprioritization of programs.

FY 1997-99 Decrease reflects revised DOD priorities.

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile:

Plan Milestones

Dec 96	Demonstrate Multichip Modules (MCM) insertions in small diameter missile.
Jun 97	Demonstrate final end-to-end Rapid Prototyping of Application Specific Signal Processors (RASSP) signal processor design.
Sep 97	Demonstrate new mixed signal ASEM foundry capability.
Jun 98	Demonstrate efficient 3-D electromagnetic modeling capability.
Aug 98	Complete testing of integrated optoelectronic devices.
Sep 98	Demonstrate MCM substrates with integrated passive components.
Jul 99	Demonstrate mixed energy domain analysis capability for integrated technology devices.
Aug 99	Demonstrate optical microne트워크 with reconfiguration capability.
Nov 99	Initial prototype of tightly integrated adaptive payload technology.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E							
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Tactical Information Systems MT-05	20,697	25,076	34,884	35,646	31,000	27,500	27,500	27,500	Continuing	Continuing	

(U) Mission Description: This project is a major DoD effort to develop the technology for displays and portable information systems for use in a variety of military systems. The project has three major programs: Head Mounted Displays (HMDs), Smart Modules, and Warfighter Visualization. The Head Mounted Display program is developing world-class miniature displays and integrating these displays into head and helmet mounted configurations for use by pilots, combat vehicle crews and individual warriors as well as for virtual environments and simulation. Smart Modules is a program to design and develop prototype modules, using core technologies that sense, think, and communicate, and integrate them into selected personal information products. Warfighter Visualization is a program to demonstrate the feasibility of combining real-time visual images of the environment with geospatially registered computer generated information for use by individual mounted and dismounted warfighters.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Head Mounted Displays. (\$10.1M)
 - Completed all on-going miniature display efforts and initiated feasibility demonstrations for miniature diffraction grating displays and Microelectromechanical Systems (MEMS) based displays.
 - Smart Modules. (\$10.6M)
 - Demonstrated four systems for use by individuals remotely located from conventional information sources. Initiated developments to demonstrate individually worn direction finding and video capture capability.

(U) FY 1997 Program:

- Head Mounted Displays. (\$5.9M)
 - Demonstrate feasibility of diffraction grating and MEMS based miniature displays. Diffraction grating displays will integrate drivers, standard interfaces, memory and controller circuitry directly on the display. This will improve the range of applications for which the display can be applied and significantly reduce power consumption requirements. The MEMS display will use a novel micro-beam steering device to control the movement of a fiber optic to scan a mirror with an image. This type of display will greatly reduce the head-borne weight to a few ounces and significantly reduce power consumption over currently available displays.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-05	
• Smart Modules - Demonstrate the feasibility of combining computation, wireless communicating capability, and high resolution display in a paper sized device operating on commercially available batteries. Device will be built using shape deposition manufacturing processes to demonstrate rapid, cost-effective prototyping. The device will be used to receive text, graphics and video and provide limited transmitting capability. Demonstrate electronic information capability integrated into soldier's clothing. A soldier's vest will incorporate computers, GPS, radio, batteries and PC card slots for various peripherals. First demonstration will be for Army maintenance application. (\$15.2M) • Warfighter Visualization - Initiate efforts to develop technologies that will allow tracking of hand and head motion for mobile, untethered individuals. (\$4.0M)			
(U) <u>FY 1998 Program:</u> • Smart Modules - Demonstrate prototype electric countermeasures system integrated into a soldier worn vest. The computational capability developed in the FY 1997 program will be augmented with two PC cards containing ECM circuitry and will allow dismounted soldiers to instantly locate radio emissions from hostile forces. Demonstrate a prototype water proof computer for underwater use in SEAL and Explosive Ordnance Disposal applications. (\$15.3M) - Demonstrate prototype inertial navigation device integrated into soldier boots. This device will use miniature accelerometers and gyros to measure direction and distance traveled. It will be used to augment GPS navigation when the user is in areas where satellite reception is unavailable. (\$6.0M) • Warfighter Visualization - Continue efforts to develop hand and head motion tracking technologies. Tracking head movement will allow a computer to display information to a head mounted display that is registered in the geospatial direction that the individual is looking. Tracking hand motion will allow a computer to recognize pointing and gestures as input mechanisms instead of using a keyboard. (\$6.3M) - Demonstrate image capture and geospatial registration of icons on terrain in a moving vehicle. The vehicle will be equipped with video cameras that provide a 360 degree view. Inside the vehicle, a person wearing a head tracked, head mounted display will be able to look around and view the images obtained from the cameras. Icons and graphical images generated by a computer will be overlaid on the camera image in the head mounted display. These images will be registered with the viewed real-world terrain. (\$7.3M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development	R-1 ITEM NONEXCLUSION Advanced Electronics Technologies, PE 0603739E, Project MT-05																					
(U) FY 1999 Program: • Smart Modules - Demonstrate a novel capture device that incorporates signal and data processing in a 3-D package for use by individual soldiers. This miniature device weighing only a few ounces will be able to capture an image and rapidly analyze movement or correlate images with all processing done on the focal plane. The camera will be able to be worn by individual soldiers and communicate via a radio to and from geographic information system data bases. (\$9.2M) - Demonstrate a wearable computer incorporating wireless communication in a one pound, one watt configuration. This represents a 3x improvement in weight and a 10x improvement in power over current technology. The wearable computer will be used in a wide variety of applications by the small unit operations soldier. (\$9.0M) • Warfighter Visualization - Demonstrate prototype capability for dismounted soldiers to view real world with overlaid graphic symbology. This capability will allow the soldier to receive visual information that is relevant to his/her mission time or location. It will also allow the soldier to interrogate databases containing information about the specific objects in his/her viewing environment. (\$5.8M) - Demonstrate prototype "see-through" tank concept. This capability will allow a "buttoned-up" tank crew wearing head mounted displays to view the outside world as though the tank were made of glass. This will be accomplished by placing cameras on the outside of the tank that provide inputs to a mapped memory. Images will be fed to the users head mounted display depending upon the direction that the user is looking. This capability will significantly enhance the situation awareness of the tank crew. (\$6.5M) - Demonstrate a capability to obtain one-dimensional and two-dimensional data from a submarine sensor suite and configure these data into a 3-dimensional image covering 360 degrees that is provided to a head-tracked, head mounted display. This capability will be used by a submarine conning officer to demonstrate an enhanced capability for under ice submarine navigation. (\$5.1M)																						
(U) Program Change Summary: (In Millions) <table> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>20.2</td> <td>19.1</td> <td>22.8</td> <td>21.6</td> </tr> <tr> <td>Appropriated Budget</td> <td>19.6</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>20.7</td> <td>25.1</td> <td>34.9</td> <td>35.6</td> </tr> </tbody> </table>				FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	20.2	19.1	22.8	21.6	Appropriated Budget	19.6	N/A	N/A	N/A	Current Budget	20.7	25.1	34.9	35.6
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	20.2	19.1	22.8	21.6																		
Appropriated Budget	19.6	N/A	N/A	N/A																		
Current Budget	20.7	25.1	34.9	35.6																		

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-05
(U)	<u>Change Summary Explanation:</u> FY 1996 Increase reflects minor repricing. FY 1997-99 Increase reflects new effort in Warfighter Visualization.	
(U)	<u>Other Program Funding Summary Cost:</u> N/A	
(U)	<u>Schedule Profile:</u> Plan Milestones Nov 96 HMD - 2560 x 2048 pixel displays demonstration. Jan 97 HMD - Integrated CCD, memory, wireless interface in Technology Advanced Mini Eyesafe Rangefinder (TAMER). Jan 97 SM - Integrated wireless interface and display in TAMER. Feb 97 HMD - 2560 x 2048 pixel display demonstration. Mar 97 SM - Demonstrate electronic information system incorporated in soldier clothing. Sep 97 HMD - Diffraction grating display demonstration. Nov 97 SM - Demonstrate electronic countermeasures system in soldier vest. Dec 97 SM - Demonstrate waterproof/computer. Feb 98 WV - Prototype head and hand tracking demonstration. Feb 98 HMD - Demonstrate low power display. Mar 98 HMD - Demonstrate air combat air controller modules. Apr 98 WV - Demonstrate prototype see-through vehicle concept. Dec 98 SM - Demonstrate image capture sensor using 3-D packaging. Feb 99 SM - Demonstrate 1 pound, 1 watt wearable computer system. Feb 99 WV - Real world viewing with computer generated graphic overlay demonstration. Jul 99 WV - Demonstrate see-through tank.	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E								
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Microwave and Analog Front End Technology MT-06	39,665	43,221	43,071	39,000	25,000	0	0	0	0	N/A	

(U) Mission Description: Microwave and millimeter wave technology for DoD electronic weapon systems is at a critical crossroads. Great progress has been made under the microwave and millimeter wave integrated circuit (MIMIC) program in terms of maturing the gallium arsenide industrial community. The DoD is now far ahead of the commercial world in microwave and millimeter wave technology in terms of performance characteristics. However, in many cases, radio frequency (RF) sub-system costs are still a major impediment to fielding DoD weapon systems. Material, processes and design technology advances must be undertaken to sustain an effective defense capability and to maintain U.S. dominance in this critical technology area. The Microwave and Analog Front End Technology (MAFET) program is the only DoD effort directed at significantly reducing non-recurring costs for military microwave/millimeter wave sensor systems through improved computer aided design capabilities and advanced technologies. It will provide urgently needed improvements in the performance and affordability of microwave and millimeter wave components. The MAFET program addresses the essential foundation for all DoD systems and programs making use of microwave and millimeter wave solid state technology.

(U) Specifically, the MAFET program will provide the DoD with the state-of-the-art electronic systems that it needs to maintain its force multiplying capability. The program will: (1) reduce design time and cost for every RF system being developed or upgraded through an improved microwave/millimeter wave design environment; (2) break the very expensive cycle and time-consuming current practice of design-build-test--redesign-rebuild-retest; (3) put in place repeatable, robust processes to produce high frequency components; (4) make strategic investments in critical passive, packaging and integrated circuits devices needed for millimeter wave systems; and (5) investigate revolutionary solutions to the long-standing problem of insufficient power in solid-state radar and communications transmitters.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Continued development and implementation of microwave/millimeter wave computer aided design (CAD) environment with quantitative demonstration of ability to reduce time and cost of producing microwave and

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-06	
millimeter wave products. Continued development and implementation of Microwave Hardware Description Language (MHDL). (\$8.0M) - Continued development of advanced sensor technology with demonstrations of improved performance coupled with cost savings. Demonstrated state-of-the-art millimeter wave probes. (\$25.4M) - Selected most appropriate system application areas and began demonstration tasks that will allow quantitative assessment of subsystem and system performance improvements and cost savings resulting from Microwave and Analog Front End Technology (MAFET) activities. Began benchmark development and assessment of design tool advances. (\$3.1M) - Investigated novel concepts, methodologies, and passive components for high-power, ultra-low-cost, all-solid-state microwave sources and high millimeter wave sources. (\$3.2M) FY 1997 Program: - Continue microwave/millimeter wave computer aided design environment development with implementation of advanced microwave/millimeter wave CAD tools and integrated tool sets and implementation of improved models. Conduct assessment and demonstration of design environment effectiveness through quantitative assessment of benchmarking metrics. Continue development and implementation of MHDL. (\$13.2M) - Complete advanced sensor technology developments in the area of millimeter wave test. In addition, demonstrate: (1) millimeter wave InP high electron mobility transistor (HEMT) monolithic microwave integrated circuits (MMICs) with high yield; (2) low cost, high Indium-content field effect transistor (FET) materials on gallium arsenide; (3) microwave and millimeter wave device arrays; (4) advanced mixed signal chips for highly integrated frequency synthesizers; (5) low cost MMIC components for electronic warfare transmitter arrays; (6) miniaturized microwave and millimeter wave ferrite circulators; (7) automated millimeter wave load pull test station; and (8) on-wafer known good die test station. Continue development of remaining advanced sensor technology with demonstrations of improved performance coupled with cost savings. (\$19.4M) - Begin development of all-solid-state X-band source with high output power and low fabrication cost. (\$4.0M) - Begin development of all-solid-state quasioptical Ka-band source with high output power. (\$3.0M) - Demonstrate MEMS X-band phase shifter technology at high power and ultra low loss. (\$1.0M) - Begin development of MEMS controlled beam-steering module at mm-wave frequencies. (\$.8M) - Begin development of high-power (10W) W-band solid-state MMICs. (\$1.8M)			

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

R-1 ITEM MONITORING

Advanced Electronics Technologies,
PE 0603739E, Project MT-06

BA 3 Advanced Technology Development

(U) FY 1998 Program:

- Complete microwave/millimeter wave computer aided design environment. Demonstrate design environment effectiveness. Continue implementation of Microwave Hardware Description Language (MHDL). (\$8.2M)
- Complete advanced sensor technology developments in the areas of: advanced fabrication, packaging, and multichip assembly (MCA) foundries. In the fabrication area, demonstrate: (1) production InP HEMT and HBT millimeter wave processes; (2) advanced manufacturing processes for: high power and high efficiency, high dynamic range, and mixed signal capability; and (3) highly manufacturable and reliable HBT high power amplifiers. In the packaging area, demonstrate: (1) a 10x cost reduction in plastic HDI module fabrication technology; and (2) a 7x volume efficiency increase due to embedded transmission lines and advanced multilayer interconnect. In the foundry area, demonstrate a 5x reduction in MCA production cost. (\$8.6M)
- Demonstrate all-solid-state X-band source with 100-W output. (\$6.5M)
- Demonstrate all-solid-state quasioptical Ka-band source with 10-W output. (\$7.2M)
- Integrate MEMS phase shifter with power amplifiers to make highly efficient X-band T-R modules. (\$4.0M)
- Demonstrate MEMS-based beam steering array at frequencies above 30 GHz. (\$3.6M)
- Demonstrate all-solid-state W-band source with 1-W output. (\$5.0M)

(U) FY 1999 Program:

- Insert and validate performance of 100-W X-band source in fielded ground-based, airborne or similar radar platform. (\$11.5M)
- Insert and validate performance of MEMS-based T-R modules. (\$4.0M)
- Demonstrate millimeter wave 10-W all-solid-state quasioptical power in laboratory system or sub-systems. (\$10.0M)
- Demonstrate millimeter wave MEMS-based beam steerer as replacement to gimbal-mounted mirror in laboratory missile-seeker subsystem. (\$4.0M)
- Initiate high efficiency, low power, RF-analog merged process and circuit development efforts to achieve major advances in the cost, size, weight, and power of sensor electronics for space-limited platforms and man-portable systems. (\$9.5M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE		
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE				
RDT&E, Defensewide		Advanced Electronics Technologies, PE 0603739E, Project MT-06				
BA 3 Advanced Technology Development						
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		50.7	47.9	50.9	28.2
	Appropriated		42.6	N/A	N/A	N/A
	Current Budget		39.7	43.2	43.1	39.0
(U)	<u>Change Summary Explanation:</u>					
	FY 1996 Decrease due to Bosnia reprogramming action.					
	FY 1997-99 Adjustment reflects program rephasing.					
(U)	<u>Other Program Funding Summary Cost:</u> N/A					
(U)	<u>Schedule Profile:</u>					
	<u>Plan Milestones</u>					
Mar 97	Standard for simulator and design environment interoperability.					
Mar 97	Produce broadband electronic warfare multichip assemblies.					
Jun 97	Demonstrate millimeter wave test probes and automated on-wafer test station.					
Sep 97	Demonstrate high power MEMS phase shifters.					
Mar 98	Demonstrate 20-W X-band all-solid-state sources.					
Sep 98	Ultra-low-cost SiGe T/R modules.					
Dec 98	Demonstrate 10-W millimeter wave power amplifier array.					
Jan 99	Demonstrate millimeter wave micromachined solid-state power amplifier.					
Mar 99	Demonstrate millimeter wave beam steering module.					
Jun 99	Demonstrate > 100-W low cost X-band electronically steerable source.					
Sep 99	Demonstrate full interoperability of CAD vendors.					

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE September 1996	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM MONITORING									
RDT&E, Defensewide BA 3 Advanced Technology Development		Advanced Electronics Technologies, PE 0603739E, Project MT-07									
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Centers of Excellence MT-07	16,841	14,000	0	0	0	0	0	0	0	N/A	
(U) <u>Mission Description:</u> This project provides funding for Centers of Excellence including the Robert C. Byrd Institute for Advanced Manufacturing at Marshall University, and the Focus: HOPE National Center for Advanced Technologies (NCAT). The purpose of these Centers is to demonstrate, deploy and provide advanced manufacturing technology to significantly reduce unit production and life cycle costs, improve product quality, and deploy manufacturing training systems. (U) The Institute for Advanced Flexible Manufacturing provides both a teaching factory and initiatives to local area industries to utilize computer-integrated manufacturing technologies and managerial techniques to improve productivity and competitiveness. The National Center for Advanced Technology (NCAT) is a component of the Focus: HOPE Project whose purpose is to train technicians/engineers in advanced manufacturing processes and methods, demonstrate state-of-the-art flexible manufacturing and serve as a testbed for emerging manufacturing research. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> • Focus: HOPE. (\$12.9M) - Developed software to integrate 3D computer models with numerically controlled machine tools, and demonstrate its production capability. - Demonstrated an electronic (digital) library in the context of education and training of machinists. • Institute for Advanced Flexible Manufacturing. (\$3.9M) - Developed, demonstrated and evaluated new technologies for insertion and transfer to manufacturing centers and industry, with a focus on small- to medium-sized manufacturing companies. (U) <u>FY 1997 Program:</u> • Focus: HOPE. (\$10.0M) - Continue development and demonstration of software to integrate computer models with numerically controlled machine tools. - Continue efforts to demonstrate a digital library to enhance the education and training of machinists.											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM MONETIZATION		
RDT&E, Defensewide		Advanced Electronics Technologies,		
BA 3 Advanced Technology Development		PE 0603739E, Project MT-07		
• Institute for Advanced Flexible Manufacturing. (\$4.0M) • Continue the on-going technology development that includes technology evaluation, research into dual-use flexible manufacturing and technology transfer to local business at the Institute for Advanced Flexible Manufacturing.				
(U)	FY 1998 Program:	N/A		
(U)	FY 1999 Program:	N/A		
(U)	Program Change Summary:	(In Millions)	FY 1996	FY 1997
	President's Budget		17.1	14.0
	Appropriated		18.8	N/A
	Current Budget		16.8	14.0
(U)	Change Summary Explanation:			
	FY 1996		Decrease reflects Bosnia reprogramming action.	
(U)	Other Program Funding Summary Cost:	N/A		
(U)	Schedule Profile:			
	Plan Milestones			
	Oct 96		Develop, demonstrate and evaluate technology insertion and technology transferred to medium and small manufacturing companies.	

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY					R-1 ITEM NOMENCLATURE						
RDT&E, Defensewide					Advanced Electronics Technologies,						
BA 3 Advanced Technology Development					PE 0603739E						
COST (in Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Manufacturing Technology Applications MT-08	59,539	33,591	30,155	25,000	21,951	0	0	0	0	N/A	

(U) Mission Description: Future military systems will be affordable only if the manufacturing process is considered as an integral part of product design, production takes place in flexible, multi-product factories, and if advanced manufacturing technology is combined effectively with advanced business practices. This program focuses on demonstrations of process technology combined with innovative industrial practices, and will measure the improvements in cost, schedule and quality achievable in key defense product areas. Three major initiatives are included in the FY 1996-2000 program: Affordable Multi-Missile Manufacturing (AM3); Agile Manufacturing Pilot Programs; and the DARPA/Tri-Service Flexible Interferometric Fiber Optic Gyroscope (IFOG) Manufacturability Program.

(U) The Affordable Multi-Missile Manufacturing (AM3) program is an Advanced Technology Demonstration initiated in FY 1995. The objective of AM3 is to demonstrate the feasibility of 25-50% reductions in the unit cost of tactical missiles, both in ongoing missile production programs and in new missiles and major modifications. This will be accomplished by teams of missile prime contractors, component suppliers and manufacturing equipment and software vendors who develop and demonstrate the combined effects of advanced design, manufacturing, assembly systems and processes, missile value engineering changes, and acquisition reform and business practice innovations. A major technical theme is to achieve economies across a mix of missiles to compensate for the decline in individual missile quantities. Demonstrations will be conducted in the design and manufacture of components and guidance and control/seeker assemblies for multiple missiles, including R&D and production programs.

(U) Agile Manufacturing is an industry-developed vision for 21st century manufacturing, which focuses on the ability to thrive in an environment of changing product technologies, customer demands, and development and production team members. This new paradigm is ideally suited to the needs of defense manufacturing in the future. Agile Manufacturing Pilot Programs are structured to evaluate the manufacturing enterprise concepts and enabling technology required for agility on and above the factory floor. Since over 50% of the cost of weapon systems is attributable to components from lower tier suppliers, the major emphasis is on tightly integrating the supplier chain and other elements of the manufacturing enterprise.

(U) Interferometric Fiber Optic Gyroscopes (IFOG) are emerging as preferred technology for future military and commercial inertial navigation applications.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
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RDT&E, Defensewide		Advanced Electronics Technologies, FE 0603739E, Project MT-08	
BA 3 Advanced Technology Development			

The emphasis of the IFOG Manufacturability Program is on achieving the design and manufacturing flexibility required to make low volume Defense components economically viable when compared to high volume commercial production. This program will develop the large through put robotic assembly, packaging and testing technologies necessary to fabricate navigation-grade (0.01 deg/hr) Interferometric Fiber Optic Gyroscopes (IFOGs) at less than \$1,500 per axis as a goal. This will enable affordable, accurate (1nm/hr) inertial navigators for use during extended periods of Global Positioning System (GPS) signal outage due to enemy jamming. Flexible manufacturability enables, from the same production line, fabrication of navigation grade, military tactical grade (0.1 - 1.0 deg/hr) IFOGs and lower performing (> 1 deg/hr) commercial IFOGs. Example technology development areas include: (1) low loss, low reflectivity, polarization-preserving optical connections between optical fiber subassemblies, optical sources, detectors and miniature integrated optical circuits; (2) rapid, precision coil winding machines; (3) geometrically stable, environmentally robust (temperature and vibration) packaging of critical optical subassemblies; and (4) automatic testing machines. Phase 1 will identify IFOG manufacturing process requirements for components, subassemblies and complete IFOG units. Phase 2 will demonstrate advanced manufacturing methods, controls and equipment. Phase 3 establishes and demonstrates a prototype automated, flexible IFOG manufacturing facility, transitioning the manufacturing processes and controls from Phase 2.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Affordable Multi-Missile Manufacturing (AM3). (\$23.7M)
 - Completed Affordable Multi-Missile Manufacturing (AM3) Phase 1, approved validation plans, and initiated Phase 2 demonstrations to assess and mitigate risks, including simulation and modeling, design and component-level manufacturing demonstrations, and qualification testing.
 - Competitively selected two system vendors for the development of supply chain integration technologies to fill gaps identified in AM3 Phase 1.
 - Continued AM3 technical integration activities, conducted independent evaluation of contractor cost savings analyses and completed initial set of benchmark comparison studies for the missile sector.
- Agile Manufacturing Program. (\$16.4M)
 - Completed Agile Manufacturing business practice demonstrations and documentation, inserted results in Pilot Program testbeds, and disseminated results for DoD and industry implementation.
 - Completed Agile Manufacturing enabling technology demonstrations, initiated beta test in Pilot Programs, and transferred technology through the Industry Forum and through vendor products.
 - Completed Agile Manufacturing pilot programs in space launch vehicles and castings.

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- Continued Agile Manufacturing industry forum activities, including delivery of agility tool kit and knowledge base, and transition to self-sustainment. • Interferometric Fiber Optic Gyroscope (IFOG). (\$19.4M) - Developed and implemented manufacturing processes for coil winding and optical components/subassemblies. - Completed IFOG architectures and began to develop and implement manufacturing processes.		
(U) <u>FY 1997 Program:</u> • Affordable Multi-Missile Manufacturing (AM3). (\$12.2M) - Complete AM3 Phase 2 component-level validation demonstrations. - Competitively select at least two pilot enterprises for AM3 Phase 3, and initiate cost-shared implementation and demonstrations of concepts and technology across the target missile mix. - Initiate initial demonstrations of supply chain technologies to fill gaps identified in AM3 Phase 1, and continue technical integration and independent cost analysis. • IFOG. (\$21.4M) - Evaluate wound coils and packaged subassemblies for IFOG. - Continue to implement brassboard Interferometric Fiber Optic Gyroscopes (IFOG) unit manufacturing processes.		
(U) <u>FY 1998 Program:</u> • Affordable Multi-Missile Manufacturing. (\$25.0M) - Continue AM3 Phase 3 implementation of new factory systems and new business practices in at least two pilot enterprises. - Complete initial design and test planning for AM3 multi-missile components and value engineering change proposals. - Complete initial demonstrations of supply chain technologies to fill gaps identified in AM3 Phase 1, and continue technical integration and independent cost analysis. • IFOG. (\$5.2M) - Demonstrate flexible production of navigation grade and tactical grade IFOG units. - Demonstrate production of packaged optical sources and automated optical fiber connections.		
(U) <u>FY 1999 Program:</u> • Affordable Multi-Missile Manufacturing. (\$25.0M)		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-08
- Continue AM3 Phase 3 implementation of flexible multi-product assembly cells and prototype production of missile hardware. - Conduct initial tests of missile seekers built with the Affordable Multi-Missile Manufacturing (AM3) scalable family of parts and commercial components.		
(U)	<u>Program Change Summary:</u> (In Millions) President's Budget Appropriated Current Budget	FY 1996 66.1 67.3 59.5 FY 1997 34.1 N/A 33.6 FY 1998 33.5 N/A 30.2 FY 1999 25.0 N/A 25.0
(U)	<u>Change Summary Explanation:</u> FY 1996 Decrease reflects inflation saving: cited on reprogramming actions and transfer of funds to the Small Business Innovative Research (SBIR) program element. FY 1997-98 Decrease reflects program repricing.	
(U)	<u>Other Program Funding Summary Cost:</u> N/A	
(U)	<u>Schedule Profile:</u> Plan Milestones Jul 97 Complete AM3 Phase 2 demos, select at least two contractors for Phase 3. Jul 97 Demonstrate production of novel wavelength stabilized IFOG light source. Aug 97 Demonstrate winding of test coils with advanced coil winding machinery. Oct 97 Complete IFOG advanced coil winding machinery. Feb 98 Demonstrate assembly of brassboard IFOG units. Dec 99 Complete AM3 Phase 3 multi-missile manufacturing demonstrations. Jun 00 Complete flight tests of AM3 missile seeker prototypes.	

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E							
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Advanced Lithography MT-10	57,509	51,404	40,000	40,000	40,000	40,000	37,500	35,754	Continuing	Continuing	

(U) Mission Description: Lithography technology has enabled the dramatic growth in microelectronics capability over the past three decades and microelectronics is a key to improved weapon system performance. The improved capabilities in semiconductor technology contribute to significant system gains in speed, reliability, cost, power consumption, and weight. Advanced microelectronics technology is essential for computing and signal processing throughout essentially all military systems, including command, control, communications, and intelligence, electronic warfare, and beam forming for radar and sonar. Further improvements in areas such as target recognition, autonomous guided missiles, and digital battlefield applications require microcircuits with smaller features to meet the operational speed, power, weight and volume constraints of these systems.

(U) Current microelectronics fabrication utilizes feature sizes of 0.35 microns. The Advanced Lithography Program emphasizes longer term research with expected high payoff in the fabrication of semiconductor devices with 0.1 or less micron feature sizes. These programs will develop technology for sub 0.1 micron features. Current programs in cross-cutting technologies (mask, stages, resists, metrology) and x-ray lithography will be completed in one - two years. The projection e-beam developments will demonstrate alpha tool versions late in the decade.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Demonstrated prototype projection electron-beam and ion-beam lithography lenses. (\$10.0M)
- Demonstrated processing using x-ray lithography and point source development. (\$23.0M)
- Developed alignment sub-assemblies and mask technology for 0.18 micron lithography system. (\$13.1M)
- Developed key subsystems for a point source x-ray lithography system. (\$11.4M)

(U) FY 1997 Program:

- Demonstrate stage control for lithography tools with 0.13 micron capability. (\$6.0M)
- Demonstrate breadboard subsystems of electron-beam projection lithography systems. (\$14.0M)
- Fabricate devices and x-ray sources for 0.13 micron design rules. (\$25.0M)
- Improve e-beam writing, inspect, repair, and processing for 0.12 mask capability. (\$6.4M)

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM NOMENCLATURE

Advanced Electronics Technologies,
PE 0603739E, Project MT-10

(U) FY 1998 Program:

- Research efforts for sub 0.1 micron in maskless lithography (emitter arrays and photocathodes), innovative imaging materials, and network of university efforts in novel patterning. (\$28.0M)
- Complete development on cross-cutting technology in precision stages and mask making (e-beam writing and inspection) for 0.13 - 0.10 micron features. (\$12.0M)

(U) FY 1999 Program:

- Continue efforts in maskless lithography, including arrays of miniature e-beam columns, and novel imaging materials and pattern transfer processes. (\$32.0M)
- Continue network of university efforts addressing potential show-stoppers with novel approaches in patterning, metrology, modeling, materials, and image placement. (\$8.0M)

(U) Program Change Summary: (in Millions)

	FY 1996	FY 1997	FY 1998	FY 1999
President's Budget	39.0	51.4	40.0	40.0
Appropriated	59.0	N/A	N/A	N/A
Current Budget	57.5	51.4	40.0	40.0

(U) Change Summary Explanation:

FY 1996 Decrease is due to Bosnia reprogramming action (\$1.9 million) and minor program repricings (\$+.4 million).

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile:

Plan Milestones

- Jan 97 Demonstrate subsystems for mask writer for writing 0.18 micron features.
- Mar 97 Demonstrate x-ray source suitable for x-ray prototype tool for 0.18 micron features.
- Mar 97 Demonstrate stage control to 10 nm, suitable for 0.12 micron lithography tools.
- Apr 97 Demonstrate breadboard (alpha) version of electron-beam lithography system.
- Jun 99 Demonstrate switched emitter arrays for maskless lithography.

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E							
cost (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Electronic Commerce Resource Centers MT-11	31,073	20,704	0	0	0	0	0	0	0	N/A	
(U) <u>Mission Description:</u> The mission of this program is the transfer of electronic commerce (EC) technologies to small- and medium-size enterprises (SMEs) through a network of regional deployment centers. This mission is a subset of the overall DoD plans for Continuous Acquisition and Life-cycle Support (CALs) and for electronic commerce as part of the overall DoD plans for Continuous Acquisition and Life-cycle Support (CALs) and for electronic commerce as part of Acquisition Reform. To reflect the focus on that subset, the program name was changed in FY 1994 from CALs Shared Resource Centers to Electronic Commerce Resource Centers (ECRCs). The regional ECRCs provide training and technical assistance to aid SMEs in defense supply chains in making effective use of electronic commerce and CALs technologies. An ECRC technology hub has been established to keep abreast of EC technologies and to ensure that technical consultants in the regional ECRCs are equipped with the latest information and training on EC technologies. (U) <u>Program Accomplishments and Plans:</u> (U) <u>FY 1996 Accomplishments:</u> - Electronic Commerce Resource Centers (ECRC). (\$31.1M) - Follow-on contracts awarded to current ECRC integrators to continue ECRC network of sites for nationwide delivery of education, training, and technical support services (Congressional direction). - Continued Technology Hub operations with initiatives for Electronic Commerce (EC) Testbed, and for advances in tools needed for development of Standard for the Exchange of Product (STEP) data model applications. (U) <u>FY 1997 Program:</u> - Electronic Commerce Resource Centers (ECRC). (\$20.7M) - Complete DARPA funded ECRC technology development and deployment. - Transition program to the Defense Logistics Agency (DLA) for continued operation. (U) <u>FY 1998 Program:</u> N/A (U) <u>FY 1999 Program:</u> N/A											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	September 1996	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE				
RDT&E, Defensewide		Advanced Electronics Technologies, PE 0603739E, Project MT-11				
BA 3 Advanced Technology Development						
(U)	<u>Program Change Summary:</u>	(In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget		32.3	20.7	15.0	0
	Appropriated		33.3	N/A	N/A	N/A
	Current Budget		31.1	20.7	0	0
(U)	<u>Change Summary Explanation:</u>					
	FY 1996 Decrease is due to Bosnia reprogramming.					
	FY 1998 Program transferred to Defense Logistics Agency.					
(U)	<u>Other Program Funding Summary Cost:</u> N/A					
(U)	<u>Schedule Profile:</u>					
	Plan Milestones					
	Sep 97 Complete transition of ECRC activities to Defense Logistics Agency.					

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development				R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E							
COST (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Microelectromechanical Systems (MEMS) MT-12	30,738	57,800	72,060	71,549	69,281	60,000	50,000	50,000	Continuing	Continuing	
(U) Mission Description: The Microelectromechanical Systems (MEMS) program is a broad, cross-disciplinary initiative to develop an enabling technology that merges computation with sensing and actuation to realize new systems for both perceiving and controlling weapons systems, processes and battlefield environments. Using fabrication processes and materials similar to those that are used to make microelectronic devices, MEMS conveys the advantages of miniaturization, multiple components, and integrated microelectronics to the design and construction of integrated electromechanical systems. The MEMS program addresses issues ranging from the scaling of devices and physical forces to new organization and control strategies for distributed, high-density arrays of sensors and actuator elements. The microfluidic molecular systems program will address issues centered around the development of automated microsystems that integrate biochemical fluid handling capability along with electronics, opto-electronics and chip-based reaction and detection modules to perform tailored analysis sequences for monitoring of environmental conditions, health hazards, and physiological states. (U) The MEMS program has three principal objectives: The realization of advanced devices and systems concepts; the development and insertion of MEMS products into DoD systems; and the creation of support and access technologies to catalyze a MEMS technology infrastructure. These three objectives cut across a number of focus application areas to create revolutionary military capabilities, make high-end functionality affordable to low-end systems, and extend the operational performance and lifetimes of existing weapons platforms. The major technical focus areas for the MEMS program are: 1) inertial measurement; 2) fluid sensing and control; 3) electromagnetic and optical beam steering; 4) mass data storage; 5) chemical reactions on chip; 6) electromechanical signal processing; 7) active structural control; 8) analytical instruments; and 9) distributed networks of sensors and actuators. (U) Accomplishments to date include: A wind-tunnel test of an integrated MEMS sensor and actuator array distributed along the leading edge of a model aircraft wing creating rolling moments of sufficient strength to control aircraft flight, pointing the way to future fighter aircraft with advanced maneuverability unattainable using conventional, large and discrete control surfaces; a demonstration of a MEMS-based accelerometer capable of surviving and operating in the near 100,000 G accelerations generated by firing artillery shells, making possible affordable guidance systems to what are presently unguided munitions and increasing both their effectiveness and life cycle costs; and the establishment of a regularly scheduled,											

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APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE	
RDT&E, Defensewide		Advanced Electronics Technologies,	
BA 3 Advanced Technology Development		PE 0603739E, Project MT-12	

shared, MEMS fabrication service for domestic DoD, commercial and academic users. The service has lowered barriers to access and has allowed hundreds of researchers, students and industrial users, nearly half for the first time, to inexpensively and rapidly fabricate MEMS devices.

(U) Program Accomplishments and Plans:

(N) FY 1996 Accomplishments:

- Achieved factor of 3-5x increase in electronics-to-mechanics integration ratios with new fabrication processes; began development of related information-driven and fault-tolerant designs for devices; began incorporation of extreme condition materials into sensor and actuator designs. (\$6.9M)
- Achieved 200-300 mechanical components/sq. cm systems densities with associated increases in both process yields and device performance uniformities; began exploration of new organization and control strategies for multiple, heterogeneous and distributed MEMS components; continued development of complete and stressing MEMS systems demonstration projects in areas such as fluid vortex control, adaptive optics, combustion control and atomic-resolution mass-data storage. (\$16.7M)
- Extended distributed shared fabrication services to enable process experimentation; continued development of fabrication, packaging and metrology tools to address devices and systems developments; expanded available set of shared fabrication processes and associated CAD tools and design libraries. (\$7.1M)

(U) FY 1997 Program:

- Achieve additional factor of 5-10x increase in electronics-to-mechanics integration ratios; explore space of related device designs and architectures enabled by order-of-magnitude increase in integration ratios including electromechanical signal processing elements and radio-frequency components; continue development of fault-tolerant and parallel designs including low-noise, low-drift multi-axis accelerometers and gyroscopes; demonstration of extreme temperature and pressure sensor function in operational environments. (\$10.7M)
- Achieve 400-500 mechanical components/sq. cm systems densities with integrated or hybrid fabrication/assembly techniques; demonstrate MEMS applications using massively parallel MEMS components; initiate new dual-use areas including analytical instruments, precision assembly, on-demand structural strength enhancement and air-vehicle aerodynamic control; begin creation of shared testbed for development and validation of new organizational and control strategies for large-scale, distributed MEMS. (\$24.9M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 5 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12																				
September 1996																						
• Begin transition of mature fabrication services to self-sufficiency; demonstrate scalable distributed fabrication services for MEMS process experimentation; continue development of MEMS-specific unit processes and associated processing equipment; continue the extension of simulators to address the modeling and coupling of multiple physical forces encountered in MEMS applications; continue dissemination and validation of CAD tools and design libraries. (\$8.3M) • Initiate plans to develop on-chip integrated microfluidic systems for improved detection and control of molecular reactions with emphasis on the development of new materials and control of reactions. (\$14.0M)																						
(U)	<u>FY 1998 Program:</u> - Accelerate and expand on MEMS systems developments that; (1) exploit physics and MEMS systems architecture to project micro scale actions into macro scale effects, (2) extend present fabrication processes to cost-effective, large-area fabrication approaches, and (3) integrate developments in MEMS, robotics and ultra-electronics to design, construct and field multiple, high-performance, mobile, autonomous systems. (\$54.1M) - Initiate system-level integration through an evolving testbed strategy in which the development of new microfluidic components and processes occurs concurrently with the integration of early prototypes with available chip-based molecular analysis components. Leverage analysis and detection technology from industry, Services, and other DoD programs when compatible with microsystems integration. (\$16.0M)																					
(U)	<u>FY 1999 Program:</u> - Initiate concept demonstrations for systems in the form of model aircraft and weight-supporting structures, and additional concepts in areas including identify friend-or-foe systems, on-chip chemical processing, and mobility. Address the key barriers in MEMS fabrication, packaging and integration to realizing systems demonstrations that will be critical to DoD validation and insertion of MEMS technology. (\$55.5M) - Continue system-level integration on new microfluidic components and processes. (\$16.0M)																					
(U)	<u>Program Change Summary:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>31.0</td> <td>54.8</td> <td>65.1</td> <td>66.5</td> </tr> <tr> <td>Appropriated</td> <td>30.2</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>30.7</td> <td>57.8</td> <td>72.1</td> <td>71.5</td> </tr> </tbody> </table>			FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	31.0	54.8	65.1	66.5	Appropriated	30.2	N/A	N/A	N/A	Current Budget	30.7	57.8	72.1	71.5
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	31.0	54.8	65.1	66.5																		
Appropriated	30.2	N/A	N/A	N/A																		
Current Budget	30.7	57.8	72.1	71.5																		

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APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Advanced Electronics Technologies, PE 0603739E, Project MT-12	
(U)	<u>Change Summary Explanation:</u> FY 1996 Increase is due to minor program repricing. FY 1997-98 Increase reflects increased efforts in microfluidic systems and enhancements to MEMS.		
(U)	<u>Other Program Funding Summary Cost:</u> N/A		
(U)	<u>Schedule Profile:</u> <u>Plan Milestones</u> Oct 96 Microcombustion heat exchanger operation. Mar 97 Navigation-grade inertial measurement and guidance devices. Jun 97 VGA-resolution monochrome grating light-valve display. Sep 97 25k Tracks/ln magnetic recording with dual-stage actuators. Jan 98 Self-sufficiency of mature shared fabrication services. Jun 98 Controlled chemical reactions and processing on chip. Jan 99 Atomic-resolution data storage using precision, multiple read/write structures.		

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide
BA 3 Advanced Technology Development

R-1 ITEM MONITORING

Maritime Technology,
PE 06037468

COST (in thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Shipbuilding Technology MR-01	46,351	37,408	50,000	0	0	0	0	0	0	N/A

(U) Mission Description: The goal of the MARITECH program is to preserve the U.S. shipbuilding industrial base by improving the industry's commercial competitiveness through advanced technology applications. For the Defense Department, a competitive shipbuilding industry optimizes Navy ship acquisition reform and allows realization of the Department's objective for affordable Navy ships. The goal of the DoD Acquisition Reform Program is to take advantage of the best commercial practices of industry and thereby achieve cost reductions of the ships and systems it purchases. Having operated exclusively in a protected domestic market, the U.S. shipbuilding industry has not implemented the best commercial processes necessary to compete in the international arena or to build affordable Navy ships. The government's attempt at acquisition reform, as it applies to ship acquisition, could fall short if U.S. shipyards are not commercially competitive. The key for acquisition reform is for the U.S. shipbuilding industry to attain global commercial competitiveness.

(U) This is a two-phased program that provides products and infrastructure for the near and far term. The near term effort enhances international competitiveness through the development of a portfolio of U.S. ship designs for the international marketplace and the build strategies for their competitive price and delivery. This effort is being enhanced by developing an infrastructure that includes the implementation of electronic communications and commerce throughout the industry, and by participating in an industry-wide forum for problem solving on a technical level.

(U) The long term effort includes the infusion of innovative product technologies and process improvements that brings the capabilities of the U.S. shipbuilding industry above those of foreign shipyards. This will result in a larger share of the international market, and a self-sustaining, highly efficient U.S. shipbuilding industry.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Completed all shipbuilding strategy development initiatives and new ship designs begun in prior years. (\$13.5M)
- Completed advanced technology development initiatives started in FY 1995. (\$8.2M)
- Established a National Shipbuilding Consortium. (\$.6M)

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APPROPRIATION/BUDGET ACTIVITY

RDT&E, Defensewide

BA 3 Advanced Technology Development

R-1 ITEM DESCRIPTION

Maritime Technology,
PE 0503746E, Project MR-01

- Commenced Electronic Commerce Computer Integrated Enterprise for Maritime community. (\$3.4M)
 - Continued to improve and expand National Shipbuilding Network (NSnet). (\$9M)
 - Commenced new initiatives for advanced shipbuilding strategies and new commercial designs. (\$5.5M)
 - Commenced new initiatives for advanced technologies to radically improve ship production processes and products. (\$7.9M)
 - Investigated applicability of Advanced Materials to hull construction. (\$2.7M)
 - Commenced development of standard data exchange translators for digital ship design and construction. (\$3.6M)
- (U) FY 1997 Program:
- Initiate additional advanced technology developments for improving ship production processes and products. (\$8.7M)
 - Complete advanced technology developments started in FY 1996. (\$12.2M)
 - Continue to improve and provide support for National Shipbuilding Network (NSnet). (\$6M)
 - Expand Electronic Commerce and Computer Integrated Enterprise. (\$7.1M)
 - Support National Shipbuilding Consortium. (\$9M)
 - Complete advanced shipbuilding strategies and commercial ship design initiatives. (\$7.9M)
- (U) FY 1998 Program:
- Complete advanced product and process technology initiatives. (\$25.0M)
 - Complete Maritime Industry Electronic Commerce Designs. (\$25.0M)

(U) FY 1999 Program: N/A(U) Program Charge Summary: (In Millions) FY 1996 FY 1997 FY 1998 FY 1999

President's Budget

47.2 37.4 50.0 0

Appropriated

48.1 N/A N/A N/A

Current Budget

46.4 37.4 50.0 0

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R-1 ITEM NOMENCLATURE

Maritime Technology,
PE 0603746E, Project MR-01

BA 3 Advanced Technology Development

(U) Change Summary Explanation:

FY 1996 Decrease due to inflation savings cited on reprogramming actions (\$-.9 million) and transfer to the SBIR program element (\$-.8 million).

(U) Other Program Funding Summary Cost: N/A

(U) Schedule Profile:

Plan Milestones

Apr 96 Commenced new initiative for Advanced Technologies to radically improve ship construction processes in the U.S. to surpass foreign competition.

Sep 96 Complete development of 19 new ship designs for the international commercial marketplace along with strategies for competitive construction.

Sep 97 Complete development of 15 process and product technological innovations focused on aiding the U.S. shipbuilding community to compete internationally.

Sep 97 Complete 2 additional ship designs for the international commercial marketplace.

Nov 97 Complete evaluation of Integrated Product Data Environment for Shipbuilding.

Feb 98 Complete test and evaluation of System Life Cycle Support Infrastructure Demonstration Project.

Sep 99 Complete development of commercialization plan for next Generation Windows based system for Integrated Product and Process Development.

Dec 99 Complete development of National Shipbuilding Information Infrastructure Protocols.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY			R-1 ITEM NOMENCLATURE								
RDT&E, Defensewide			Joint Strike Fighter Program,								
BA 3 Advanced Technology Development			PE 0603800E								
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
Joint Strike Fighter Program JA-01	28,917	78,400	23,900	0	0	0	0	0	0	N/A	

(U) Mission Description: The Joint Strike Fighter (JSF) Program is the focal point for defining affordable next generation strike aircraft weapon systems for the USN, USMC, USAF, and allies. Program emphasis is on facilitating the evolution of fully validated and affordable joint operational requirements, and demonstrating cost leveraging technologies and concepts to lower risk prior to entering engineering and manufacturing development (E&MD) of the JSF in FY 2001. The JSF Program is a joint program with no executive Service. Beginning in FY 1995, the Navy and Air Force each provide approximately equal shares of annual program funding. DARPA's Advanced Short Take Off Vertical Landing (ASTOVL)/Conventional Take Off and Landing (CTOL) Common Affordable Lightweight Fighter (CALF) project (previously known as ASTOVL) was integrated with the JSF program by FY 1995 legislation. DARPA contributed funding for the JSF program in FY 1996 under this new program element. The US/UK international collaborative CALF program conceived by DARPA was investigating a revolutionary approach for melding advanced technology, multi-service commonality, and improved business practices directed toward demonstrating an affordable, capable replacement for the F-16, F/A-18, and AV-8B. DARPA is bringing this insight and experience to bear in integrating the structure and philosophy of the CALF program within the JSF framework. The DARPA program manager now is serving as a Director within the JSF program organization. This ensures that DARPA's expertise in ASTOVL technologies, streamlined acquisition, and rapid prototyping are brought to bear in the JSF technology demonstration program.

(U) Program Accomplishments and Plans:

(U) FY 1996 Accomplishments:

- Completed critical technology validation program for the Direct Lift and Shaft Coupled Lift Fan Concepts. (\$7.4M)
- Commenced Preliminary Demonstration Design Propulsion and JSF Competitive Engine efforts. (\$18.3M)
- Commenced concept definition and design research for weapon system concept for a tri-service family of aircraft. (\$3.2M)

(U) FY 1997 Program:

- Commence Joint Strike Fighter Concept demonstration phase, including ground and flight demonstrations and concept refinement for the tri-service family of aircraft. (\$78.4M)

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																												
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE																												
RDT&E, Defensewide BA 3 Advanced Technology Development		Joint Strike Fighter Program, PE 0603800E, Project JA-01																												
(U) <u>FY 1998 Program:</u> • Continue Joint Strike Fighter, including ground and flight demonstrations and concept refinement for the tri-service family of aircraft. (\$23.9M)																														
(U) <u>FY 1999 Program:</u> N/A																														
(U)	<u>Program Change Summary:</u> (In Millions) President's Budget Appropriated Current Budget	FY 1996 30.7 29.9 28.9 FY 1997 78.4 N/A 78.4 FY 1998 23.9 N/A 23.9 FY 1999 0 N/A 0																												
(U)	<u>Change Summary Explanation:</u> FY 1996 Decrease reflects Bosnia reprogramming (\$-.3 million) and transfer of funds to the SBIR PE (\$-.7 million).																													
(U)	<u>Other Program Funding Summary Cost:</u> (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> <th>FY 2000</th> <th>FY 2001</th> </tr> </thead> <tbody> <tr> <td>PE 0603800F</td> <td>81.2</td> <td>263.8</td> <td>431.1</td> <td>458.5</td> <td>238.9</td> <td>18.9</td> </tr> <tr> <td>PE 0603800N</td> <td>81.2</td> <td>246.8</td> <td>421.8</td> <td>457.3</td> <td>239.0</td> <td>18.9</td> </tr> <tr> <td>United Kingdom</td> <td>14.0</td> <td>71.0</td> <td>55.0</td> <td>20.0</td> <td>20.0</td> <td>20.0</td> </tr> </tbody> </table>			FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	PE 0603800F	81.2	263.8	431.1	458.5	238.9	18.9	PE 0603800N	81.2	246.8	421.8	457.3	239.0	18.9	United Kingdom	14.0	71.0	55.0	20.0	20.0	20.0
	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001																								
PE 0603800F	81.2	263.8	431.1	458.5	238.9	18.9																								
PE 0603800N	81.2	246.8	421.8	457.3	239.0	18.9																								
United Kingdom	14.0	71.0	55.0	20.0	20.0	20.0																								
(U)	<u>Related RDT&E:</u> PEs 0604800N & 0604800F: Milestone II for a joint follow-on engineering & manufacturing development (E&MD) program for the Joint Strike Fighter (JSF) is planned in FY 2000. The follow-on program will develop a tri-service family of aircraft from concepts proven under the JSF Program, incorporating affordable technologies transitioned from the JSF Program.																													

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996														
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide PA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Joint Strike Fighter Program, PE 0603800E, Project JA-01															
(U) <u>Schedule Profile:</u> <table> <thead> <tr> <th>Planned</th> <th>Milestones</th> </tr> </thead> <tbody> <tr> <td>Oct 96</td> <td>Award concept demonstration contract.</td> </tr> <tr> <td>Mid 97</td> <td>Complete preliminary design of Concept Demonstration Aircraft.</td> </tr> <tr> <td>Early 98</td> <td>Complete detailed design of Demonstration Aircraft.</td> </tr> <tr> <td>Mid 98</td> <td>Complete detailed design of Demonstration Aircraft.</td> </tr> <tr> <td>FY 99</td> <td>Begin flight demonstrations.</td> </tr> <tr> <td>FY 01</td> <td>End concept demonstration phase.</td> </tr> </tbody> </table>				Planned	Milestones	Oct 96	Award concept demonstration contract.	Mid 97	Complete preliminary design of Concept Demonstration Aircraft.	Early 98	Complete detailed design of Demonstration Aircraft.	Mid 98	Complete detailed design of Demonstration Aircraft.	FY 99	Begin flight demonstrations.	FY 01	End concept demonstration phase.
Planned	Milestones																
Oct 96	Award concept demonstration contract.																
Mid 97	Complete preliminary design of Concept Demonstration Aircraft.																
Early 98	Complete detailed design of Demonstration Aircraft.																
Mid 98	Complete detailed design of Demonstration Aircraft.																
FY 99	Begin flight demonstrations.																
FY 01	End concept demonstration phase.																

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)										DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE									
RDT&E, Defensewide		Dual Use Applications Program,									
BA 3 Advanced Technology Development		PE 0603805E									
COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost	
	0	250,000	195,000	175,000	145,000	75,000	0	0	0	N/A	
Dual Use Applications Programs GC-01											
(U) Mission Description: The Dual Use Applications Program (DUAP) will introduce dual use R&D approaches into the Military Services as a new norm by developing dual use technologies, i.e. technologies that are militarily useful and commercially viable, for the direct benefit of Military users. Building on previous experience, the DUAP will help embed this new way of doing business throughout the Military Services by familiarizing a cadre of people who understand and accept the concept through real experience with it. DUAP is a joint program of the three Military Departments, DARPA, and DDR&E; the Service S&T executives are committed to using DUAP to both develop technology and spread dual use R&D more deeply into their departments. (U) Dual use R&D improves the DoD's access to some of the most affordable, advanced technology -- technology created and sustained in the dynamic and growing commercial sector. The key to dual use is actively, intentionally leveraging the commercial sector's research, products, and processes for the benefit of the DoD. By its nature, this is an entrepreneurial activity that requires foregoing many of the rules, regulations, and procedures typically required in traditional DoD research and development activities. While experience has shown that dual use R&D is practical, it has also shown that it is unfamiliar to many and has not been widely adopted. DoD's current challenge is to spread dual use R&D more deeply throughout the Department and "normalize" it. (U) DUAP's pool of R&D funds will create an incentive and opportunity for Service program managers to fund new technology using a dual use approach under the tutelage of senior personnel experienced with the unique acquisition requirements of dual use programs. R&D projects will be solicited as government/industry partnerships, selected to meet Service needs, and managed by the Services using new authorities and methods. Each project will include, up front, a clear path for the technology to be used in a military system. As a joint program, DUAP is a unique forum for all the Services to simultaneously refine and share what they learn about dual use R&D while working on technologies of joint interest. (U) DUAP is managed by the Joint Dual Use Program Office (JDUPO). JDUPO is led by DARPA during FY 1997. Beginning with FY 1998, DUAP will transition to the Military Departments under the direction of the DDR&E.											

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE	September 1996
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 3 Advanced Technology Development		R-1 ITEM NOMENCLATURE Dual Use Applications Program, PE 0603805E, Project GC-01	
(U)	<u>Program Accomplishments and Plans:</u>		
(U)	FY 1996 Accomplishments: N/A		
(U)	FY 1997 Program: • Potential technology thrusts (R&D areas) will be finalized based on the following criteria: 1) military utility; 2) potential commercial viability; and 3) prospects for timely acceptance by both military and commercial users after the DUAP R&D is completed. • Competition(s) will be announced during the first quarter of FY 1997; projects will be selected by the fourth quarter of FY 1997. These R&D projects will be performed primarily by industry and be managed by a Military Service with ties to the expected military users. JDUPO's Service representatives will actively link the users and developers to help ensure the dual use benefits for each project, particularly performance, affordability, and accessibility. • Technology thrusts for the FY 1998 competition will be selected in the fourth quarter of FY 1997.		
(U)	FY 1998 Program: • Early in FY 1998, JDUPO will sponsor competition(s) for R&D projects similar to that of FY 1997. • JDUPO will sponsor demonstration and transition projects to directly encourage the insertion of dual use technologies into military systems. These projects would be developed and suggested by Service program managers and selected by JDUPO based on such things as: 1) military benefit; 2) commercial leverage; 3) defense user interest/commitment; 4) technical feasibility; 5) project plan. • JDUPO will start sponsoring a wider variety of projects that leverage the commercial sector for the benefit of the military in some essential way. The scope of these projects will cover R&D, demonstrations, and the adaption of Non-Development-Items for military use. The goal will be to encourage leveraging the commercial sector in the widest variety of acquisition situations throughout the DOD. These projects will be suggested by Service program managers and acquisition offices, and selected for JDUPO sponsorship via criteria similar to those in the bullet above; the Services, not JDUPO, would manage any competitions to fund these projects.		
(U)	FY 1999 Program: • JDUPO will continue to sponsor R&D projects in FY 1999 but will increasingly emphasize execution and management by the Services, and relegate itself to a sponsorship, advocacy, and advice role.		

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)				DATE	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
BA Advanced Technology Development		Dual Use Applications Program, PE 0603805E, Project GC-01			
RDT&E, Defensewide					
(U)	Program Change Summary: (In Millions)	FY 1996	FY 1997	FY 1998	FY 1999
	President's Budget	0	250.0	195.0	195.0
	Appropriated	N/A	N/A	N/A	N/A
	Current Budget	0	250.0	195.0	175.0
(U)	Change Summary Explanation:				
	FY 1999 Decrease reflects a phase down of the program as approved by the POM 98 Program Decision Memorandum.				
(U)	Other Program Funding Summary Cost: N/A				
(U)	Schedule Profile: N/A				

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE

September 1996

APPROPRIATION/BUDGET ACTIVITY

R-1 ITEM NOMENCLATURE

RDT&E, Defensewide
BA 6 RDT&E Management SupportManagement Headquarters (R&D),
PE 0605898E, Project MH-01

COST (In Thousands)	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	Cost to Complete	Total Cost
Management Headquarters MH-01	33,419	37,149	38,515	39,686	40,347	41,191	42,794	43,409	Continuing	Continuing

(U) Mission Description: This program element is budgeted in the Management Support Budget Activity because it provides funding for the administrative support costs of the Defense Advanced Research Projects Agency. The funds provide for personnel compensation for civilians as well as costs for building rent, physical and information security, travel, supplies and equipment, communications, printing and reproduction. In addition, funds are included for reimbursing the Military Services for administrative support costs associated with contracts undertaken on the Agency's behalf.

(U) Program Accomplishments and Plans:(U) FY 1996 Accomplishments:

- Funding under this program element in FY 1996 supported management and administration for the RDT&E programs assigned to DARPA. The majority of the funds were required for the pay of personnel who operate the Agency. The funding level reflects the rental costs associated with the expansion of office space, and the related support and security requirements.

(U) FY 1997 Program:

- DARPA will continue the management and administrative support efforts for headquarters at approximately the same level as FY 1996 as well as enhanced physical and information security requirements. Increases reflect annualization of increased support begun in FY 1996.

(U) FY 1998 Program:

- DARPA will continue the management and administrative support efforts for headquarters at approximately the same levels as FY 1997. The funding level reflects increased rent and pay raise requirements.

(U) FY 1999 Program:

- DARPA will continue the management and administrative support efforts for headquarters at approximately the same levels as FY 1998. The funding level reflects pay raise requirements.

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)		DATE																				
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defensewide BA 6 RDT&E Management Support		September 1996																				
R-1 ITEM MONICLATURE Management Headquarters (R&D), PE 0605898E, Project MH-01																						
(U)	Program Change Summary: (In Millions) <table border="1"> <thead> <tr> <th></th> <th>FY 1996</th> <th>FY 1997</th> <th>FY 1998</th> <th>FY 1999</th> </tr> </thead> <tbody> <tr> <td>President's Budget</td> <td>32.6</td> <td>36.4</td> <td>37.3</td> <td>38.5</td> </tr> <tr> <td>Appropriated</td> <td>32.6</td> <td>N/A</td> <td>N/A</td> <td>N/A</td> </tr> <tr> <td>Current Budget</td> <td>33.4</td> <td>37.1</td> <td>38.5</td> <td>39.7</td> </tr> </tbody> </table>		FY 1996	FY 1997	FY 1998	FY 1999	President's Budget	32.6	36.4	37.3	38.5	Appropriated	32.6	N/A	N/A	N/A	Current Budget	33.4	37.1	38.5	39.7	
	FY 1996	FY 1997	FY 1998	FY 1999																		
President's Budget	32.6	36.4	37.3	38.5																		
Appropriated	32.6	N/A	N/A	N/A																		
Current Budget	33.4	37.1	38.5	39.7																		
(U)	Change Summary Explanation: FY 1996 Increase reflects minor repricing and enhanced security requirements. FY 1997-99 Increase reflects enhanced physical and information security requirements.																					
(U)	Other Program Funding Summary Cost: N/A																					
(U)	Schedule Profile: N/A																					

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DEPARTMENT OF DEFENSE
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1988/1989 DEFENSE BIENNIAL BUDGET REVIEW
Fiscal Year 1988

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars		Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	
Direct Hire Civilian, United States: Classified and administrative	148	150	11571	1966	90.25
Other:					
Intergovernmental Personnel Act (IPA)	39	37	5291	0	143.00
Total United States	187	187	16862	1966	100.68
Benefits to Former Employees (O.C. 13)					
Total Civilian Personnel Costs	187	187	16862	1966	101.89
ROUTINE Deliverables					
Direct Hire Civilian, United States: Classified and administrative	148	150	11571	1966	90.25
Other:					
Intergovernmental Personnel Act (IPA)	39	37	5291	0	143.00
Total United States	187	187	16862	1966	100.68
Benefits to Former Employees (O.C. 13)					
Total Civilian Personnel Costs	187	187	16862	1966	101.89

EXHIBIT PB 31-R
SEPTEMBER 1986

DEPARTMENT OF DEFENSE
DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL BUDGET CALCULATION
FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
Fiscal Year 1997

	Full-Time Equivalent End Strength	Work Years	In thousands of dollars			Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	Total Compensation	
SUMMARY						
Direct Hire Civilians, United States: Classified and administrative	157	152	12090	2104	14194	93.38
Other:						
Intergovernmental Personnel Act (IPA)	60	58	8700	0	8700	150.00
Total United States	217	210	20790	2104	22894	109.02
Benefits to Former Employees (O.C. 13)					100	
Total Civilian Personnel Costs	217	210	20790	2104	22994	109.50
BOEING Defense						
Direct Hire Civilians, United States: Classified and administrative	157	152	12090	2104	14194	93.38
Other:						
Intergovernmental Personnel Act (IPA)	60	58	8700	0	8700	150.00
Total United States	217	210	20790	2104	22894	109.02
Benefits to Former Employees (O.C. 13)					100	
Total Civilian Personnel Costs	217	210	20790	2104	22994	109.50

EXHIBIT PB-31-R
SEPTEMBER 1998

DEPARTMENT OF DEFENSE
 DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
 CIVILIAN PERSONNEL BUDGET CALCULATION
 FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
 Fiscal Year 1998

SUMMARY	Full-Time Equivalent End Strength	Work Years	In thousands of dollars		Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	
Direct Hire Civilian, United States: Classified and administrative	157	152	12452	2207	96.44
Other:					
Intergovernmental Personnel Act (IPA)	60	58	9164	0	158.00
Total United States	217	210	21616	2207	113.44
Total Civilian Personnel Costs	217	210	21616	2207	113.44

ROUTINE Data	Full-Time Equivalent End Strength	Work Years	In thousands of dollars		Average Compensation
			Compensation O.C. 11	Benefits O.C. 12	
Direct Hire Civilian, United States: Classified and administrative	157	152	12452	2207	96.44
Other:					
Intergovernmental Personnel Act (IPA)	60	58	9164	0	158.00
Total United States	217	210	21616	2207	113.44
Total Civilian Personnel Costs	217	210	21616	2207	113.44

EXHIBIT PB 31-R
 SEPTEMBER 1998

DEPARTMENT OF DEFENSE
 DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
 CIVILIAN PERSONNEL BUDGET CALCULATION
 FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
 Fiscal Year 1999

	Full-Time Equivalent End Strength	Work Years	In thousands of dollars		Average Compensation
			Compensation O.G. 11	Benefits O.G. 12	
SUMMARY					
Direct Hire Civilians United States: Classified and administrative	157	152	12713	2289	98.70
Other:					
Intergovernmental Personnel Act (IPA)	60	58	9686	0	167.00
Total United States	217	210	22399	2289	117.56
Total Civilian Personnel Costs	217	210	22399	2289	117.56
RD/3E Defensewide					
Direct Hire Civilians United States: Classified and administrative	157	152	12713	2289	98.70
Other:					
Intergovernmental Personnel Act (IPA)	60	58	9686	0	167.00
Total United States	217	210	22399	2289	117.56
Total Civilian Personnel Costs	217	210	22399	2289	117.56

EXHIBIT PB 31-R
 SEPTEMBER 1996

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
 FY 1998/1999 DEFENSE BIENNIAL REVIEW
 BUDGETED MILITARY AND CIVILIAN PAY RAISE AMOUNTS
 (\$ in Thousands)

FY 1997 FY 1998 FY 1999

MILITARY PERSONNEL N/A 0 0 0

CIVILIAN PERSONNEL
RDT&E Defensewide
Classified

	Effective	Percent			
FY 1997	1-Jan-97	3.0%	309	412	412
FY 1998	1-Jan-98	2.1%	0	222	295
FY 1999	1-Jan-99	2.1%	0	0	227
Total			309	634	934

TOTAL CIVILIAN PERSONNEL 309 634 934

Exhibit PB-53
 September 1996

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
FY 1996/97/98/99
(\$ in Thousands)

DATE: September 1998

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Prior Year (PY) = 1998

DP LN JRES CD II	DESCRIPTION	PY BEGIN		PY END STRENGTH		WORK YEARS		PY BASIC COMP	PY OVER TIME	PY HOL FEBM	PY OTHER OC.11	PY TOTAL VARIABLE	PY TOTAL OC.11	PY BENEFIT OC.12	PY TOTAL COST
		STRENGTH		TOTAL	ETP	TOTAL	ETP								
400 50 1	Senior Executive Schedule	23	23	21	21	18		2374	0	0	190	190	2564	420	2984
400 50 3	General Schedule	135	125	123	123	123	123	8721	55	1	230	286	9007	1548	10553
400 50	Subtotal	158	148	144	144	150	144	11095	55	1	420	476	11571	1868	13537
400 50	Subtotal (Rate)							73.96667				0.04290	77.14000	0.17720	90.24667
400 50 4	Special Schedule (IPA)	38	39	39	39	37	37	5291				5291			5291
400 50	IPA (Rate)							143.00000					143.00000		143.00000
400 50 18	Benefits for Former Employees (OC-13)													225	225
400 50	Total Civilian	196	187	183	181	187	181	16386	55	1	420	476	16862	2191	19053
400 50	Total Civilian (Rate)							87.62567				0.02905	90.17112	0.13371	101.88770

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
 CIVILIAN PERSONNEL COSTS
 FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
 FY 1996/97/98/99
 (\$ in Thousands)

DATE: September 1998

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Current Year (CY) - 1997

DP LN IBBS CD IL	DESCRIPTION	CY BEGN		CY END STRENGTH		WORK YEARS		CY BASIC COMP	CY OVER TIME	CY HOL FROM	CY OTHER OC.11	CY TOTAL VARIAB	CY TOTAL OC.11	CY BENEFIT OC.12	CY TOTAL COST
		STRENGTH	END STRENGTH	TOTAL	FTE	TOTAL	FTE								
400 50 1	Senior Executive Schedule	23	23	21	20	22	20	2561	0	0	193	193	2754	441	3195
400 50 3	General Schedule	125	134	133	127	130	127	9053	59	2	223	283	9336	1663	10999
400 50	Subtotal	148	157	154	147	152	147	11614	59	2	416	476	12090	2104	14192
400 50	Subtotal (Rate)					58	58	76,40789				0.04096	79,53947	0.18116	93,38158
400 50 4	Special Schedule (IPA)	39	60	60	58	58	58	8700					8700		8700
400 50	IPA (Rate)							150,00000					150,00000		150,00000
400 50 18	Benefits for Former Employees (OC-13)													100	100
400 50	Total Civilian	187	217	214	205	210	205	20314	59	2	416	476	20790	2204	22994
400 50	Total Civilian (Rate)							96,73333				0.02343	99,00000	0.10650	109,49524

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
 CIVILIAN PERSONNEL COSTS
 FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
 FY 1998/97/98/99
 (\$ in Thousands)

DATE: September 1998

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-08 Civilian Personnel

Budget Year (BY1) = 1998

OP UN ITEM CD II	DESCRIPTION	BY1 END STRENGTH			WORK YEARS			BY1 BASIC COMP	BY1 OVER TIME	BY1 HOL FROM	BY1 OTHER OC.11	BY1 TOTAL VARIABLE	BY1 TOTAL OC.11	BY1 BENEFIT OC.12	BY1 TOTAL COST
		BY BEGIN STRENGTH	TOTAL	FTE	TOTAL	FTE	FTE								
400 50 1	Senior Executive Schedule	23	23	21	22	20	20	2615	0	0	240	240	2855	463	3318
400 50 3	General Schedule	134	134	133	130	127	127	9243	62	2	290	354	9597	1744	11341
400 50	Subtotal	157	157	154	152	147	147	11858	62	2	530	594	12452	2207	14659
400 50	Subtotal (Rate)							78.01316				0.05009	81.92105	0.18612	96.44079
400 50 4	Special Schedule (IPA)	60	60	60	58	58	58	9164				9164			9164
400 50	IPA (Rate)							158.00000					158.00000		158.00000
400 50	Total Civilian	217	217	214	210	205	205	21022	62	2	530	594	21616	2207	23823
400 50	Total Civilian (Rate)							100.10476				0.02826	102.93333	0.10499	113.44286

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
CIVILIAN PERSONNEL COSTS
FY 1998/1999 DEFENSE BIENNIAL BUDGET REVIEW
FY 1996/97/98/99
(\$ in Thousands)

DATE: September 1998

APPROPRIATION: RESEARCH AND DEVELOPMENT

OP-06 Civilian Personnel

Budget Year Plus One (BY2) - 1999

IBBS CD II	DP LN	DESCRIPTION	BY1 REGN STRENGTH	BY2 END STRENGTH		WORK YEARS		BY2 BASIC COMP	BY2 OVER TIME	BY2 HOL FROM	BY2 OTHER OC-11	BY2 TOTAL OC-11	BY2 BENEFIT OC-12	BY2 TOTAL COST
				TOTAL	FTE	TOTAL	FTE							
400 50	1	Senior Executive Schedule	23	23	21	22	20	2670	0	0	243	243	480	3393
400 50	3	General Schedule	134	134	133	130	127	9437	65	2	296	9800	1809	11809
400 50		Subtotal	157	157	154	152	147	12107	65	2	539	12713	2289	15002
400 50		Subtotal (Rate)						79.55132				0.05005	83.63816	98.89737
400 50	4	Special Schedule (IPA)	60	60	60	58	58	9686				9686		9686
400 50		IPA (Rate)						167.00000				167.00000		167.00000
400 50		Total Civilian	217	217	214	210	205	21793	65	2	539	22399	2289	24688
400 50		Total Civilian (Rate)						103.77619				0.02781	106.66190	117.56190

Advisory and Assistance Services

PB-15 Exhibit

Defense Advanced Research Projects Agency

Appropriation: RDT&E Defensewide

(Dollars in Thousands)

	<u>FY 1996</u>	<u>FY 1997</u>	<u>FY 1998</u>	<u>FY 1999</u>
I. Management & Professional Support Services	36,758	35,045	36,447	37,176
II. Studies, Analysis, & Evaluations	8,868	9,297	9,669	9,862
III. Engineering & Technical Services	0	0	0	0
Totals	45,626	44,342	46,116	47,038

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September 1996**

MANAGEMENT HEADQUARTERS

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY

	FY 1996 Actual					FY 1997 Estimate					FY 1998 Estimate					FY 1999 Estimate				
	Mil	Civ	FTE	Tot	Oblig	Mil	Civ	FTE	Tot	Oblig	Mil	Civ	FTE	Tot	Oblig	Mil	Civ	FTE	Tot	Oblig
Departmental Activities																				
Military Services																				
Military																				
U.S. Army	3			3	209				3	229	3			3	227	3			3	235
U.S. Navy	4			4	314	4			4	322	4			4	322	4			4	325
U.S. Air Force	12			12	909	12			12	918	12			12	917	12			12	964
					1,432				19	1,469				19	1,486				19	1,524
Defense Agencies																				
RDTE Defensewide																				
Civilian																				
U.S. Direct Hire	150			150	13,762				152	14,294				152	14,659				152	15,002
IPAs	37			37	5,291	58			58	8,700	58			58	9,164	58			58	9,606
Other Costs					14,366					14,155					14,592					14,998
					33,419				210	37,149				210	38,515				210	39,606
TOTAL STRENGTH					206				229					229					229	

(Dollars in Thousands; Strength in Whole Numbers)

Exhibit PB-22
September 1996

