UNCLASSIFIED

Supporting Data FY 2011 Budget Estimate
Submitted to OSD – February 2010

DESCRIPTIVE SUMMARIES OF THE

RESEARCH, DEVELOPMENT, TEST AND EVALUATION
Army Appropriation, Budget Activity 1

Department of the Army
Office of the Secretary of the Army (Financial Management and Comptroller)

Persuasive in Peace, Invincible in War

VOLUME I

UNCLASSIFIED

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS
OF THE
RESEARCH, DEVELOPMENT, TEST AND
EVALUATION, ARMY
FY 2011
BUDGET ESTIMATE SUBMISSION
FEBRUARY 2010

VOLUME I
Budget Activity 1

Department of the Army
Office of the Assistant Secretary of the Army (Financial Management and Comptroller)

FY 2011 RDT&E, ARMY
PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

INTRODUCTION AND EXPLANATION OF CONTENTS

1. General. The purpose of this document is to provide summary information concerning the Research, Development, Test and Evaluation, Army program. The Descriptive Summaries are comprised of R-2 (Army RDT&E Budget Item Justification – program element level), R-2A (Army RDT&E Budget Item Justification – project level), R-3 (Army RDT&E Cost Analysis), R-4 (Schedule Profile), R-4A (Schedule Profile Detail) and R-5 (Termination Liability Funding for MDAPs) Exhibits, which provide narrative information on all RDT&E program elements and projects for FY 2009 through FY 2011.

2. Relationship of the FY 2011 Budget Submitted to Congress to the FY 2010 Budget Submitted to Congress. This paragraph provides a list of program elements restructured, transitioned, or established to provide specific program identification.

A. Program Element Restructures. Explanations for these changes can be found in the narrative sections of the Program Element R-2A Exhibits.

OLD PE/PROJECT	NEW PROJECT TITLE	NEW PE/PROJECT
0603308A/978	Long Endurance Multi-Intelligence Vehicle	0305205A/LE4
0604270A/L16	TROJAN – RH12-MIP	0303032A/RH5
0604802A/S23	SLAMRAAM	0605455A/S35
0604805A/589	Joint Battle Command – Platform (JBC-P)	0604805A/593
0604869A/M06	PAC-3/MSE Missile	0605456A/PA3
0303140/5PM	Biometrics Enabled Intelligence – MIP	0307665A/BI7
0303140/5PM	Intelligence Support to Cyber (ISC) – MIP	0203347A/CY7
0305204A/114	RQ-7 Shadow UAV	0305233A/RQ7
0305204A/D10	RQ-11 Raven (MIP)	0305232A/RA7
0307207A/024	Aerial Common Sensor – SDD	0605626A/AC5

B. Developmental Transitions. Explanations for these changes can be found in the narrative sections of the Program Element R-2/R-3 Exhibits.

OLD PE/PROJECT	NEW PROJECT TITLE	NEW PE/PROJECT
0305204A/D09	ER/MP Unmanned Aircraft System (MIP)	0604276A/TU1
0307207A/024	Aerial Common Sensor (ACS)	0605626A/AC5

C. Establishment of New FY 2011 Program Elements/Projects. There are no major system new starts.

TITLE	PE/PROJECT
Aerial Common Sensor – SDD	0605626A/AC5
Armed Scout Helicopter	0604220A/53Z
Army Integrated Air and Missile Defense (AIAMD)	0605457A/S40
Army Integrated Military Human Resources System (A-IRMS)	0605018A/HR5
Biometrics Enabled Intelligence – MIP	0307665A/BI7
ER/MP Unmanned Aircraft System (MIP)	0604276A/TU1
Intelligence Support to Cyber (ISC) – MIP	0203347A/CY7
Joint Battle Command - Platform (JBC-P)	0604805A/593
Long Endurance Multi-Intelligence Vehicle	0305205A/LE4
MQ-1 Sky Warrior – Army UAV (MIP)	0305219A/MQ1
PAC-3/MSE Missile	0605456A/PA3
RQ-7 Shadow UAV	0305233A/RQ7
RQ-11 Raven (MIP)	0305232A/RA7
SLAMRAAM	0605455A/S35
Suicide Prevention/Mitigation	0602787A/VJ4
TROJAN – RH12-MIP	0303032A/RH5
Advanced Geospatial Intelligence (AGI)	0304348A/NI7

D. FY 2011 programs for which funding existed in the FY 2010 President's Budget Submit (May 2009), but which are no longer funded in the FY 2011 President's Budget Submit.

PE/PROJECT	TITLE	BRIEF EXPLANATION
0603004A/L94	Electric Gun System Demo	Program restructured
0604270A/L12	Signals Warfare Development (MIP)	Program moved to a separate MIP PE
0604270A/L16	TROJAN Development (MIP)	Program moved to a separate MIP PE
0604666A/FC7	FCS – Spin Out Technology/Capability Integration	Terminated
0604802A/S23	Surface Launched Advanced Medium Range Air-to-Air Missile (SLAMRAAM)	Program moved to a separate missile defense PE
0604818A/C15	Mounted Battle Command On-The-Move (MBCOTM)	Terminated
0604818A/C39	Tactical Operations Center (TOCs)	Terminated
0303142A/562	Multi-band Integrated Satellite Terminal (MIST)	Terminated
0307207A/024	Aerial Common Sensor (MIP)	Program transitioned to BA 5 for proper execution

3. Classification. This document contains no classified data. Classified/Special Access Programs that are submitted offline are listed below.

0203801A/DF8/DF9	0603005A/C66	0604328A
0203808A	0603006A/DF7	
0301359A	0603009A	
0304348A	0603020A	
0602122A	0603322A	

4. Performance Metrics. Performance metrics used in the preparation of this justification book may be found in the FY 2010 Army Performance Budget Justification Book, dated March 2009.

Department of the Army

FY 2011 RDT&E Program

President's Budget FY 2011

Exhibit R-1

01-Feb-2010

Summary

Summary Recap of Budget Activities	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
Basic research	422,136	431,777	406,873	0	406,873
Applied Research	1,224,889	1,337,114	841,364	0	841,364
Advanced technology development	1,438,797	1,373,609	696,592	0	696,592
Advanced Component Development and Prototypes	1,010,485	932,004	746,248	57,900	804,148
System Development and Demonstration	5,025,850	4,454,743	5,021,546	13,500	5,035,046
Management support	1,470,157	1,196,744	1,142,383	0	1,142,383
Operational system development	1,482,756	1,823,380	1,473,939	79,506	1,553,445
Total RDT&E, Army	12,075,070	11,549,371	10,328,945	150,906	10,479,851

Department of the Army

Exhibit R-1

FY 2011 RDT&E Program

President's Budget FY 2011

Approriation: 2040 A RDT&E, Army

01-Feb-2010

Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	19,357	19,568	21,780		21,780
2	0601102A	01	DEFENSE RESEARCH SCIENCES	193,968	197,471	195,845		195,845
3	0601103A	01	UNIVERSITY RESEARCH INITIATIVES	87,485	99,400	91,161		91,161
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	121,326	115,338	98,087		98,087
			Tota Basic research	422,136	431,777	406,873	0	406,873
			Applied Research					
5	0602105A	02	MATERIALS TECHNOLOGY	80,686	99,447	29,882		29,882
6	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	76,213	70,272	48,929		48,929
7	0602122A	02	TRACTOR HIP	17,659	14,250	14,624		14,624
8	0602211A	02	AVIATION TECHNOLOGY	46,232	49,273	43,476		43,476
9	0602270A	02	ELECTRONIC WARFARE TECHNOLOGY	20,058	22,303	17,330		17,330
10	0602303A	02	MISSILE TECHNOLOGY	57,502	70,924	49,525		49,525
11	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	22,638	21,964	18,190		18,190
12	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	18,205	27,330	20,582		20,582
13	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	84,436	78,923	64,740		64,740
14	0602618A	02	BALLISTICS TECHNOLOGY	84,827	78,034	60,342		60,342
15	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	8,873	13,622	5,324		5,324
16	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	9,165	7,634	7,893		7,893
17	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	106,253	144,864	42,645		42,645
18	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	99,118	134,532	60,859		60,859
19	0602709A	02	NIGHT VISION TECHNOLOGY	45,329	50,877	40,228		40,228
20	0602712A	02	COUNTERMINE SYSTEMS	27,827	23,621	19,118		19,118
21	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	42,208	30,446	21,042		21,042
22	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	15,786	25,469	18,364		18,364
23	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	45,350	30,036	25,573		25,573
24	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	7,786	5,609	6,768		6,768
25	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	58,671	60,779	79,189		79,189
26	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	16,096	16,614	22,198		22,198
27	0602786A	02	WARFIGHTER TECHNOLOGY	35,866	38,347	27,746		27,746

Approriation: 2040 A RDT&E, Army 01-Feb-2010

Line No	Program Element Number	Act	Item	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
28	0602787A	02	MEDICAL TECHNOLOGY	198,105	221,944	96,797		96,797
			Tota Applied Research	1,224,889	1,337,114	841,364	0	841,364
			Advanced technology development					
29	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	72,271	54,290	37,364		37,364
30	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	329,258	339,752	71,510		71,510
31	0603003A	03	AVIATION ADVANCED TECHNOLOGY	102,207	112,388	57,454		57,454
32	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	112,544	89,861	64,438		64,438
33	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	270,195	240,190	89,499		89,499
34	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOL	11,307	12,352	8,102		8,102
35	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLC	6,725	7,371	7,921		7,921
36	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	61,192	57,199	50,359		50,359
37	0603009A	03	TRACTOR HIKE	14,157	11,270	8,015		8,015
38	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	24,769	25,362	15,334		15,334
39	0603020A	03	TRACTOR ROSE	11,216	14,493	12,309		12,309
40	0603103A	03	EXPLOSIVES DEMILITARIZATION TECHNOLOGY	17,213	12,495			
41	0603105A	03	MILITARY HIV RESEARCH	14,867	29,502	6,688		6,688
42	0603125A	03	COMBATING TERRORISM - TECHNOLOGY DEVELOPMENT	12,656	11,927	10,550		10,550
43	0603270A	03	ELECTRONIC WARFARE TECHNOLOGY	32,544	21,877	18,350		18,350
44	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	74,967	86,559	84,553		84,553
45	0603322A	03	TRACTOR CAGE	12,037	12,090	9,986		9,986
46	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	36,883	34,855	26,953		26,953
47	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	8,568	8,949	9,151		9,151
48	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	69,778	72,250	39,912		39,912
49	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	16,782	16,121	15,878		15,878
50	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	34,935	45,394	27,393		27,393
51	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECH	91,726	57,062	24,873		24,873
			Tota Advanced technology development	1,438,797	1,373,609	696,592	0	696,592

Approriation: 2040 A RDT&E, Army 01-Feb-2010

Line No	Program Element Number	Act	Item	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
			Advanced Component Development and Prototypes					
52	0603024A	04	UNIQUE ITEM IDENTIFICATION (UID)	628	1,990			
53	0603305A	04	ARMY MISSLE DEFENSE SYSTEMS INTEGRATION	90,552	71,788	11,455		11,455
54	0603308A	04	ARMY SPACE SYSTEMS INTEGRATION	53,416	118,610	27,551		27,551
55	0603327A	04	AIR AND MISSILE DEFENSE SYSTEMS ENGINEERING	115,567	166,061			
56	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	13,789	17,445	15,596		15,596
57	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	3,721	4,894	2,425		2,425
58	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	39,590	33,757	42,183		42,183
59	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	76,072	89,828	136,302		136,302
60	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	18,058	33,178	18,556	57,900	76,456
61	0603766A	04	TACTICAL ELECTRONIC SURVEILLANCE SYSTEM - ADV DEV	12,235	12,164	17,962		17,962
62	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	2,508				
63	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY - DEM/VAL	20,443	18,374	4,695		4,695
64	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	392,138	169,783	190,903		190,903
65	0603790A	04	NATO RESEARCH AND DEVELOPMENT	4,883	5,022	5,060		5,060
66	0603801A	04	AVIATION - ADV DEV	26,507	8,492	8,355		8,355
67	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	42,939	59,662	80,490		80,490
68	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION AN	17,267	9,817	14,290		14,290
69	0603807A	04	MEDICAL SYSTEMS - ADV DEV	29,572	35,886	28,132		28,132
70	0603827A	04	SOLDIER SYSTEMS - ADVANCED DEVELOPMENT	41,599	73,785	48,323		48,323
71	0603850A	04	INTEGRATED BROADCAST SERVICE	9,001	1,468	970		970
72	0305205A	04	ENDURANCE UAVS			93,000		93,000
			Tota Advanced Component Development and Prototypes	1,010,485	932,004	746,248	57,900	804,148
			System Development and Demonstration					
73	0604201A	05	AIRCRAFT AVIONICS	60,781	89,508	89,210		89,210
74	0604220A	05	ARMED, DEPLOYABLE HELOS	63,017	66,169	72,550		72,550
75	0604270A	05	ELECTRONIC WARFARE DEVELOPMENT	38,256	281,570	172,269	5,400	177,669
76	0604280A	05	JOINT TACTICAL RADIO			784		784
77	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	13,211	13,039	22,574	8,100	30,674

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Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
78	0604328A	05	TRACTOR CAGE	16,300	16,201	23,194		23,194
79	0604601A	05	INFANTRY SUPPORT WEAPONS	57,677	83,178	80,337		80,337
80	0604604A	05	MEDIUM TACTICAL VEHICLES	2,169	5,653	3,710		3,710
81	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS - ENG DEV	5,428	973	5,335		5,335
82	0604611A	05	JAVELIN			9,999		9,999
83	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	4,550	9,826	3,519		3,519
84	0604633A	05	AIR TRAFFIC CONTROL	16,092	7,538	9,892		9,892
85	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES			1,990		1,990
86	0604646A	05	NON-LINE OF SIGHT LAUNCH SYSTEM	253,684	91,223	81,247		81,247
87	0604647A	05	NON-LINE OF SIGHT CANNON	87,038	47,964			
88	0604660A	05	FCS MANNED GRD VEHICLES & COMMON GRD VEHICLE	760,744	275,116			
89	0604661A	05	FCS SYSTEMS OF SYSTEMS ENGR & PROGRAM MGMT	1,022,165	912,399	568,711		568,711
90	0604662A	05	FCS RECONNAISSANCE (UAV) PLATFORMS	55,923	75,107	50,304		50,304
91	0604663A	05	FCS UNMANNED GROUND VEHICLES	104,571	124,962	249,948		249,948
92	0604664A	05	FCS UNATTENDED GROUND SENSORS	20,135	26,778	7,515		7,515
93	0604665A	05	FCS SUSTAINMENT & TRAINING R&D	819,721	655,745	610,389		610,389
94	0604666A	05	SPIN OUT TECHNOLOGY/CAPABILITY INSERTION	122,788				
95	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	96,678	57,111	52,549		52,549
96	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	2,422	2,081	2,118		2,118
97	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	36,826	30,052	27,756		27,756
98	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTELLIGENCE - ENG D	21,737	28,785	34,209		34,209
99	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	25,095	33,039	30,291		30,291
100	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	17,020	15,240	14,041		14,041
101	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENG DEV	18,999	15,645	15,547		15,547
102	0604778A	05	POSITIONING SYSTEMS DEVELOPMENT (SPACE)		9,396			
103	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT) CORE	32,541	26,107	27,670		27,670
104	0604783A	05	JOINT NETWORK MANAGEMENT SYSTEM	659				
105	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	101,823	87,022	24,345		24,345
106	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	29,884	37,023	41,039		41,039
107	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	9,489	58,688	90,736		90,736
108	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPMENT	41,081	41,794	34,474		34,474
109	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	113,590	72,380	95,577		95,577
110	0604814A	05	ARTILLERY MUNITIONS - EMD	70,008	42,230	26,371		26,371
111	0604817A	05	COMBAT IDENTIFICATION	8,967	10,018	29,884		29,884

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Line No	Program Element Number	Act	Item	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
112	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWAI	63,552	79,448	60,970		60,970
113	0604822A	05	GENERAL FUND ENTERPRISE BUSINESS SYSTEM (GFEBS)	50,308	23,777	13,576		13,576
114	0604823A	05	FIREFINDER	64,834	20,227	24,736		24,736
115	0604827A	05	SOLDIER SYSTEMS - WARRIOR DEM/VAL	20,086	19,683	20,886		20,886
116	0604854A	05	ARTILLERY SYSTEMS - EMD	32,261	115,811	53,624		53,624
117	0604869A	05	PATRIOT/MEADS COMBINED AGGREGATE PROGRAM (CAP)	454,665	566,215	467,139		467,139
118	0604870A	05	NUCLEAR ARMS CONTROL MONITORING SENSOR NETWORK	6,064	7,103	7,276		7,276
119	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	68,194	66,561	23,957		23,957
120	0605018A	05	ARMY INTEGRATED MILITARY HUMAN RESOURCES SYSTEM (A-IMHRS)			100,500		100,500
121	0605450A	05	JOINT AIR-TO-GROUND MISSILE (JAGM)	114,817	126,775	130,340		130,340
122	0605455A	05	SLAMRAAM			23,700		23,700
123	0605456A	05	PAC-3/MSE MISSILE			62,500		62,500
124	0605457A	05	ARMY INTEGRATED AIR AND MISSILE DEFENSE (AIAMD)			251,124		251,124
125	0605625A	05	MANNED GROUND VEHICLE		79,583	934,366		934,366
126	0605626A	05	AERIAL COMMON SENSOR			211,500		211,500
127	0303032A	05	TROJAN - RH12			3,697		3,697
128	0304270A	05	ELECTRONIC WARFARE DEVELOPMENT			21,571		21,571
			Tota System Development and Demonstration	5,025,850	4,454,743	5,021,546	13,500	5,035,046
			Management support					
129	0604256A	06	THREAT SIMULATOR DEVELOPMENT	22,015	25,091	26,158		26,158
130	0604258A	06	TARGET SYSTEMS DEVELOPMENT	13,124	13,544	8,614		8,614
131	0604759A	06	MAJOR T&E INVESTMENT	62,699	51,576	42,102		42,102
132	0605103A	06	RAND ARROYO CENTER	19,817	17,812	20,492		20,492
133	0605301A	06	ARMY KWAJALEIN ATOLL	169,367	162,662	163,788		163,788
134	0605326A	06	CONCEPTS EXPERIMENTATION PROGRAM	33,178	26,407	17,704		17,704
135	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	297,531				
136	0605601A	06	ARMY TEST RANGES AND FACILITIES	356,720	352,845	393,937		393,937
137	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	84,905	84,389	59,040		59,040
138	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	40,037	44,782	41,812		41,812
139	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	6,772	7,352	4,710		4,710

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Line No	Program Element Number	Act	Item	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
140	0605606A	06	AIRCRAFT CERTIFICATION	5,001	3,746	5,055		5,055
141	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	8,120	8,347	7,185		7,185
142	0605706A	06	MATERIEL SYSTEMS ANALYSIS	17,472	19,864	18,078		18,078
143	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	3,908	5,403	5,460		5,460
144	0605712A	06	SUPPORT OF OPERATIONAL TESTING	76,231	77,471	68,191		68,191
145	0605716A	06	ARMY EVALUATION CENTER	61,461	67,555	61,450		61,450
146	0605718A	06	ARMY MODELING & SIM X-CMD COLLABORATION & INTEG	5,159	5,328	3,926		3,926
147	0605801A	06	PROGRAMWIDE ACTIVITIES	72,659	77,419	73,685		73,685
148	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	44,051	51,351	48,309		48,309
149	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS AND SAFETY	44,326	72,851	53,338		53,338
150	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MGMT SUPPORT	9,966	5,165	3,195		3,195
151	0605898A	06	MANAGEMENT HQ - R&D	15,586	15,784	16,154		16,154
152	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	52				
			Tota Management support	1,470,157	1,196,744	1,142,383	0	1,142,383
			Operational system development					
153	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	53,954	27,549	51,619		51,619
154	0102419A	07	AEROSTAT JOINT PROJECT OFFICE	344,850	328,356	372,493		372,493
155	0203347A	07	INTELLIGENCE SUPPORT TO CYBER (ISC) MIP			2,360		2,360
156	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	16,200	29,174	24,622		24,622
157	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	139,100	196,393	204,481		204,481
158	0203740A	07	MANEUVER CONTROL SYSTEM	36,072	21,283	25,540		25,540
159	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAM	298,640	231,792	134,999		134,999
160	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	326	788	710		710
161	0203758A	07	DIGITIZATION	7,835	10,636	6,329		6,329
162	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2)	22,688		3,935		3,935
163	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	34,189	39,068	24,280		24,280
164	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS	5,167	3,979			
165	0203808A	07	TRACTOR CARD	15,818	19,930	14,870		14,870
166	0208010A	07	JOINT TACTICAL COMMUNICATIONS PROGRAM (TRI-TAC)	892				
167	0208053A	07	JOINT TACTICAL GROUND SYSTEM	1,949	36,005	12,403		12,403

Approriation: 2040 A RDT&E, Army 01-Feb-2010

Line No	Program Element Number	Act	Item	Thousands of Dollars FY2009	FY2010	FY2011	FY2011 OCO	FY2011 Total
			Basic research					
168	0208058A	07	JOINT HIGH SPEED VESSEL (JHSV)	2,986	3,066	3,153		3,153
169	0301359A	07	SPECIAL ARMY PROGRAM					
170	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	3,189	9,777			
171	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	39,679	60,866	54,784	63,306	118,090
172	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	107,693	143,979	125,569		125,569
173	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	46,799	39,889	33,694		33,694
174	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	12,599	11,972	13,024		13,024
175	0303158A	07	JOINT COMMAND AND CONTROL PROGRAM (JC2)	13,228				
176	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	100,454	202,116	54,300		54,300
177	0305208A	07	DISTRIBUTED COMMON GROUND/SURFACE SYSTEMS	88,483	188,465	103,002	16,200	119,202
178	0305219A	07	MQ-1 SKY WARRIOR A UAV			123,156		123,156
179	0305232A	07	RQ-11 UAV			1,599		1,599
180	0305233A	07	RQ-7 UAV			7,805		7,805
181	0307207A	07	AERIAL COMMON SENSOR (ACS)		115,430			
182	0307665A	07	BIOMETRICS ENABLED INTELLIGENCE			14,114		14,114
183	0702239A	07	AVIONICS COMPONENT IMPROVEMENT PROGRAM	991				
184	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	88,975	102,867	61,098		61,098
			Tota Operational system development	1,482,756	1,823,380	1,473,939	79,506	1,553,445
Total: RDT&E, Army				12,075,070	11,549,371	10,328,945	150,906	10,479,851

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	19.357	19.568	21.780	0.000	21.780	19.139	20.692	21.301	21.650	0	143.487
91A: *ILIR-AMC*	13.739	14.794	17.205	0.000	17.205	14.376	15.940	16.236	16.521	Continuing	Continuing
91C: *ILIR-MED R&D CMD*	4.053	3.009	2.860	0.000	2.860	2.817	2.809	2.858	2.906	Continuing	Continuing
91D: *ILIR-CORPS OF ENGR*	1.395	1.115	1.075	0.000	1.075	1.066	1.067	1.088	1.107	Continuing	Continuing
91E: *ILIR-ARI*	0.170	0.161	0.152	0.000	0.152	0.151	0.151	0.154	0.155	Continuing	Continuing
F16: *ILIR-SMDC*	0.000	0.489	0.488	0.000	0.488	0.729	0.725	0.965	0.961	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) is utilized to attract and retain top doctoral degreed scientists and engineers at the Army's research organizations. The In-House Laboratory Independent Research (ILIR) program provides a source of competitive funds to Army laboratories to stimulate high quality, innovative research with significant opportunity for payoff to Army warfighting capability. The basic research lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The ILIR program serves as a catalyst for major technology breakthroughs by giving the laboratory directors flexibility in implementing novel research ideas and nurturing promising young scientists and engineers. This PE supports ILIR at the Army Materiel Command's (AMC) six Research, Development, and Engineering Centers (RDECs) (project 91A); at the six Medical Research and Materiel Command (MRMC) laboratories (project 91C); at the Corps of Engineer's seven Engineer Research, and Development Center (ERDC) laboratories (project 91D); at the Army Research Institute for the Behavioral and Social Sciences (ARI) validate new techniques in social network analysis as well as training techniques to enhance expertise and adaptability and decrease training time project (91E); at the Space and Missile Defense Command (SMDC) high energy lasers and directed energy for air and missile defense (project F16).The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.The work in this PE is performed by the Army Materiel Command (AMC), Ft. Belvoir, VA, Army Medical Research and Materiel Command (MRMC), Ft. Detrick, MD, the Army Corps of Engineers Engineer Research, and Development Center (ERDC), Vicksburg, MS, the Space and Missile Defense Command (SMDC), Huntsville, AL, and the Army Research Institute (ARI), Arlington, VA.

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601101A: *In-House Laboratory Independent Research*

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	19.766	19.671	19.686	0.000	19.686
Current President's Budget	19.357	19.568	21.780	0.000	21.780
Total Adjustments	-0.409	-0.103	2.094	0.000	2.094
• Congressional General Reductions		-0.103			
• Congressional Directed Reductions					
• Congressional Rescissions		0.000			
• Congressional Adds		0.000			
• Congressional Directed Transfers					
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	-0.409	0.000			
• Adjustments to Budget Years	0.000	0.000	2.094	0.000	2.094

Change Summary Explanation

FY11 funding increases for Edgewood Chemical Bbiological Center ILIR.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*				PROJECT 91A: *ILIR-AMC*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
91A: *ILIR-AMC*	13.739	14.794	17.205	0.000	17.205	14.376	15.940	16.236	16.521	Continuing	Continuing

A. Mission Description and Budget Item Justification

The project funds basic research within the Army Materiel Command's (AMC) Research, Development, and Engineering Centers and lays the foundation for future developmental efforts by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.The work in this program is performed by the Communications and Electronics Research, Development, and Engineering Center (CERDEC), Ft. Monmouth, NJ, the Armaments Research, Development, and Engineering Center (ARDEC), Picatinny, NJ, the Tank and Automotive Research, Development, and Engineering Center (TARDEC), Warren, MI, the Natick Soldier Research, Development, and Engineering Center (NSRDEC), Natick, MA, the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), Huntsville, AL, and the Edgewood Chemical and Biological Center (ECBC), Aberdeen Proving Grounds, MD within AMC.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	**FY 2010**	**Base FY 2011**	**OCO FY 2011**	**Total FY 2011**
Program #1	1.036	0.919	3.007	0.000	3.007
Edgewood Chemical Biological Center: In FY09, conducted cell toxicity studies using nuclear magnet resonance spectroscopy; investigated hydrogen production from novel bioenergy crops and characterizing the volatile organic compound profiles of bacteria for detection. Investigated electrospun fiber mats as a substrate for surface-enhanced infrared spectroscopy; invested molecule-surface interactions with overtone absorption spectroscopy; developed a themostable platform for single domain antibodies; investigated the synthetic routes to produce TETS (Tetramethylenedisulfotetramine); and used proteomics mass spectrometry to study the discrimination of pathogenic vs. non-pathogenic bacteria. In FY10 investigate recent advances in "panomics" for molecular toxicology; rational molecular design for the design of functional self-organizing supramolecular self-assembly; the complex behavior of mass transport in microporous systems at the nano scale; the application of controlled coherent laser radiation to direct the dynamics of quantum systems; and the characterization of chemical and biochemical phenomena occurring at or near solid surfaces and interfaces. In FY11, ECBC will conduct research in the following areas; fundamental studies in surface science, specifically furthering the characterization of					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
chemical and biochemical phenomena occurring at or near solid surfaces and interfaces; exploring molecular techniques for bio-energy production; rational design of nano- biomolecular abiotic structures; further explore the interaction of matter and energy transfer at the nano-scale; and the synthesis of new nanomaterials for control of electromagnetic energy propagation and to drive photonic behavior. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Armaments RDEC: In FY09, conducted basic research for developing new explosives and smaller warheads for increased lethality and volume reduction, lighter and stronger materials for guns, algorithms for future intelligent munitions using various sensors, and area denial technologies. In FY10, research ways to synthesize more powerful explosives with IM properties, technologies for detection and neutralization of IEDs/explosives, sensors/ sensor fusion for area denial, smaller more lethal warheads and composite materials. In FY11, will conduct further basic research into synthesizing more powerful explosives with IM properties, technologiesproperties; technologies for detection and neutralization of IEDs/explosives, sensors/sensor fusion for area denial, smaller more lethal warheads and composite materials.	1.834	1.628	1.684	0.000	1.684

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91A: *ILIR-AMC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Tank-automotive RDEC: In FY09, recorded real-time polarization images for robotic vehicle terrain perception and signature countermeasure applications; investigated ultra-wide band (UWB) radar development for localizing mobile robots in battlefield scenarios, and explored fuzzy logic clustering algorithms for robotic vehicle stereovision range perception in difficult urban terrain environments. In FY10, develop high performance control algorithms for unmanned ground vehicles in heterogeneous off-road terrain environments; use fuzzy logic C-mean clustering algorithms for vehicle terrain classification; and investigate JP-8 heat release combustion chemistry as a function of cetane number and nozzle geometry. In FY11, will develop reinforcement-based Learning and Control for Robots Using Ethical Behavior Frameworks; will investigate photophysical response measurements for directed energy carbon-60 (C60) colloid materials; and will use event-driven control strategies to couple remote dynamical systems. *FY 2009 Accomplishments:* FY 2009	1.307	1.255	1.201	0.000	1.201

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Natick Soldier RDEC: In FY09, utilized morphology control data results to make initial selections of methodology to verify ability to regulate nanoscale characteristics, identified nanomaterials (metal or dielectrics) and developed preliminary design for nanorectenna array for converting visible/near-infrared light to direct current for photonic applications and derived a fundamental understanding of how immobilization influences the antimicrobial peptide mechanisms of lytic behavior for Soldier protection against pathogens. In FY10 solicit new concepts for basic research efforts with broad applicability to science and technology that enable advancement of developments such as electro-textiles, multifunctional fibers, advanced nutrient delivery, performance enhancing biomechanics and precision airdrop systems. In FY11, will continue fundamental research of nanoelectronics that has the potential to provide new nanomaterials and nanoarchitectures that could help revolutionize the performance and miniaturization of optoelectronic devices; will further the understanding of fundamental principles which govern Botulinim Neurotoxin catalytic activity and binding of peptide and aptamers to this catalytic domain that may lead to new technologies which couple toxin capture and inactivation. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.441	1.384	1.323	0.000	1.323

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Aviation and Missile RDEC Missile Efforts: In FY09, demonstrated new mechanism for transmission of light through an absorptive semiconductor, demonstrated first use of symbolic dynamical model for chaotic, high-dimensional turbulent flow, demonstrated performance of ZnO-based phosphor for lighting and combat ID, developed THz spectroscopic imager for non-destructive testing and stand-off agent detection. In FY10, explain why complex networks can respond consistently to external signals, explore phase locked harmonic generation of light, demonstrate quantum EM field sensor, and demonstrate THz holographic imaging of obscured object/IED. In FY11, will solicit new concepts for basic research efforts with broad applicability to science and technology that support exploratory and advanced development for guided missile and rocket systems, directed energy weapons, unmanned vehicles, and related components. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	2.441	2.346	2.243	0.000	2.243

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #6	1.769	1.698	1.623	0.000	1.623
Aviation and Missile RDEC Aviation Efforts: In FY09, wind tunnel tested advanced airfoil aerodynamics for passive rotor performance improvement, investigated phenomenon and assessed computational fluid dynamics, accuracy using existing data for pitching airfoil double dynamic stall events, investigated the behavior of fluidic oscillators. In FY10 conduct dynamic stall testing of advanced active and passive concepts with an emphasis on the fundamental flow physics of unsteady separation of turbulent boundary layers, develop microscopic particle image velocimetry for identification of flow reversal and separation in unsteady turbulent boundary layers, develop an analytical framework that enables the systematic evaluation of autonomous UAV path planning algorithms. In FY11, will investigate the effectiveness of fluidic oscillators to control separation for bluff body flows, will initiate computational fluid dynamics and computational structural dynamics methods for accurate rotor stability analysis. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #7	1.619	1.436	1.487	0.000	1.487
Communications-Electronics RDEC: In FY09, investigated novel means of creating wideband high-dielectric Electromagnetic Metamaterials using carbon nanotubes for use in designing future generations of antennas; investigated a new family of polymer based electrolyte materials (required to be ionically conductive and					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
both chemically and electro-chemically stable to voltages greater than 5.0 Volts) for advanced lithium high energy electrochemical couples; conducted basic research on the pseudo noise modulation of radar wave forms; developed a novel approach for lower defect IR detector materials by investigating lattice phonons and electrons interactions within a sensor material, such as HgCdTe. In FY10 investigate new metamaterial to significantly improve antenna signature and power handling capacity and conduct research in network science to investigate novel neural management tools for optimum network performance; research separator-electrolyte sub-components for high voltage electrochemical cells; develop a novel approach for extensions of advanced signal processing from a cooperative regime (known parameters) to a non-cooperative regime. In FY11 will investigate new anode and cathode materials for electrochemical couples with increased kinetic properties; will perform experimental validation of the derived theoretical limits of EO interference cancelation systems intended to enable communications during jamming; will perform experimental validation of new cognitive radio techniques for blind signal interception; will investigate fundamental parameters affecting Shockley-Reed-Hall (SRH) defect centers in narrow gap infrared (IR) semiconductors (e.g. III-V and II-VI epitaxial compounds), will research and investigate novel conducting polymers for use as explosive specific sensors and as low power displays, will explore new measurement methodologies (e.g. catholuminescence) for studying IR detector defects at the atomic level. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91A: *ILIR-AMC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #8	2.292	3.845	4.637	0.000	4.637
Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY09, solicited new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems. In FY10, award 5 new projects in Network/Internet optimization of detection capabilities; Infrared (IR) detectors and focal plane arrays (FPAs) for night vision, surveillance, target acquisition, searching, tracking and missile seeking; effect of vortex interactions not only on the tip vortex formation, but also on the lift and drag aircraft wings.In FY11, will solicit new basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research and apply them to Army problems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #9	0.000	0.283	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	13.739	14.794	17.205	0.000	17.205

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*				PROJECT 91C: *ILIR-MED R&D CMD*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
91C: *ILIR-MED R&D CMD*	4.053	3.009	2.860	0.000	2.860	2.817	2.809	2.858	2.906	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to address investigator-driven medical and force health protection basic research initiatives performed at the six US Army Medical Research and Materiel Command laboratories. Research areas address countermeasures against infectious diseases, defense against environmental extremes and operational hazards to health, mechanisms of combat trauma and innovative treatment and surgical procedures, and medical chemical/biological warfare threats.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; US Army Medical Research Institute of Chemical Defense (USAMRICD), Aberdeen Proving Ground, MD; US Army Medical Research Institute of Infectious Diseases (USAMRIID), Fort Detrick, MD; US Army Institute of Environmental Medicine (USARIEM), Natick, MA; US Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; and US Aeromedical Research Laboratory (USAARL), Fort Rucker, AL.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	**FY 2010**	**Base FY 2011**	**OCO FY 2011**	**Total FY 2011**
Program #1	3.075	2.425	2.860	0.000	2.860
Independent Research Efforts: In FY09, the ILIR program funded innovative in-house basic research proposals that focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; and mechanisms of combat trauma and innovative treatment and surgical procedures. In FY10 and FY11, the program will fund innovative in-house basic research proposals that will focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; mechanisms of combat trauma and innovative treatment and surgical procedures, and medical chemical/biological warfare threats.					
FY 2009 Accomplishments: FY 2009					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91C: *ILIR-MED R&D CMD*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Peer Reviewed Proposal efforts: In FY09, solicited new and continuing basic research efforts aimed at developing and maintaining a cadre of active basic research scientists who can initiate new research as well as extend results from worldwide research and apply them to Army problems. In FY10, continue ongoing awarded innovative basic research activities and continue to solicit new innovative medical and force protection basic research efforts in support of Army needs. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.978	0.503	0.000	0.000	0.000
Program #3	0.000	0.081	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91C: *ILIR-MED R&D CMD*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	4.053	3.009	2.860	0.000	2.860

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91D: *ILIR-CORPS OF ENGR*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
91D: *ILIR-CORPS OF ENGR*	1.395	1.115	1.075	0.000	1.075	1.066	1.067	1.088	1.107	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds In-house Laboratory Independent Research (ILIR) in the areas of geospatial research and engineering, military engineering, and environmental quality/installations at the seven laboratories within the Corps of Engineer's Engineering Research and Development Center. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.The work in this project is performed by the U.S. Army Engineer Research and Development Center (ERDC), at Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.190	1.098	1.075	0.000	1.075

Geospatial Research and Engineering/Military Engineering/Environmental Quality and Installations: In FY09, conducted research to determine factors influencing partitioning and ecological risk of military unique nanomaterials in the environment. In FY10 investigate reduction potentials for military compounds through the application of computationally feasible approximations for predicting reduction-oxidation reaction potentials of explosives and their environmental transformation products. Determine whether mineral surfaces or surface chemical processes can be exploited to promote the adsorption and transformation of nitroaromatic compounds and other explosives munitions on military training, testing and demolition ranges. In FY11, will investigate a set of theoretical algorithms for poly-disperse soil packings based upon historical granular research and using simulations to validate performance; and continue basic research efforts focused on fundamental questions in science relevant to military application such as signature physics, next generation remote sensing, and ecological risk of military unique emerging contaminates in the environment.

FY 2009 Accomplishments:
FY 2009

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Peer reviewed proposal efforts: Proposal efforts will be selected near the start of each fiscal year through competitive applications among the Army laboratories with ILIR funding. Selections are based on an outside independent peer review of the proposals. The intent to provide increased quality and responsiveness in exploring in basic research new technological concepts that are highly relevant to Army needs. This funding will also enhance recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army which will bring a constant flow of new knowledge to our laboratories. In FY09, sought new and continuing basic research efforts focused on fundamental questions in science that relate to U.S. Army requirements such as network science. Beginning in FY10, this effort is funded in project 91A. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.205	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.017	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	1.395	1.115	1.075	0.000	1.075

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
91E: *ILIR-ARI*	0.170	0.161	0.152	0.000	0.152	0.151	0.151	0.154	0.155	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides funding for In-house Laboratory Independent Research (ILIR) in the Army Research Institute. This project supports basic research in the Cognitive Sciences is focused on theories, approaches, and models from the Behavioral and Social Sciences that have the highest potential to improve human performance. Improved recruiting, selection, assignment, training, leader development, performance, performance assessment, organizational dynamics, and retention are the goals. Work in this project is performed by the Army Research Institute.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.170	0.157	0.152	0.000	0.152
Army Research Institute: In FY09: identified training strategies that will help Soldiers recognize challenges that require novel solutions and to adapt their behavior to overcome such challenges. In FY10, identify relevant variables for longitudinal modeling of career performance using latent curve analysis. FY11: will identify key training aspects of synthetic teammates in virtual worlds that will promote training transfer to a team performance setting.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					
Base FY 2011 Plans: FY 2011 Base					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT 91E: *ILIR-ARI*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #2	0.000	0.004	0.000	0.000	0.000
Small Business Innovative Research/Small Business Technology Transfer Program *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.170	0.161	0.152	0.000	0.152

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT F16: *ILIR-SMDC*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
F16: *ILIR-SMDC*	0.000	0.489	0.488	0.000	0.488	0.729	0.725	0.965	0.961	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to provide funding for In-house Laboratory Independent Research (ILIR) in the Space and Missile Defense Command Technical Center. This basic research on lasers and directed energy lays the foundation for future developmental efforts on high energy lasers and directed energy systems for missile defense by identifying the fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan.Work in this project is performed by the Army Space and Missile Defense Command (SMDC), Huntsville, AL.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.000	0.476	0.488	0.000	0.488
Adaptive optics algorithms and approaches for future directed energy weapon systems.In FY10, investigate beam propagation codes versus real laser beam propagation down an open air range to improve the accuracy of beam propagation codes and understanding of the impact that various atmospheric phenomena have, to include a detailed mapping of the beam path unrivaled to date via Schlieren, optical sensors, and weather metrology data; conduct an experiment implementing quantum optics rather than classical optics for beam propagation to compare the two approaches for computational ease, accuracy, and time requirements; and set up a laboratory tabletop version of a high energy laser adaptive optic system and develop algorithms for sensing and correcting for atmospheric distortion in open loop (without a wavefront sensor or beacon). In FY11, will use prior year data to develop more complex beam propagation experimentation to improve the beam propagation knowledge, codes, and algorithms for Adaptive Optics (AO) systems for directed energy weapons; will begin scaling to higher powers using a 2 KW fiber laboratory laser.					
FY 2009 Accomplishments: FY 2009					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 SBIR/STTR *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.013	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	0.000	0.489	0.488	0.000	0.488

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT F16: *ILIR-SMDC*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	193.968	197.471	195.845	0.000	195.845	188.160	207.424	216.332	227.412	0	1,622.457
305: *ATR RESEARCH*	2.272	2.366	2.401	0.000	2.401	2.433	2.462	2.508	2.554	Continuing	Continuing
31B: *INFRARED OPTICS RSCH*	2.543	2.662	2.721	0.000	2.721	2.787	2.831	2.887	2.946	Continuing	Continuing
52C: *MAPPING & REMOTE SENS*	2.674	2.773	2.841	0.000	2.841	2.915	2.979	3.038	3.097	Continuing	Continuing
53A: *BATTLEFIELD ENV & SIG*	3.003	3.200	3.341	0.000	3.341	3.435	3.530	3.611	3.697	Continuing	Continuing
74A: *HUMAN ENGINEERING*	4.973	5.673	6.971	0.000	6.971	6.711	7.710	7.836	8.068	Continuing	Continuing
74F: *PERS PERF & TRAINING*	5.588	5.829	5.549	0.000	5.549	5.766	7.023	7.148	7.266	Continuing	Continuing
F20: *ADV PROPULSION RSCH*	3.299	3.331	3.429	0.000	3.429	3.496	4.193	4.272	4.355	Continuing	Continuing
F22: *RSCH IN VEH MOBILITY*	0.547	0.564	0.576	0.000	0.576	0.588	0.601	0.612	0.624	Continuing	Continuing
H42: *MATERIALS & MECHANICS*	5.722	6.009	6.975	0.000	6.975	7.461	8.676	8.835	8.990	Continuing	Continuing
H43: *RESEARCH IN BALLISTICS*	7.995	8.208	8.318	0.000	8.318	8.463	9.224	9.395	9.563	Continuing	Continuing
H44: *ADV SENSORS RESEARCH*	6.112	6.343	9.695	0.000	9.695	7.005	7.623	7.769	7.912	Continuing	Continuing
H45: *AIR MOBILITY*	2.298	2.361	2.399	0.000	2.399	2.449	2.497	2.543	2.588	Continuing	Continuing
H47: *APPLIED PHYSICS RSCH*	2.841	2.940	5.009	0.000	5.009	3.077	3.167	3.228	3.290	Continuing	Continuing
H48: *BATTLESPACE INFO & COMM RSC*	8.814	11.374	13.685	0.000	13.685	14.726	17.816	18.285	18.890	Continuing	Continuing
H52: *EQUIP FOR THE SOLDIER*	0.978	1.030	1.078	0.000	1.078	1.105	1.134	1.158	1.181	Continuing	Continuing
H57: *Single Investigator Basic Research*	63.397	64.649	73.075	0.000	73.075	68.663	75.881	82.178	90.434	Continuing	Continuing
H66: *ADV STRUCTURES RSCH*	1.711	1.808	1.889	0.000	1.889	1.942	1.996	2.040	2.089	Continuing	Continuing
H67: *ENVIRONMENTAL RESEARCH*	0.906	0.941	0.967	0.000	0.967	0.997	1.018	1.039	1.072	Continuing	Continuing

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification									DATE: February 2010		
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H68: *PROC POLLUT ABMT TECH*	0.420	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
S04: *MIL POLLUTANT/HLTH HAZ*	0.701	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
S13: *SCI BS/MED RSH INF DIS*	10.747	10.481	10.652	0.000	10.652	10.900	11.121	11.348	11.544	Continuing	Continuing
S14: *SCI BS/CBT CAS CARE RS*	6.067	6.505	6.818	0.000	6.818	7.049	7.725	7.860	7.990	Continuing	Continuing
S15: *SCI BS/ARMY OP MED RSH*	9.374	7.083	8.839	0.000	8.839	9.381	10.338	10.531	10.723	Continuing	Continuing
S19: *T-MED/SOLDIER STATUS*	0.729	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*	25.085	20.573	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
T22: *SOIL & ROCK MECH*	2.208	2.299	2.358	0.000	2.358	2.426	2.481	2.531	2.581	Continuing	Continuing
T23: *BASIC RES MIL CONST*	1.688	1.761	3.839	0.000	3.839	1.901	1.970	2.005	2.042	Continuing	Continuing
T24: *Signature Physics and Terrain State Basic Research*	1.451	1.513	1.573	0.000	1.573	1.616	1.660	1.693	1.727	Continuing	Continuing
T25: *Environmental Science Basic Research*	5.980	7.917	8.106	0.000	8.106	8.234	8.562	8.719	8.870	Continuing	Continuing
T61: *Basic Research Initiatives - MRMC (CA)*	2.392	4.775	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
T63: *ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH*	1.453	1.224	1.463	0.000	1.463	1.457	1.935	1.969	2.001	Continuing	Continuing
T64: *SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE*	0.000	1.279	1.278	0.000	1.278	1.177	1.271	1.294	1.318	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) fosters fundamental scientific knowledge and contributes to the sustainment of US Army scientific and technological superiority in land warfighting capability and military problems related to long-term national security needs, provides new concepts and technologies for the Army's future force, and provides the means to exploit scientific breakthroughs and avoid technological surprises. The PE fosters innovation in Army niche areas (such as lightweight armor, energetic materials, night vision) and areas where there is no commercial investment due to limited markets (e.g., vaccines for tropical diseases). It also focuses university single investigator research on Army areas of interest, such as

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification	DATE: February 2010
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high-density compact power and novel sensor phenomenologies. The in-house portion of the program capitalizes on the Army's scientific talent and specialized facilities to transition knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry. The work in this PE is coordinated and integrated between four primary contributors: 1) the Army Research, Development, and Engineering Command (RDECOM); 2) the US Army Engineer Research and Development Center (ERDC); 3) the Army Medical Research and Materiel Command (MRMC) laboratories; and 4) the Army Research Institute for Behavioral and Social Sciences (ARI). The basic research program is coordinated with the other Services via Defense Basic Research Advisory Group and other inter-Service working groups.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this PE is primarily managed by: the US Army Research Laboratory (ARL), Adelphi, MD and RDECOM, Aberdeen, MD; the Medical Research and Materiel Command (MRMC), Ft. Detrick, MD; the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS; and the US Army Research Institute for the Behavioral and Social Sciences (ARI), Arlington, VA.

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	198.103	173.024	183.403	0.000	183.403
Current President's Budget	193.968	197.471	195.845	0.000	195.845
Total Adjustments	-4.135	24.447	12.442	0.000	12.442
• Congressional General Reductions		-1.033			
• Congressional Directed Reductions					
• Congressional Rescissions		0.000			
• Congressional Adds		25.480			
• Congressional Directed Transfers					
• Reprogrammings	-0.425	0.000			
• SBIR/STTR Transfer	-3.710	0.000			
• Adjustments to Budget Years	0.000	0.000	12.442	0.000	12.442

Change Summary Explanation

FY10 Congressionally directed increases.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
305: *ATR RESEARCH*	2.272	2.366	2.401	0.000	2.401	2.433	2.462	2.508	2.554	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides automatic target recognition (ATR) research to enhance the effectiveness of Army systems while simultaneously reducing the workload on the Soldier. This project focuses on the fundamental underpinnings of aided and unaided target detection and identification techniques for land warfare scenarios including tagging, tracking, and locating (TTL) of non-traditional targets. This research enables Army systems that can act independently of the human operator to detect and track targets including clandestine tracking of non-cooperative targets. Such capabilities are needed for smart munitions, unattended ground sensors, and as replacements for existing systems, such as land mines. Critical technology issues include low depression angle, relatively short range, and highly competing clutter backgrounds. The resulting research will provide fundamental capability to predict, explain, and characterize target and background signature content, and reduce the workload on the analyst. This research is aimed at evaluating the complexity and variability of target and clutter signatures and ultimately utilizing that knowledge to conceptualize and design advanced ATR paradigms to enhance robustness and effectiveness of land warfare systems. ATR research strategies include emerging sensor modalities such as spectral and multi-sensor imaging. This research supports several technology efforts including multi-domain smart sensors, third generation Forward Looking Infrared (FLIR), and advanced multi-function laser radar (LADAR). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.286	1.320	1.387	0.000	1.387
ATR Algorithms: Investigate new algorithms to improve aided/unaided target detection and identification. In FY09, researched novel behavior characterization algorithms for color and FLIR video; researched methods to develop ATR algorithms that exploit the fusion of disparate spatial views of a target for unattended ground sensor (UGS) network applications; and designed advanced nonlinear band selection methods and implemented new hyperspectral algorithms based on the selected bands. In FY10, enhance hyperspectral anomaly detections and validate rapid reconstruction of hyperspectral images by using 3D compressed sensing techniques; and develop novel fusion detection and classification algorithms based on kernel learning theory. In FY11, will develop					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
restoration techniques for atmospheric turbulence distorted imagery and new anomaly detection algorithms based on novel computational imaging methods. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 TTL: Conduct basic research to support advances in state-of-the-art clandestine TTL for non-traditional hostile force and non-cooperative targets. Specific technical objectives, products, and deliverables are in accordance with the Hostile Forces TTL Capabilities Development Document and the TTL Science and Technology Roadmap. This effort will directly support ARL's efforts in applied research and the Communications-Electronics Research, Development, and Engineering Center's advanced research in clandestine TTL In FY09, began to prove technologies selected for further exploration. This includes both device and algorithm development. In FY10, explore RF techniques and technologies for TTL, investigate advances in RF Integrated Circuits for an RF Tag and model an enhanced IR Tag. In FY11, will fabricate a RF tag sample and validate an enhanced capability in hyperspectral target detection for tracking & locating. *FY 2009 Accomplishments:* FY 2009	0.986	1.010	1.014	0.000	1.014

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 305: *ATR RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.036	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.272	2.366	2.401	0.000	2.401

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 305: *ATR RESEARCH*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 31B: *INFRARED OPTICS RSCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
31B: *INFRARED OPTICS RSCH*	2.543	2.662	2.721	0.000	2.721	2.787	2.831	2.887	2.946	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports Army research in materials and devices for active and passive infrared (IR) imaging systems and radio frequency (RF) photonics. This research aims to generate new technologies for unprecedented battlefield situational awareness and to continue the dominance of Army units during night operations. To achieve these objectives, IR focal plane arrays (FPAs), and interband cascade lasers (ICLs) with significantly improved performance, lower cost, and increased operating temperatures are required. This research has direct application to Army ground vehicles, aviation platforms, weapon systems, and the individual Soldier. Research is focused on material growth, detector and laser design, and processing for large area multicolor IR FPAs and interband cascade lasers. The principal efforts are directed towards novel materials for detectors and lasers, and investigating energy band-gap structures in semi-conductor materials to enhance the performance of lasers and IR FPAs. In the Area of RF Photonics near-IR modeling and nanofabrication techniques are applied to the design and fabrication of IR photonic-crystal waveguide structures having customized IR properties. Micro Electro Mechanical System (MEMS) configurations are incorporated into the photonic-crystal waveguide structures to enable reconfigurable IR waveguide properties. Customized IR photonic materials and components in conjunction with fiber optic interconnects are applied to the control of microwaves. The technical goals are to manage and control defects in the raw, unprocessed materials, maintaining quality control in the fabrication of the devices and arrays, limiting introduction of impurities in the material, surface passivation of the devices so that they are resistant to degradation over time and thermal management, particularly as it applies to interband cascade lasers. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.543	2.651	2.721	0.000	2.721
Increase situational awareness in open and complex terrain; improve target detection, identification, and discrimination; and enhance IR countermeasure (IRCM) protection against missile threats. In FY09, researched frequency modulated IR lasers for covert communication applications, fabricated high operating temperature Long Wave Infrared (LWIR) Type detector arrays. Investigated dilute Nitride materials. Designed and researched chip-scale integrated IR-photonic circuit based on the reconfigurable photonic crystal-MEMS waveguide devices; and assembled innovative fiber optic circuits with a patented new concept in photonic crystals for microwave					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 31B: *INFRARED OPTICS RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
true-time-delay applications. In FY10, utilize fiber optic integrated circuits to improve mode control of ultra-low-noise microwave oscillator. Improve LWIR superlattice quantum efficiency and lifetime at higher operation temperature. In FY11, fiber-optic RF-photonic techniques will be applied to the advancement of opto-electronic processing of military signals. Will validate large area dual color LWIR/Midwave Infrared detector arrays. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	0.011	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 31B: *INFRARED OPTICS RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	2.543	2.662	2.721	0.000	2.721

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 52C: *MAPPING & REMOTE SENS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
52C: *MAPPING & REMOTE SENS*	2.674	2.773	2.841	0.000	2.841	2.915	2.979	3.038	3.097	Continuing	Continuing

A. Mission Description and Budget Item Justification

This basic research project increases knowledge of the terrain with a focus on improving the generation, management, analysis/reasoning, and modeling of geospatial data, and the exploitation of multi-sensor data. This fundamental knowledge forms the scientific "springboard" for the future development of applications, techniques, and tools to improve the tactical commander's knowledge of the battlefield. Results of this research are used to extract and characterize natural and man-made features from reconnaissance imagery in near-real time; to exploit terrain analysis and reasoning techniques; and to explore the potential of space technology and tactical geospatial sensor technology to provide real-time terrain intelligence, command and control, and targeting support. This research exploits terrain and environmental data to improve situational awareness and enhance information dominance, leading to increased survivability, lethality, and mobility. The research provides the theoretical underpinnings for PE 0602784A (Military Engineering Technology), project 855 (Mapping and Remote Sensing). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.674	2.748	2.841	0.000	2.841
Sensor Phenomenology and Spatial-Temporal Pattern Discovery: In FY09, created recoverable semiconductor particles based on paramagnetic properties for distributed robotic sensing, and examining the quantum confined Stark Effect exhibited in nanoscale wires as a new chemical, biological, radiological, nuclear, and explosive (CBRNE) detection scheme. Also, creating a new taxonomy for multi-scale spatial-temporal cascade patterns. In FY10, examine the synthesis of high quantum yield optical reporters for remote sensing. Also, will create new interest measures for multi-scale spatial-temporal cascade patterns. In FY11, will explore the relationship of magnetic core nanomaterials and the stand-off recovery of these materials as sensors using Surface-Enhanced Raman Scattering (SERS). Also, will investigate social network concepts to better assess important interaction within and between our adversaries, directly relating objects, events, actions, and trajectories to spatial-temporal dimensions.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 52C: *MAPPING & REMOTE SENS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.025	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.674	2.773	2.841	0.000	2.841

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 52C: *MAPPING & REMOTE SENS*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 53A: *BATTLEFIELD ENV & SIG*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
53A: *BATTLEFIELD ENV & SIG*	3.003	3.200	3.341	0.000	3.341	3.435	3.530	3.611	3.697	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides an in-depth understanding of the complex atmospheric boundary layer associated with high-resolution meteorology, the transport, dispersion, optical properties, and characterization of chemical and biological aerosols, and the propagation of full-spectrum electro-magnetic and acoustic energy. The future force will operate in very complex environments (e.g. urban and mountainous terrain) requiring new approaches to understanding, characterizing, and depicting microscale atmospheric phenomena. The lack of a complete understanding of the meteorological aspects of the complex microscale boundary layer in which the Army operates continues to impact our abilities to provide accurate and timely tactical weather intelligence to battlefield commanders. This project focuses on boundary layer meteorology especially over open, complex and urban terrain. It supports the future Army through formulation of novel capabilities and techniques in such areas as characterization of urban turbulence for its effects on platforms and payloads, high resolution urban wind modeling, the characterization of aerosols for force protection and soldier health, the characterization and identification of bio-warfare agents, atmospheric effects on acoustic wave propagation in urban domains, electro-optic propagation modeling techniques for improved target detection and acquisition, and formulation of objective analysis tools that can assimilate on-scene weather observations and fuse this information with forecasts to provide immediate Nowcast products. These capabilities will have a direct impact on ensuring Soldier survivability, weapon system lethality, effective surveillance and reconnaissance, and the mobility required for future Warfighter operations. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.896	1.995	1.976	0.000	1.976
Research in optical and acoustical propagation in the atmosphere for enhanced Intelligence, Surveillance, and Reconnaissance capabilities for the future force to support situational understanding and rapid targeting. In FY09, devised and employed a model for illumination effects of clouds on night vision devices to improve prediction of range limits, analyzed the measurements of heated aerosol particle laser induced fluorescence spectra to enhance identification, investigated techniques for classification of non-spherical aerosol particles for improved chem/bio aerosol identification, and investigated effects of multiple urban structures on sound fields to enhance detection and targeting. Developed building effects parameterizations for acoustic models. In FY10, design algorithms for					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 53A: *BATTLEFIELD ENV & SIG*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
atmospheric propagation of acoustic signatures in urban and complex terrain. Develop processing techniques for enhancing target contrast and minimizing background clutter for infrared polarimetric imagery. Measure Raman spectra of individual particles. In FY11, will develop acoustic propagation algorithms for complex urban domains accounting for multiple building structure effects. Exploit broader frequency acoustic propagation including ultrasound. Investigate and employ the capabilities of Two-dimensional Angular Optical Scattering (TAOS) and Ultra Violet-Laser Induced Fluorescence (UV-LIF) technologies for the characterization of hazardous particles in the atmosphere. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Increase survivability and improve situational awareness through research to enhance accuracy of predictive modeling of the boundary layer and improve the ability to function effectively "anyplace and anytime". In FY09 investigated methods to solve problems encountered in computing wind flows for steep terrain and across large elevation differences by introducing immersed boundary methods and vertical coordinate stretching; investigated spectral analysis of measured urban meteorological profiles to produce new wake parameterizations to improve the high resolution urban wind model. Investigated water vapor fluctuation spectra influenced by urban boundary layer for propagation effects on sensor performance and imaging capabilities. Measured and characterized the	1.107	1.201	1.365	0.000	1.365

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 53A: *BATTLEFIELD ENV & SIG*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
length scale transitions from 3D isotropic to 2D non-isotropic turbulence in the atmospheric surface layer for their effects on propagation and micro air vehicles. In FY10, investigate methods for optimizing aircraft routes in adverse weather conditions; extend physics-based version of the 3 dimensional wind field (3DWF) microscale wind model to improve fidelity for simulation and prediction of wind fields in urban and complex terrain. In FY11, will devise ensemble modeling techniques leading to fine-scale battlefield probabilistic weather and effects forecasting; will produce improved theory and approach to modeling turbulence based on sonic anemometer array field evaluations for more accurate and realistic effects in propagation and turbulence models; and improve microscale wind modeling in complex terrain using advances in high-performance computing technology and computational acceleration using general-purpose graphical processing units. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs. *FY 2009 Accomplishments:* FY 2009	0.000	0.004	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 53A: *BATTLEFIELD ENV & SIG*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	3.003	3.200	3.341	0.000	3.341

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
74A: *HUMAN ENGINEERING*	4.973	5.673	6.971	0.000	6.971	6.711	7.710	7.836	8.068	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project focuses on improving Soldier-system performance in future force environments. Research is on key underlying Soldier performance phenomena such as judgment under uncertainty; echo-location and distance-estimation under degraded conditions; extending and protecting auditory and cognitive performance; human performance in automated, mixed-initiative (human control-machine control) environments; associated neurological dynamics; communications in hearing-degraded conditions; collaborative (team) and independent multi-task, multi-modal, multi-echelon Soldier-system performance, all cast against the influx of emerging Transformation-driven technological solutions and opportunities. Technical barriers include lack of methods for describing, measuring, and managing the interplay of these relatively novel phenomena in the consequent task due to situational complexity and ambiguity that characterize operations in the future force. Technical solutions are being pursued in the areas of data generation and algorithm development in these emerging environments in order to update and improve our understanding of performance boundaries and requirements. These solutions include multi-disciplinary partnerships, metrics, simulation capabilities, and modeling tools for characterizing Soldier-system performance, and provide a shared conceptual and operational framework for militarily relevant research on cognitive and perceptual processes. In the area of neuroergonomics, the study of the brain at work, research is carried out to examine leading edge methodologies and technologies to improve cognitive and behavioral performance, particularly under high stress conditions and to assess how neural pathways implicated in functional processing can be enhanced to improve the training of Soldiers in an operational context. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.438	1.308	1.991	0.000	1.991
Research to characterize and enhance Soldier performance: In FY09, investigated synergy between bone conduction (BC) and tactile communication for military applications. Formulated an algorithm for predicting localization error due to headgear. In FY10, investigate and determine optimum ear coverage by infantry helmets. Devise binaural criterion of speech intelligibility. In FY11, will determine neurological pathways of BC sounds. Will conduct initial experiments to quantify the contributions of visual, auditory, tactile, olfactory, kinesthetic					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
and narrative factors to an individual Soldier's immersive experiences; will develop measures to capture how individuals perceive the effectiveness/contribution of immersion in simulation environments. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Soldier performance. In FY09, used computer modeling/social network analyses to study Soldier decision-making to examine quality of information flow in defined command & control structures; conducted follow-on study to explore valid robot lexicon for human-robot communication; began research to determine important variables for human-robot teams control; investigated effect of information quality on low-level decision making. In FY10, conduct investigations of situational understanding & prediction in uncertain environments; identify usability deficiencies & mismatches between battle command processes & technology enhancements; further investigate the effects of information presentation on the Soldier's ability to perceive information. In FY11, will begin development of cognitive models predictive of team decision making; will continue work on determining effects of information quality and presentation on Soldier system performance. *FY 2009 Accomplishments:* FY 2009	2.048	2.181	2.294	0.000	2.294

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Research in Neuroergonomics: Enable systems designs that are consistent with human brain function, taking into account its limitations and exploiting its potentials, to maximize Soldier performance. In FY09, investigated novel approaches to capture brain activity and Soldier behavior in complex, dynamic operationally-relevant environments, examined differences in neural processes between individuals, and explored the neural processes underlying visual scanning. In FY10, explore the feasibility of using dry, wireless neurophysiological sensors suitable for high-density arrays in operationally-relevant environments; identify and model specific neural processes underlying visual scanning and target identification. In FY11, will advance the state-of-the-art in data analytic capabilities to extract brain-relevant information from multi-dimensional data arrays obtained in operationally-relevant contexts; will validate models of neural mechanisms underlying visual scanning and explore the neural processes underlying human interaction with autonomous systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.487	1.078	1.551	0.000	1.551

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Cognition and Neuroergonomics: Devise and show fundamental translational principles for neuroscience-based research and theory to complex operations settings in three focus areas: Soldier-system information transfer, commander-level decision making, and individualized analysis and assessment of cognitive performance in operational environments. In FY10, investigate perceptual-motor interactions, including those between sensory-perceptual channels and motor systems; explore the complex effects of information quality and quantity on physical and cognitive performance; explore the neural representations of command-level decision making through identification of information representation; examine factors leading to successful or faulty decisions, including biases, heuristics, implicit versus explicit knowledge, context and stressor; identify key individual differences and stressors and investigate their impact on neural processing and cognitive performance; explore the appropriate neuro-sensing approaches for assessment in operational environments.In FY11, will explore models of information presentation, including multi-modal and adaptive displays; will examine the effects of information systems on physical and cognitive performance; will examine how the nervous system filters large-scale, multi-dimensional data sets for decision making; will identify individual differences in neural processing underlying successful and unsuccessful decision making; will identify key individual differences and stressors and investigate their impact on neural processing and cognitive performance; will explore the appropriate neuro-sensing approaches for assessment in operational environments; will explore methods for state detection and signal processing techniques for signal integration; will develop static algorithms that account for the variability in individual differences and/or environmental stressors on performance. *FY 2009 Accomplishments:* FY 2009	0.000	1.069	1.135	0.000	1.135

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.037	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	4.973	5.673	6.971	0.000	6.971

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74A: *HUMAN ENGINEERING*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74F: *PERS PERF & TRAINING*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
74F: *PERS PERF & TRAINING*	5.588	5.829	5.549	0.000	5.549	5.766	7.023	7.148	7.266	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds behavioral and social science basic research in areas with high potential to improve personnel selection, training, leader development, human performance, and the human and social dynamics of network operations. Research covers areas such as assessment of practical intelligence as an aptitude that can be measured across job domains; identifying principles and potential methods for training and sustaining complex tasks arising from digital, semi-automated, and robotic systems requirements; identifying potential methods for faster learning, improved skill retention, and adaptable transfer of training to new tasks; identifying likely methods for developing leader adaptability and flexibility and for speeding the maturation process; discovering and testing the basic cognitive principles that underlie effective leader-team performance; understanding the role of emotions in regulating behavior; extending social network theory to assist in training effectiveness for counter insurgency operations; and improving the match between Soldier skills and their jobs to optimize performance. Research is focused on fundamental issues that will improve the Army's capability to: (1) select, classify, train, and/or develop Soldiers and leaders who are adaptable in novel missions and operational environments, can function effectively in digital, information rich, and semi-autonomous environments, can effectively collaborate in quickly formed groups and when distributed in high stress environments, and possess interpersonal and intercultural skills and attributes relevant to Joint-Service and multi-national operations; (2) accelerate the training of leadership, interpersonal, and emotional skills that traditionally develop over long periods of time and through direct experience; and (3) support the Army's new Network Science initiative by focusing on the human cognitive and social domains - understanding individual, unit, and organizational behavior within the context of complex networked environments that will be essential for synergy between technology and human performance. Research in this project is related to and fully coordinated with efforts funded in PE 0602785A, project 790 (Personnel Performance and Training Technology).The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Defense of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the US Army Research Institute for the Behavioral and Social Sciences (ARI), Arlington, VA.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	3.633	3.768	3.764	0.000	3.764
Human Behavior: In FY09: identified and measured individual attributes and learning principles that foster adaptive performance and promote rapid adaptability skill acquisition and retention; developed a new, culture free measure of self-control that will allow prediction of achievement above and beyond cognitive ability; and matured theoretical framework for addressing the human dimension for training and enhanced performance, Soldier					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74F: *PERS PERF & TRAINING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
retention, productivity, and organizational citizenship. In FY10: achieve a better understanding of the interplay between cognition and emotion in training, performance, and socio-cultural interactions; link training methods and learning principles to performance such that they can be incorporated into models that predict job performance and could be used to improve immersive training environments that are tailorable to the individual needs of learners; systematically examine how nonverbal behaviors are encoded and decoded in human communications in a variety of settings (in particular, we will be concerned with training, leadership, and negotiation types of settings); and determine whether and how nonverbal behaviors affect outcomes in these environments. In FY11, will continue basic research in the areas of psychological measures of individual abilities, implicit and explicit learning, cognition, and social influence. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Network-Human Science: In FY09, conducted research on modeling and simulation of the human use of networks, communication, and command and control technologies to create semantic networks of common sense knowledge in tactical military settings; created new technologies to integrate the human, biological, mathematical, and engineered domains of network science, to extract higher level principles that illuminate each domain in new ways; and explored the regularities of networked social behavior within massively multi-	1.955	1.908	1.785	0.000	1.785

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
user online environments as simulations of real behavior. In FY10, create new computational measures of leadership and organizational expertise in on-line networks and distinguish novices from experts in order to rate the reliability of the contributed information; and match those needing information to those who are able to share it to investigate the dynamics that foster a thriving online community. In FY11, will continue basic research on variables that influence the interaction of individuals and teams within distributed environments. In all years, research will be done in collaboration with the Army Research Laboratory and Army Research, Development, and Engineering Centers and with researchers at the Army's University Affiliated Research Centers, i.e., the Institute for Creative Technologies at the University of Southern California, the Institute for Collaborative Biotechnology at the University of California, Santa Barbara, the Massachusetts Institute of Technology, and Carnegie Mellon University. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovation Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009	0.000	0.153	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 74F: *PERS PERF & TRAINING*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	5.588	5.829	5.549	0.000	5.549

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT F20: *ADV PROPULSION RSCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
F20: *ADV PROPULSION RSCH*	3.299	3.331	3.429	0.000	3.429	3.496	4.193	4.272	4.355	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds research to increase the performance of small air-breathing engines and power trains to support improved system mobility, reliability, and survivability, and ultimately serve to reduce the logistics cost burden for the future. Problems addressed include the need for greater fuel efficiency and reduced weight in these propulsion systems. Technical barriers to advanced propulsion systems are the inadequacy of today's materials to safely withstand higher temperature demands, the lack of capability to accurately simulate the flow physics and the mechanical behavior of these systems, including the engine and drive train. The Army is the lead Service in these technology areas (under Project Reliance) and performs basic research in propulsion, as applicable to rotorcraft and tracked and wheeled vehicles. Technical solutions are being pursued through analysis, code generation, and evaluations to improve engine and drive train components and investigate advanced materials. Component level investigations include compressors, combustors, turbines, energy sources and conversion, injectors, pistons, cylinder liners, piston rings, gears, seals, bearings, shafts, and controls. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.303	2.301	2.389	0.000	2.389
Thermal Materials: Investigates new materials needed to withstand the higher temperature regimen of advanced high performance engines, and evaluates improved tools and methods that will accurately simulate the flow physics and the mechanical behavior of future engines and drive trains which will contribute to the design of more fuel efficient and reliable propulsion systems In FY09, investigated synchronized speed control shifting algorithms that could enable variable speed helicopter transmissions and formulate diagnostic fault detection methods to improve the safety and reliability of helicopter transmissions. In FY10, investigate optimum fiber architecture needed to fabricate uncooled turbine components for increased fuel efficiency and develop improved sand trajectory modeling methodology to improve the safety, durability, and reliability of turbine engines. In FY11, will complete computational assessment of gear windage for various gear rotational conditions and compare with validation results to identify and mitigate power losses.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT F20: *ADV PROPULSION RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Reliable Small Engines for Unmanned Systems: Develops improved tools and methods to enhance the reliability and fuel efficiency of small engines for air and ground vehicles and to enable the use of heavy fuels. In FY09, investigated high priority engine technology shortfalls associated with small unmanned aerial systems (UAS) that can also benefit emerging robotic platforms and energy generation platforms with similar power requirements. Conducted research to establish a small engine-class analytical database and tools. In FY10, utilize validated suite of system simulation tools to identify and improve component and system operation of current and potential Army small engine applications. In FY11, will evaluate potential for improving fuel consumption and reliability of heavy fuel engine concepts for small (<100 HP) system applications. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.996	1.008	1.040	0.000	1.040

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.022	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	3.299	3.331	3.429	0.000	3.429

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT F20: *ADV PROPULSION RSCH*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT F22: *RSCH IN VEH MOBILITY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
F22: *RSCH IN VEH MOBILITY*	0.547	0.564	0.576	0.000	0.576	0.588	0.601	0.612	0.624	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts research in support of advanced military vehicle technology with emphasis on advanced propulsion, sophisticated vehicle dynamics and simulation, and advanced track and suspension concepts. Advanced propulsion research will dramatically improve power density, performance and thermal efficiency for advanced adiabatic diesel engines, transient heat transfer, high temperature materials and thermodynamics. This project also supports state-of-the-art simulation technologies to achieve a more fundamental understanding of advanced high-output military engines. The subject research is directed at unique, state-of-the-art phenomena in specific areas such as: 1) non-linear ground vehicle control algorithms, using off-road terrain characteristics; and 2) instantaneous diesel engine optimizations, using advanced analytical and experimental procedures. This work is performed at the Tank and Automotive Research, Development and Engineering Center.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.547	0.556	0.576	0.000	0.576
Advanced mathematical algorithms for improved vehicle efficiency: In FY09, investigated JP-8 versus DF-2 combustion differences, expanded physics based human modeling effort for vehicle-human interaction dynamics, and explored improved vehicle-terrain methodologies. In FY10, develop engineering models for JP-8 ignition and combustion profiles, explore reduced chemical kinetics JP-8 ignition models, and further investigate vehicle-human interaction dynamics. In FY11, will continue to develop JP-8 engineering models for combustion and ignition as a function of fuel ignition quality, will continue exploring vehicle-human interaction dynamics, and will study better modeling techniques for vehicle-terrain interaction dynamics.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					

Exhibit R-2A, PB 2011 Army **RDT&E Project Justification**		**DATE:** February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** F22: *RSCH IN VEH MOBILITY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Program *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.008	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	0.547	0.564	0.576	0.000	0.576

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT F22: *RSCH IN VEH MOBILITY*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H42: *MATERIALS & MECHANICS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H42: *MATERIALS & MECHANICS*	5.722	6.009	6.975	0.000	6.975	7.461	8.676	8.835	8.990	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the Army's basic research in materials science, which includes research into key phenomena enabling the creation and production of revolutionary materials that will provide higher performance, lighter weight, lower cost, improved reliability, and environmental compatibility for Army unique applications. The current approach of using materials to gain added functionality for Army systems is to use a layered approach, whereby each layer provides added capability (i.e. ballistic, chemical/biological, signature, etc.) but ultimately makes the system too heavy and too expensive. Technical solutions are being pursued through understanding the fundamental aspects of chemistry and microstructure that influence the performance and failure mechanisms of ceramics, advanced polymer composites, and advanced metals, with the goal of creating hierarchically organized materials systems that possess multifunctional attributes at greatly reduced weight and cost. These advanced materials will enable revolutionary lethality and survivability technologies for the future. This research supports materials technology applied research in PE 0602105A, project H84. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.121	2.258	2.759	0.000	2.759
Microscopic/Nanostructural Materials: Devise new materials and design capabilities, based upon fundamental concepts derived at the microscopic and nano-structural levels, for the future force. In FY09, performed comprehensive materials characterization for damage-tolerant sub-micron Silicon Carbide (SiC) ceramic materials, and developed 1st-generation phenomenological constitutive and failure model for Silicon Carbide Nitride (SiC-N) ceramic materials for armor. In FY10, research grain boundary engineering of ceramics to improve fracture tolerance at low and high rates; and characterize materials using a combination of electron microscopy and crystallographic orientation tools to identify optimum microstructures for ballistic protection. In FY11, will research novel processing method concepts for improved armor ceramics; and characterize multifunctional materials systems seeking performance at minimum weight.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 High deformation rate materials: In FY09, investigated engineered scalable materials for armor applications using nanoscale building blocks; characterized their properties and fed ballistic modeling efforts to rapidly screen for performance. Created underpinning understanding to enable the engineering of expedient materials. In FY10, investigate the relationships existing between high rate properties and prior processing; and characterize nanoscale materials using high resolution microscopic analytical methods for feedback to processing and modeling research for protection materials. In FY11, will perform research relating high rate properties and microstructures to ballistic property observations; and will use model results of static and transient electric/magnetic/flow fields to identify new materials and mechanisms. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	2.021	1.838	2.124	0.000	2.124

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Materials research and processing at small scale: In FY09, researched concept of materials by design which enables conduct of material modeling studies to enable bottom-up armor materials design. Researched methods relating processing to materials microstructure that feeds ballistic property models with focus of the effort largely on ceramics. In FY10, perform materials research to relate properties observed at small scale to microstructure; and perform research relating ballistic model output to processing, properties and microstructure.In FY11, will determine the relationship between textile properties and fabrication methods; and will characterize novel protective materials using state of the art microscopy tools. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.580	1.816	2.092	0.000	2.092
Program #4	0.000	0.097	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H42: *MATERIALS & MECHANICS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	5.722	6.009	6.975	0.000	6.975

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H43: *RESEARCH IN BALLISTICS*	7.995	8.208	8.318	0.000	8.318	8.463	9.224	9.395	9.563	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project seeks to improve the understanding of the chemistry and physics controlling the propulsion, launch, and flight of gun launched projectiles and missiles, and to understand the interaction of these weapons with armored targets. This research results in basic new knowledge, which allows the formulation of more energetic propellants, more accurate and non-lethal/lethal projectiles and missiles, and advanced armors for increased survivability of Army combat systems. This effort supports the Office of the Secretary of Defense Advanced Energetics Initiative to mature the fundamental technologies required to transition the next generation of energetic materials into field use. This research supports survivability and lethality technology applied research in PE 0602618A, project H80.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Aberdeen Proving GroundAdelphi, MD, and Research Triangle Park, NC.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.580	2.547	2.672	0.000	2.672
National Advanced Energetics Initiative: Expand and confirm physics-based models and validation techniques to enable design of novel insensitive propellants/explosives with tailored energy release for revolutionary Future Force survivability and weapons effectiveness In FY09, designed smart, molecularly engineered energetics; designed insensitive, nano-reactive energetic materials/structural energetic composites; differentiated initiation reactions caused by conductive versus shear stimuli; explored turbulent mixing and combustion in late-time energy release; and characterized sensitivity and performance of insensitive warhead explosive fills and validated refined propellant models. In FY10, provide new theoretical descriptions, quantum mechanical models, and real-time, in-situ validation measurements of energy storage and release mechanisms in non-traditional condensed phase materials such as structural nano-reactives, metastable polymerics, strained crystals, and diamond-like explosives. In FY11, will link atomistic descriptions of disruptive energy storage and release mechanisms to new mesoscale models to describe space-time fluctuating microstructure behavior critical to understanding reactive behavior at the continuum modeling level.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Launch and flight of gun launched projectiles and missiles: Improve the fundamental understanding of the mechanisms controlling the launch and flight of gun launched projectiles and missiles, and understand the interaction of these weapons with armored targets In FY09, devised 1st-generation physically consistent phenomenological constitutive and failure model for select damage-tolerant ceramics; implemented both controlled fragmentation and reactive material ignition models into a continuum mechanics code; and modeled effects of secondary debris on humans and compared model results with actual human injury data obtained from the medical community. In FY10, identify the controlling mechanisms through modeling and validation that are responsible for the ballistic effectiveness of ceramic materials; expand the reactive material ignition model to include a variety of reactive materials with different terminal effects; and adjust the urban material failure model to account for numerous urban construction materials. In FY11, will establish a validation technique that directly probes and quantifies the fundamental mechanism responsible for ceramic material ballistic performance; will develop suitable post-ignition thermal and equation of state models for reactive material ignition products; and will quantify the terminal ballistic effects of a variety of urban construction materials impacting the human body through extensive modeling and sub-scale experiments.	2.564	2.580	2.686	0.000	2.686

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Extramural research in non-lethal (NL) control methods to exploit potentially innovative approaches that offer unique battlefield and homeland defense capabilities In FY09, focused research efforts on bridging gaps that link these governing mechanisms and laid the groundwork for the prediction of overall response, including human functions such as cognitive and physical performance. Attempted to validate man-portable microwave sources operating at 94 GHz for active denial and crowd control, intending to leverage the development of the micro-machined sources. In FY10, conduct research on high rate response of biological materials, cause of injury, and injury mechanisms for development of novel protection concepts. Research energy flow processes at interfaces to develop precise control of explosive effects. Focus on the analysis and understanding of hyper-spectral image data and the development of rigorous mathematical models and hierarchical statistical techniques to characterize impacts. In FY11, will develop fast hierarchical Bayesian inference algorithms and fusion techniques to combine results obtained from analyzing hyper-spectral imagery with information obtained from other sources such as biological validation or knowledge base for increased battlefield awareness *FY 2009 Accomplishments:* FY 2009	0.883	0.927	0.932	0.000	0.932

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Armor research: In FY09, investigated modeling and simulation of ballistic impact events to include modeling materials response with enhanced failure models that capture realistic behavior with minimum parameterization; created fundamental ceramic/glass model and developed mesoscale approaches. For electromagnetic armor technology created physics based models to address coupling ballistic and electrodynamics models for solid mechanics, computational fluid dynamics, and material failure models; and validated model predictions. In FY10, develop models for armor plate acceleration that do not utilize explosive materials; obtain laboratory derived mesoscale modeling parameters for ceramic materials to enable modeling of ceramic armor materials at the micro-structural level; and begin the study of a thermodynamically-consistent equation of state theory. In FY11, will formulate and validate explosive-free plate acceleration models and equation of state models into continuum mechanics codes; and will use the mesoscale modeling approach to identify ceramic material microstructures that will result in their improved ballistic resistance. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.968	2.017	2.028	0.000	2.028

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.137	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	7.995	8.208	8.318	0.000	8.318

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H43: *RESEARCH IN BALLISTICS*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H44: *ADV SENSORS RESEARCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H44: *ADV SENSORS RESEARCH*	6.112	6.343	9.695	0.000	9.695	7.005	7.623	7.769	7.912	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds basic research to produce future generations of sensors with capabilities beyond those currently being employed. Technical barriers include the fundamental speed and bandwidth limitations of current materials and devices, the efficiency of current algorithms, current computing architectures, organic material lifetimes, the understanding of the fundamental concepts of quantum cryptography, and spatial resolution of current radio frequency (RF) sensors. The technical approach is to exploit large scale electromagnetic (EM) models to predict and explain target and clutter scattering behavior, digital and image processing modules and algorithms, beam propagation and material modeling of nonlinear optical effects, hazardous material detection, remote sensing and intelligent system distributive interactive simulations, unique sensor development, sensor data fusion, and battlefield acoustic signal processing algorithms. Research performed under this project supports survivable sensor systems, organic thin film transistor (OTFT) technology and organic light emitting diode (OLED) technology for affordable rugged flexible displays, and hazardous material monitoring, both point and remote. Payoffs include low cost compact flexible displays for the Soldier and for the Army, improved radar signal processing techniques that will allow existing systems to improve spatial resolution, improved ultra wideband (UWB) radar technology for detection of explosives including mine detection, through the wall sensing and robotics perception, improved sensor approaches and signal processing techniques for enhanced acoustic/seismic sensing systems in noisy environments, distributed sensor data fusion in ad hoc networks, improved cryptography techniques, and hazardous material and event sensing. This project also funds research in the development of biologically inspired materials for use as sensors as well as for power generation and storage. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.662	1.708	1.761	0.000	1.761
Adaptive, active, and intelligent optical systems for high-data-rate military communications and directed energy applications: In FY09, researched parameters and defined the operational envelope for the use of ultra short (femtosecond) laser illumination for the Army's active imaging and directed energy applications. In FY10, explore long range atmospheric laser beam propagation paths for military reconnaissance, laser communications, and directed energy applications. In FY11, will devise target-in-loop (TIL) laser beam control techniques for Army long range and tactical scenario engagements.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H44: *ADV SENSORS RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Improving sensor capabilities: create more survivable/secure systems and displays, improve hazardous material monitoring, and investigate new magnetic sensor technologies for personnel and IED detection. In FY09, researched target & clutter scattering to support radar detection of concealed targets; evaluated signal processing algorithms for networks of heterogeneous sensor nodes; assessed, and continued to improve high conducting films to integrate with OLED and OTFT development. In FY10, integrate conductive organic materials and high stability OLED with flexible backplanes and demonstrate a Micro Electric Mechanical System (MEMS) low-noise magnetic sensor. Model metamaterial antennas and explore their theoretical limits. In FY11, will optimize conducting organic materials for flexible display and electronics, will investigate 3-D Synthetic Aperture Radar (SAR) imaging using wide-angle simulation data of complex buildings for through-the-wall sensing research, will develop conductive organic materials and thin film transistors and integrate into flexible electronic devices. In FY11, will also research networked fusion concepts across distributed multimodal sensor nodes and develop novel magnetic sensors with enhanced performance. Will fabricate and test metamaterial inspired antennas based on theoretical simulations.	2.471	2.518	2.644	0.000	2.644

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H44: *ADV SENSORS RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Biologically-inspired sensing and power generation: In FY09, conducted research to advance novel biologically inspired sensor methodologies for biological hazards detection and bio-inspired routes to assembly of electronic structures. Researched bio-inspired materials for lightweight, portable energy generation and storage. In FY10, investigate bacteria that remediate energetic materials and produce small organic molecules useful as fuels, bio-inspired structural materials for energy absorption, bio-inspired batteries, and biologically directed assembly of electronic structures. In FY11, will manipulate bacteria for improved remediation of energetic materials and generation of organic fuels, investigate electric properties of bio-assembled materials for battery applications, will investigate mechanical properties of bio-inspired structural materials, and will investigate the electronic properties of bio-assembled electronic structures. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.979	2.033	2.290	0.000	2.290

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H44: *ADV SENSORS RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Multi-scale Modeling for Novel Materials: In FY11, will perform fundamental studies to identify and model physics and atomic interactions that control material deformation, progressive / catastrophic failure, and phase response across length scales; will evolve interface physics between nano- and meso-scales; will create new multi-scale experimental techniques and characterization methods to probe materials microstructure and response under extreme conditions. Supporting computational research will investigate and develop scalable interdisciplinary data models to address spatial one-way coupling of software on massively parallel petaflop systems, and multi-core computing systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.000	3.000	0.000	3.000
Program #5	0.000	0.084	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H44: *ADV SENSORS RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	6.112	6.343	9.695	0.000	9.695

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H45: *AIR MOBILITY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H45: *AIR MOBILITY*	2.298	2.361	2.399	0.000	2.399	2.449	2.497	2.543	2.588	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports basic research in aerodynamics for manned and unmanned rotary wing aircraft. The goal of this effort is to develop improved tools and methods to analyze, evaluate, and test rotorcraft unique aerodynamic properties in conventional helicopter and tilt rotor aircraft. The efforts in this project will result in a better understanding of rotorcraft aeromechanics and will result in improved performance, safety and, ultimately, improved combat effectiveness of the manned and unmanned rotorcraft in the future force. This project supports the future force by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing aircraft. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Aviation & Missile RDEC, Aero-Flight Dynamics Directorate at NASA Ames Research Center, CA and Langley Research Center, VA.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.298	2.317	2.399	0.000	2.399
Rotary Wing Aerodynamics: In FY09, developed computational fluid dynamics and computational structural dynamics methods for active rotors, assessed capability of state-of-the-art turbulence models for capturing rotorcraft flow physics such as intersecting and vortical flows, and developed improved dynamic stall models for comprehensive analysis. In FY10, investigate interacting vortex wakes for rotors in close proximity, and identify the high speed aeromechanics boundaries of compound helicopter configurations. In FY11, will develop improved and validated hover performance methods, will investigate the ability of pressure sensitive paint to acquire unsteady pressure measurements for both fuselage and rotor blades.					
FY 2009 Accomplishments: FY 2009					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H45: *AIR MOBILITY*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.044	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.298	2.361	2.399	0.000	2.399

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H45: *AIR MOBILITY*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H47: *APPLIED PHYSICS RSCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H47: *APPLIED PHYSICS RSCH*	2.841	2.940	5.009	0.000	5.009	3.077	3.167	3.228	3.290	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project performs basic research on electronic materials and structures as well as energetic batteries and fuel cells to enable higher performance and more efficient electronic systems. This includes nanoelectronic devices for low-power and high-frequency applications; sensors, emissive nonlinear and nanophase electrode, and electronic materials; thin heterostructure systems where quantum confinement effects are important; advanced batteries and more efficient fuel cells for hybrid power; and the manipulation of cold atoms on a chip for application to very sensitive sensors and ultra-stable atomic clocks. These investigations will impact the development of power sources and specialty electronic materials for the Army's future force, including improved wide band gap semiconductor performance in electric vehicles and advanced radar systems. Applications of cold atom chips include gyroscopes and accelerometers for inertial navigation units, gravitational sensors for detecting underground facilities, very-low-phase noise precision oscillators for low-velocity Doppler radar, and atomic clocks denied global positioning system (GPS) environments for possible space applications. Technical barriers affecting performance, weight, cost, and power consumption will be addressed. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.841	2.902	3.002	0.000	3.002
Research focuses on nanoelectronic devices and sensors; materials for advanced batteries; fuel cells and reformers for Soldier and vehicle power; electronic materials structures and defects of high-temperature wide-band-gap semiconductors for high-power electronic applications; cold-atom chip devices for advanced sensors and ultra-stable atomic clocks; and integration of nanoenergetics and micro electro mechanical system (MEMS) for fuzing and microrobotic applications. In FY09, investigated system insertion for nanoelectronic devices and sensors and failure mechanisms for wide-bandgap electronic devices; attempted measurements of a cloud of cold atoms on an atom chip; and developed capability for creation of bio-inspired materials for batteries and fuel cells. Formulated electrode/electrolyte systems based on fundamental understanding of their interface. In FY10, attempt to load and launch cold atoms into an atom waveguide. Integrate nanoporous energetic silicon with MEMS acceleration switch; investigate carbon based materials for application to nanoelectronic devices. Use computer					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H47: *APPLIED PHYSICS RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
modeling and simulation to guide design of reformer components, which involves developing gas and liquid phase sulfur sorbents to strip sulfur from the JP8 to avoid poison fuel cell catalysts after reformation. In FY11, will attempt to split a guided atomic beam on an atom chip. Will integrate nanoporous energetic silicon with MEMS microthruster devices and demonstrate nanoelectronic devices. Will develop new battery electrode prospects by bio-inspired processes from Institute for Collaborative Biotechnologies, PE 0601104A/project H05. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Advanced Energy Science Research: In FY11, will conduct research to advance novel materials by design approach of modeling and theoretical computations to predict characteristics and performance a priori for energy storage and conversion materials; will investigate multidisciplinary approaches for novel energy harvesting (light, heat, vibration, isotope, biological energy, sources); will investigate emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, diamond) for energy storage electrodes, thin films, and energy conversion applications. *FY 2009 Accomplishments:* FY 2009	0.000	0.000	2.007	0.000	2.007

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H47: *APPLIED PHYSICS RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.038	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.841	2.940	5.009	0.000	5.009

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H47: *APPLIED PHYSICS RSCH*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H48: *BATTLESPACE INFO & COMM RSC*	8.814	11.374	13.685	0.000	13.685	14.726	17.816	18.285	18.890	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports basic research to enable intelligent and survivable command and control, communication, computing, and intelligence (C4I) systems for the future force. As the combat force structure becomes smaller and operates in more dispersed formations, information systems must be more robust, intelligent, interoperable, and survivable if the Army is to retain both information and maneuver dominance. This research supports the Army's new Network Science initiative and in the process addresses the areas of information assurance, the related signal processing for wireless battlefield communications, document and speech machine translation, and intelligent systems for C4I. Major barriers to achieving the goals are the inherent vulnerabilities associated with using standardized protocols and commercial technologies while addressing survivability in a unique hostile military environment that includes highly mobile nodes and infrastructure, bandwidth-constrained communications at lower echelons, resource-constrained sensor networks, diverse networks with dynamic topologies, high-level multi-path interference and fading, jamming and multi-access interference, levels of noise in speech signals and document images, new low-density languages, and information warfare threats. The intelligent systems for C4I research will focus on providing the agent technology capabilities that will produce highly relevant tactical events for mounted or dismounted commanders, leaders and soldiers; improve the timeliness, quality and effectiveness of actions; and speed the decision-making process of small teams operating in complex natural or urban terrain.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.651	1.678	1.568	0.000	1.568
Perform research to provide communications capability for a fully mobile, fully communicating, and situationally aware force operating in a highly dynamic, wireless, mobile networking environment populated by hundreds to thousands of networked nodes. In FY09, performed laboratory analysis to incorporate technologies in mobile radio units. Developed scaling laws for mobile ad hoc and sensor networks under military constraints. In FY10, perform validation analysis to extract tractable models of network behavior to enhance military network design tools. In FY11, will use network behavior models and scaling laws to develop cognitive networking protocols to enhance the performance of tactical mobile networks.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Design and implement a laboratory scale common information-processing infrastructure, inclusive of service oriented architecture for networking processes that aids in the transformation of data into actionable intelligence to support decision-making under uncertainty. In FY09, evaluated 3-D scene reconstruction and pose recognition for enhanced situational awareness, along with information mediation improvements to the military operational and tactical decision and planning process. In FY10, extend scene recognition algorithms to mobile platforms to support biologically inspired collaborative behaviors. Investigate local and global policy aware information exchange and information exploitation algorithms in collaboration with the Network Science CTA initiative. In FY11, will conduct validations in a laboratory environment to assess the impact of policy aware algorithms on Situation Understanding. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.453	1.480	1.636	0.000	1.636

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Perform research in protecting information in highly mobile wireless tactical environments with severe bandwidth, energy, and processing constraints and operating without reliance on centralized security services. In FY09, designed and evaluated analytically and via simulation/emulation, robust classes of algorithms that provided a dynamic architecture to support detection of attackers under conditions of mobility. In FY10, refine and evaluate the dynamic security services architecture for mobile tactical networks for assured Soldier communications. In FY11, will investigate and develop techniques for securing information flows in highly mobile wireless tactical environments. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.668	1.710	1.765	0.000	1.765
Program #4	1.061	1.082	1.222	0.000	1.222

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Establish formal methods for bridging language barriers in tactical environments, incorporating state of the art techniques in machine translation and natural language processing. In FY09, explored multi-engine machine translation architectures for processing and exploiting multi-media, multi-language (e.g. Arabic, Farsi, and Swahili) sources. In FY10, develop and assess novel metrics for evaluating new multi-engine machine translation architectures. In FY11, will conduct laboratory validations to assess multi-engine machine translation concepts, addressing scalability and robustness in noisy environments. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Study the behavior of mobile ad-hoc networks (MANETs) as part of the Army's Network Science initiative. Emphasis is on mobile communications networks research with the Army's University Affiliated Research Center, the Institute for Collaborative Biotechnology at the University of California - Santa Barbara. In FY09, conducted component-based performance modeling and analysis of routing protocols and design networking protocols that adapt to varying operating environments in order to optimize performance. In FY10, develop and compare component based analytical models with executable models to enable the design of robust tactical networks. In FY11, will develop algorithms, techniques and metrics for robust local/global network optimization using cognitive and communication network metrics.	0.994	1.001	1.036	0.000	1.036

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Advanced Computing. In FY09, researched advanced computing algorithms and techniques to addresses implementation issues for mobile networking, machine based language translation, and information processing infrastructure. Researched computer based modeling, simulation and data analysis techniques for the study of scientific phenomena and engineering designs. In FY10, investigate algorithms, approaches, and methodologies for battle command applications that exploit emerging mobile hybrid computing architectures. Battle command applications will include large-scale battlefield network modeling; real-time algorithms to assist network emulations; comprehensive data representation, models and analysis techniques; information fusion of different data types; engineering design based approaches. In FY11, will implement large-scale battlefield network modeling; real-time algorithms to assist network emulations; models and analysis techniques; information fusion of different data types for battle command applications that exploit emerging mobile hybrid computing architectures. *FY 2009 Accomplishments:* FY 2009	1.987	2.524	2.599	0.000	2.599

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #7 Network Science Technology Experimental Center. Supports in-house Network Science studies in conjunction with the Network Science and Technology Research Center (PE 0601104A/project J22) and is coordinated through the Network Sciences CTA (0601104A/project H50). Investigate fundamental network behaviors utilizing high performance computing software that enables the design and analysis of mobile ad hoc networks at sufficient levels of fidelity and with sufficient speed to understand network centric warfare (NCW) technologies in the full range of conditions in which they will be employed. Investigate and devise scalable software tools that significantly extend the capabilities to perform simulation, emulation and validation of mobile ad hoc networks. Devise a software environment that will enable the eventual integration and linking of the simulation-emulation-validation cycle. In FY10, devise advanced computing based tools to accelerate scenario/model development, coupling of different models, verification and validation (V&V), and enhanced multi-disciplinary collaboration through common user interfaces, scalable library routines, pre-processing, scalable optimization routines, and post-processing analysis tools. In FY11, will extend the wireless emulation and simulation tools to support the modeling of networks of 1000s of nodes with high-fidelity propagation models and realistic traffic models. The simulation and emulation tools will be linked to field validations to extend the scale of the network tested These efforts will significantly improve the understanding of network behaviors under a full range of operational conditions, significantly improving the design of NCW technologies.	0.000	1.756	3.859	0.000	3.859

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.143	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	8.814	11.374	13.685	0.000	13.685

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H48: *BATTLESPACE INFO & COMM RSC*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H52: *EQUIP FOR THE SOLDIER*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H52: *EQUIP FOR THE SOLDIER*	0.978	1.030	1.078	0.000	1.078	1.105	1.134	1.158	1.181	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports basic research to achieve technologies for the Soldier of the future which focus on core technology areas that include mathematical modeling, physical and cognitive performance, polymer science/textile technology, nanotechnology, biotechnology, and combat ration research. Effort is targeted on enhancing the mission performance, survivability, and sustainability of the Soldier by advancing the state-of-the-art in the sciences underlying human performance, clothing, and protective equipment to defend against battlefield threats and hazards such as ballistics, chemical agents, lasers, environmental extremes, and ration shortfalls.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Defense of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work is performed and managed by the Natick Soldier Research, Development, and Engineering Center (NSRDEC), Natick, MA.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.978	1.027	1.078	0.000	1.078
Equipment for the Soldier: This project supports basic research to achieve technologies for the Soldier of the future which include mathematical modeling, physical and cognitive performance, polymer science/textile technology, nanotechnology, biotechnology, and combat ration research. In FY09, screened multiple isolates for advancement to biofilm formation for rapid screening of foods for pathogenic bacteria; and addressed selected behavioral principles most likely to impact long term acceptance and use results. In FY10, use novel computational methodologies to understand techniques necessary to simulate dynamics/interactions of fluid structure systems undergoing topology change as would be found in parachutes, parafoils and flexible structures. In FY11, will continue fundamental work in supporting the goals of understanding cognition while performing multiple tasks; will explore novel approaches to representing body geometry in biomechanical applications to address fundamental errors in measurement and analysis techniques of earlier human limb mass property studies; and will conduct experiments to improve the understanding of the basic phenomena of the biomimetic approach to metal oxide formation for the production of novel multifunctional materials.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H52: *EQUIP FOR THE SOLDIER*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.003	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	0.978	1.030	1.078	0.000	1.078

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H52: *EQUIP FOR THE SOLDIER*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H57: *Single Investigator Basic Research*	63.397	64.649	73.075	0.000	73.075	68.663	75.881	82.178	90.434	Continuing	Continuing

A. Mission Description and Budget Item Justification

This extramural research project discovers and exploits new scientific opportunities and technology breakthroughs, primarily at universities, to improve the Army's Transformational Capabilities. Current technologies are unable to meet the operational requirements of the future force. The Army Research Office of the Army Research Laboratory (ARL) maintains a strong peer-reviewed scientific research program through which leap-ahead technological solutions may be discovered, matured, and transitioned to overcome the technological barriers associated with next generation capabilities. Included are research efforts for increasing knowledge and understanding in fields related to long-term future force needs in the physical sciences (physics, chemistry and biology), the engineering sciences (mechanical sciences, electronics, materials science and environmental science (atmospheric and terrestrial sciences)), and mathematical and information sciences (mathematics, computer, and information sciences) and network science. Targeted research programs in nanotechnology, smart structures, multifunctional and microminiature sensors, intelligent systems, countermine, compact power, and other mission-driven areas will lead to a Future Force that is more strategically deployable, more agile, more lethal, and more survivable. The breadth of this basic research program covers approximately 900 active, ongoing research grants and contracts with leading academic researchers and approximately 1,600 graduate students yearly, supporting research at nearly 250 institutions in 50 states. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	5.820	5.729	6.351	0.000	6.351
Basic research in molecular, physiological, and systems biology:In FY09, focused on exploiting multidisciplinary interface of bionanoengineering to engineer bioinspired nanodevices with novel capabilities, using biomimetics to create new protective materials, and to understand and engineer countermeasures to molecular and physiological factors that impair Soldier cognitive and physical performance. Undertook systems biology approach to bioremediation focused on the few microbial species capable of degrading toxic halogenated pollutants, investigated modulating effects of oxidative stress on Soldier health and performance, investigated biophysics and modeling of spore germination and inactivation for effective biowarfare countermeasures, and explored other					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
species sense and computing capabilities for novel algorithms usable in automated and remote military systems. Studied use of synthetic materials and molecular circuits capable of promoting tissue regeneration, developed tools in synthetic biology to construct genetic programmable circuits that could serve as the basis for chemical and biological sensing, used noninvasive human state sensors, correlated physiological signals with behavioral functions and human performance, and model and engineered relevant microbial species for the optimal synthesis of energy for military specific needs. In FY10, basic research in all of these areas is being continued with a concurrent transition and focus towards field use. New initiatives in non-invasive modulation of neural systems, bridging the living/nonliving interface in peripheral nerves, and sensing of brain signals will commence. Biofuel development studies will expand; improved methods to convert operating base biological waste to energy, and development of methodologies to convert sunlight "directly" to biofuels are being initiated.In FY11, this research will mature and enable new biotechnologies and bionanoengineering for new Army capabilities and materiel. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Basic research in environmental science possesses three areas: (i) atmospheric science research to measure, model, and theoretically understand the nighttime atmospheric boundary layer; (ii) terrestrial science research to enable the Army to operate effectively in all military operating environments by understanding fundamental	1.989	2.030	2.474	0.000	2.474

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
terrain and land-based phenomena; and (iii) military habitation science, basic research to allow military power projection that meets operational needs in a sustainable manner. In FY09, investigated environmental effects on geophysical techniques used remotely to sense both the surface and shallow subsurface and understanding relationships between surface and subsurface characteristics of the soil system, with a focus on soil moisture through a multi-agency R&D initiative. Military habitation science focused on basic research to support resource reuse and transformation, energy recovery, and energy conversion at base camps. In FY10, address Army-unique atmospheric operational needs and investigate automated terrain navigation by autonomous vehicles and use geographic information systems (GIS)-based approaches for cognitive understanding and utilization of geospatial information, analysis, representation, and modeling of multiple types of geospatial data. In FY11, environmental sciences will examine small-scale processes of the diurnal continental atmospheric boundary layer, will investigate the overlapping topics of network science and geographic information science research as related to social networks, and will improve operational sustainment through basic research in military habitation science. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Basic research in chemical sciences for advanced energy control, protective materials, and threat detection. Advanced energy control will provide light-weight, reliable, compact power sources for the soldier and more	6.894	6.920	8.373	0.000	8.373

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
effective, lower vulnerability propellants and explosives for tailored precision strikes with minimum collateral damage. Protective materials will shield soldiers and their platforms from ballistic, chemical, and biological threats; and reduce signatures for identification by the enemy while providing clear identification by friendly forces. Threat detection will provide advance warning of explosive, chemical, and biological weapons and dangerous industrial chemicals. In FY09, research focused on nano-particle material repair, optical limiting, fuel cell catalysts and membranes, structure/function for protective membrane transport, and reactive surfaces for decontamination. In FY10 research focuses on functionalized morphology, novel reactive monomers, environmentally stable self-assembled materials and reactions in extreme media. In FY11, will continue research of functionalized morphology, novel reactive monomers, environmentally stable self-assembled materials, and reactions in extreme media. Will research mechanophores, never-before-created molecules that provide automatic conversions between mechanical, thermal and chemical energy, will synthesize and incorporate these into polymers and polymeric materials. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Basic research in physics for precision guidance, superior optics, signature management properties, ultra-sensitive sensors, quantum computing, and secure communications. In FY09, devised flat lenses and sub-	9.353	9.325	12.457	0.000	12.457

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
wavelength imaging for ultra light optical components and detection of pathogens; explored physics of attosecond light pulses for remote spectroscopy, armor fatigue analysis and "seeing through the wall"; conducted optical lattice simulation of magnetism and high temperature superconductivity; studied artificially layered oxides for remote passive sensors and ultra-low power electronics; devised multi-modal plasmon enhanced environmental sensors, elucidated decoherence in quantum computation platforms and extended ion trap qubit fidelity to solve "unsolvable" problems. In FY10, demonstrate ultra-light negative-index optical components; simulate intractable condensed matter theories with optical lattices; devise ultra cold chemistry concepts heralding novel chemical synthesis routes; engineer artificial oxides to stimulate a second electronics revolution; and explore cross-platform qubit entanglement. In FY11, will advance transformation optics for cloaking and omni-directional light collection; will devise models guiding materials development for next generation electronics using optical lattices; will engineer artificially layered oxides to enable disruptive electronic technology; and will study quantum entanglement-enhanced metrology and stealth imaging. Will study techniques to exploit quantum entanglement and controllable quantum physics effects for imaging. Will research new spin-based electronics technology (spintronics) and 'cold atom' spintronics. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5	12.463	12.342	14.474	0.000	14.474

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Basic research in electronics and photonics for situational awareness, communications, information processing, electro-magnetic warfare, and power efficiency. In FY09, devised small tactical antennas operating across high frequency bands; determined feasibility of quartz oscillator infrared detectors; created methods to control magnetization dynamics in nanostructures for high speed electronics; improved mid-IR lasers based on antimonide type-I quantum well lasers in 2-3 micron range; and determined the optical/magnetic properties of doped Gallium Nitride (GaN) semiconductors for magnetic semiconductor applications. In FY10, generate small avalanche photodiode arrays of the (Ga,In)(As,Sb) family providing low noise/high gain for night vision applications in mid infrared spectral region; show feasibility of electrically-injected room temperature continuous-wave mid-infrared semiconductor lasers based on group IV-VI lead salt materials for optical communications; validate optical subwavelength sensing on biomolecules for Chem/Bio analysis; and show proof of concept for a single-chip 2.4GHz transceiver on silicon with integrated antenna for improved radio communications. In FY11 will determine feasibility of quantum cascade superlattice IR detector; will create wide-bandgap ZincOxide(ZnO)/ GaN based semiconductor lasers; tunable composition nanowire visible lasers with improved efficiencies/scalable power for low cost applications; and will determine effects of polarization field upon ferromagnetic and optical properties of magnetically doped GaN for sensing/information processing. Will study theory, materials growth and characterization of complex oxides that exhibit strong electron correlations leading to emergent phenomena not possible with semiconductors. Will research non-invasive techniques to interface electronics with the brain. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #6 Basic research in mechanical and material sciences for survivable armor, more lethal anti-armor, improved mobility, and flexible displays for Soldier systems.In FY09, validated chemical kinetic mechanisms for alternative hydrocarbon-based fuels at high temperature and pressure in diesel and turbine engine applications. Researched new materials for armor and Soldier protection, and improved techniques to predict material failures. In FY10, investigate topological optimization strategies to devise tools to optimize structures based on damage tolerance. Validate new vorticity-based computational methods for rotorcraft flows capable of convecting the wake without the deleterious effects of numerical diffusion for improved model accuracy. Research implementation of reduced hydrocarbon combustion kinetics codes into engine models for future fuel flexible engines and devise physical understanding of hypergolic ignition to enable gel-propellant rocket propulsion. In FY11, will devise a comprehensive understanding of the propagation of intense stress-waves in adaptive media with random, locally varying, and discontinuous properties for unprecedented armor material designs. Will investigate novel/emerging composite materials system that mimics biological adaptive and self-healing characteristics for novel structural materials. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	12.491	12.387	12.385	0.000	12.385

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #7	11.982	12.301	11.273	0.000	11.273
Basic research in mathematical and computer sciences is the backbone for performing complex, multi-system analysis, modeling and understanding simulation, and information systems. Advancements in mathematical and computer sciences have a direct impact on enhancing the warfighters' decision-making, situation awareness, command and control, as well as on the overall performance of weapon, intelligence, transportation and logistics systems. In FY09, devised tools for design of heterogeneous swarms for desired emergent behavior, which led to better system design or control design for military systems such as UAVs, UGAs, or robotics. In FY10, experimentally validate the effectiveness of the devised products and tools on swarming and sensor fusion in laboratory test-beds. These results help to identify computer techniques designed to identify attacks against information systems, protecting information systems from attacks, and on devising techniques for inherently hardened software. New understanding and knowledge gained from these efforts contribute to the development of robust and resilient information systems that address the processing and delivery of authentic, secure, reliable, and timely information to the warfighters, regardless of threat conditions. In FY11, will use the results of the testing and validation efforts from FY10 to refine and improve tools and an enhance theory.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					
Base FY 2011 Plans: FY 2011 Base					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #8 Basic research to gain an understanding of the fundamental aspects of how networks develop, function, and adapt to the environmental and the rate of information flow in manmade and naturally occurring networks. This understanding will have a direct impact on net-centric force operations, such as better communication system design and operations, or more efficient logistics or communications support.. In FY09, examined mechanisms by which different layers interact with one another. In particular, a universal representation of information (information theory, metrics, topology, etc.) within physical, biological, and social networks was constructed to enable network interfacing and control across multiple scaled networks. Moreover, the barriers to network control across multiple scales was addressed in this general information context. The goal was to gain a deep understanding of network systems that provides a basis for their properties. In FY10, define and conduct first order laboratory experiments and simulations to refine network representations. In FY11, developing the theory to understand the non-stationary, non-ergodic statistics of complex biological, social and cognitive networks observed in the experiments of FY10 will be addressed. Understanding the limitations of traditional statistical theory on which predictions have been historically based will strongly impact the capabilities of the net-centric force. Specifically, the influence of intermittent uncertainty on situation awareness and decision-making in a networked environment will be determined. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	2.405	2.158	3.623	0.000	3.623

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #9 Bioforensics and Microscale Manipulation with Bacteria:In FY11 will conduct research leading to an understanding of adaptation in microbes enabling the ability to determine where microbes originated, how closely related they are, and how they were most recently grown. Taken together, this will provide a means of attribution of a biological event, whether naturally occurring or nefarious. Will study micro-scale locomotion and manipulation using flagellated bacteria for actuation, which lends itself to bacteria propelled micro-structures for engineering of micro-manipulators and micro-robotics. Research will include extending theory to address the use of attractants for controlling the trajectory of bacteria-propelled barge. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.000	1.665	0.000	1.665
Program #10 Small Business Innovative Research/Small Business Technology Transfer Programs	0.000	1.457	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	63.397	64.649	73.075	0.000	73.075

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H66: *ADV STRUCTURES RSCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H66: *ADV STRUCTURES RSCH*	1.711	1.808	1.889	0.000	1.889	1.942	1.996	2.040	2.089	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds basic research for improved tools and methods to enable the structural health monitoring capabilities and condition-based maintenance for rotorcraft and ground vehicles. This research also enables the design and use of composite structures that can better address the cost, weight, performance, and dynamic interaction requirements of future platforms identified by the Army Modernization Strategy. Ultimately, these technologies result in safer, more affordable vehicles with a greatly reduced logistics footprint. This project is a joint Army/NASA effort that includes structures technology research into: structural integrity analyses; failure criteria; inspection methods which address fundamental technology deficiencies in both metallic and composite Army rotorcraft structures; use of composite materials in the design and control of structures through structural tailoring techniques; rotorcraft aeroelastic modeling and simulation; helicopter vibration (rotating and fixed systems); and the design and analyses of composite structures with crashworthiness as a goal. The problems in structures are inaccurate structural analysis and validation methods to predict durability and damage tolerance of composite and metallic rotorcraft structures and inadequate structural dynamics modeling methods for both the rotating and fixed system components to address reliability issues for future aircraft. The technical barriers include a lack of understanding of failure mechanisms, damage progression, residual strength, high-cycle fatigue, the transfer of aerodynamic loads on the rotor to the fixed system, and impact of these unknown loads on aircraft components. Technical solutions are focused on: advanced fatigue methodologies for metallic structures, improved composites technology throughout the vehicle, long-term investigation of integrated stress-strength-inspection, advanced methods for rotor system vehicle vibratory loads prediction, improved methods to predict vehicle stability, and improved analyses to address Army Aviation requirements. These advancements will extend service life, reduce maintenance costs, enhance durability, and reduce the logistics footprint of existing and future Army vehicles. As agreed under Project Reliance, this is the only project for rotorcraft and ground vehicle structures basic research within DoD. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL), located in facilities at the NASA Langley Research Center, Hampton, VA, and at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.711	1.806	1.889	0.000	1.889
Structural Analysis and Vibration Methods: This research devises new structural analysis and validation methods to more accurately predict durability and damage tolerance of composite and metallic rotorcraft structures, and evaluates structural dynamics modeling methods to address critical reliability issues in the rotating and fixed					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
system components of future aircraft.In FY09, evaluated multibody-compatible thin-walled elastic finite element methods to enable aeroelastic predictions for small-scale air vehicle systems. In FY10, complete characterization testing for materials used in finite element models for delamination fatigue life prediction, and validates life prediction tools for dynamic rotorcraft sub-components. In FY11, will develop predictive tools for residual strength after impact for thin-skin structural concepts; will develop damage resistant and damage tolerant core and skin concepts; and will validate residual strength prediction tools for stiffened skin components. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.002	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H66: *ADV STRUCTURES RSCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	1.711	1.808	1.889	0.000	1.889

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H67: *ENVIRONMENTAL RESEARCH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H67: *ENVIRONMENTAL RESEARCH*	0.906	0.941	0.967	0.000	0.967	0.997	1.018	1.039	1.072	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to focus basic research on innovative technologies for both industrial pollution prevention (P2) that directly supports the Army production base and weapon systems as well as non-stockpile chemical warfare (CW) site remediation. The pollution prevention work invests in next generation manufacturing, maintenance, and disposal methods that will result in significantly reducing the usage of hazardous and toxic substances and their associated costs. The goal is to decrease the overall life-cycle costs of Army systems by 15-30% through the application of advanced pollution prevention technologies. The CW remediation efforts concentrate on the application of biotechnology in the characterization and physical clean up of agent contaminated soils and groundwater and reduced corrosive and more environmentally benign decontamination of biological warfare (BW) agents on field equipment and weapon systems. The goal is to reduce the cost of remediating a site by at least 50% versus the use of conventional methods. CW thrusts include establishing the ecotoxicity of CW compounds, environmental fate and effect of CW compounds in soils and biodegradation of CW compounds. Pollution prevention thrusts include: environmentally acceptable, advanced, non-toxic processes to manufacture lightweight alternative structural materials to enhance weapon system survivability; clean synthesis of more powerful and improved energetic compounds to eliminate the use of hazardous materials and minimize the generation of wastes; and surface protection alternatives to hazardous paints, cadmium, chromium, and chromate conversion metal and composite surfaces. This project is linked to the Army Environmental Requirements Technology Assessment (AERTA) requirements. The program element contains no duplication with any effort within the Military Departments. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and the defense Technology Area Plan (DTAP). Work is under the direction of the U.S. Army Armament, Research, Development and Engineering Center.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.906	0.938	0.967	0.000	0.967
Industrial pollution prevention: This effort conducts research on innovative environmentally- friendly technologies that support the warfighter (focusing on pollution prevention technologies). In FY09, developed environmentally benign approaches to nitration reaction in microreactors (ARDEC), conducted modeling, processing, and characterization of highly layered polymer films (NSRDEC), investigated new physical vapor deposition technologies for new ordnance coatings (Benet Labs), developed polysiloxane nanocomposites for environmental and human safe flame-retardant materials (NSRDEC), conducted research on anaerobic hydrogen					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H67: *ENVIRONMENTAL RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
production from a variant of clostridium phytofermentans (ECBC), investigated bio-based gel coats with zero hazardous air pollutant contents for composites applications (ARL), and researched ammonium perchlorate replacements (AMRDEC). In FY10, continue efforts in FY09 that were selected by the Peer Panel during the Gate Reviews in September 2009 and conduct research on additional new yet undetermined projects. In FY11will continue the ongoing programs based on the Peer Panel review and any new starts selected by the Panel. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.003	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H67: *ENVIRONMENTAL RESEARCH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.906	0.941	0.967	0.000	0.967

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H68: *PROC POLLUT ABMT TECH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H68: *PROC POLLUT ABMT TECH*	0.420	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides fundamental understanding of the physical, chemical and biological properties and mechanisms that control the degradation and treatment of hazardous wastes on military installations. This research is used to obtain basic technical information necessary for the design of treatment systems for both cleanups of existing hazardous waste sites and control of future hazardous waste generation. Wastes of concern include explosives, propellants, chemical agents and smokes. This project supports applied research efforts in Program Element (PE) 0602720A, Projects AF25 and DO48. Work in this project is performed by the Army Corps of Engineers Engineer Research and Development Center.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.420	0.000	0.000	0.000	0.000
Degradation and treatment of hazardous waste: In FY09, conducted redox system experiments to determine Cyclotrimethylenetrinitramine (RDX) degradation enzymatic processes. Initiated mineralization rates and mass balance studies. Completed explosive exposures and cellular assays, and initiate proteomic and genomic analyses. In FY10, basic research efforts in project H68 move to project T25, Environmental Science Basic Research. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H68: *PROC POLLUT ABMT TECH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.420	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S04: *MIL POLLUTANT/HLTH HAZ*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
S04: *MIL POLLUTANT/HLTH HAZ*	0.701	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project provides basic research in innovative, less costly, and less time consuming toxicity assessment methods for determining potential human health and environmental effects of military-unique hazardous wastes and chemicals, including explosives, propellants, and smokes. These new testing techniques will help to prioritize hazardous waste and waste treatment technologies and screen new Army chemicals for potential toxic effects. The work is conducted at U.S. Army Center for Environmental Health Research (CEHR) and U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM). Work in this project is performed by the Army Corps of Engineers Engineer Research and Development Center.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.701	0.000	0.000	0.000	0.000

Human health and environmental effects research: In FY09, completed measurements of the fundamental aspects of control-fractured versus un-fractured mineral surface affects on the fate and transport of explosives. Continued the study of neurotoxicants on neurotransmitter pathway related gene expression in a gene regulatory network. Utilized systems biology, toxicogenomics, computational modeling and bioinformatics in the approach. In FY10, basic research efforts in project S04 move to project T25, Environmental Science Basic Research.

FY 2009 Accomplishments:
FY 2009

FY 2010 Plans:
FY 2010

Base FY 2011 Plans:
FY 2011 Base

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.701	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S13: *SCI BS/MED RSH INF DIS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
S13: *SCI BS/MED RSH INF DIS*	10.747	10.481	10.652	0.000	10.652	10.900	11.121	11.348	11.544	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports basic research that provides for healthy, medically protected Soldiers. This project funds basic research leading to medical countermeasures for naturally occurring diseases impacting military operations. Basic research provides understanding of the mechanisms that make organisms infectious and the effective human body response which prevents disease. Understanding the biological characteristics of infectious organisms also enables the development of point-of-care and laboratory-based diagnostic tools. Understanding of disease transmission by insects and other organisms helps in developing new interventions to prevent disease. Infectious disease threats from malaria, diarrhea, and dengue (a severe debilitating disease transmitted by mosquitoes), which are common in Africa, Central, European, Southern, and/or Pacific Commands, are the highest priorities for basic research. Research conducted in this project focuses on the following four areas:(1) Prevention/Treatment of Parasitic (symbiotic relationship between two organisms) Diseases: Conduct basic research to better understand the biology of malaria and Leishmania (a skin-based disease transmitted by sand flies) parasites, and to gain the necessary foundation for discovering medical countermeasures to protect military personnel from infection. Malaria, which can cause fatal and chronic disease, is the most significant military infectious disease threat. Since the malaria parasite becomes resistant to drugs over time, it is necessary to continually search for parasite weaknesses that can be exploited with new, effective, user-friendly drugs and vaccines. A highly effective vaccine could reduce/eliminate the use of anti-malarial drugs and the development of drug resistance to current/future drugs. (2) Bacterial Threats: Conduct research to better understand the biology of bacterial organisms and their effects on humans and how to prevent wound infections, diarrhea and scrub typhus (a debilitating mite-borne disease that is developing resistance to currently available antibiotics).(3) Viral Threats: Conduct research to better understand highly lethal or incapacitating viruses, including those that cause hemorrhagic diseases (leakage of blood from vessels), such as dengue hemorrhagic fever and hantaviruses (Korean hemorrhagic fever). Basic research includes understanding risk of disease prevalence to the Warfighter, viral biology (including structure, function, lifecycle, and interactions with the environment), the disease process, and interaction with the human body. (4) Diagnostics and Disease Transmission Control: Conduct research to investigate the biology of biting insects (including mosquitoes and Leishmania-infected sand flies and mosquitoes) and other organisms that transmit disease (called disease vectors) and their control. Expand medical diagnostic and disease surveillance capabilities in the field. This research will help to direct new interventions into preventing disease transmission.Work is managed by the US Army Medical Research and Materiel Command in coordination with the Naval Medical Research Center (NMRC). The Army is responsible for programming and funding all DoD naturally occurring infectious disease research requirements, thereby precluding duplication of effort within the Military Departments. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the co-located Walter Reed Army Institute of Research (WRAIR) and Naval Medical Research Center (NMRC), Silver Spring, MD, and its their overseas laboratories.

B. Accomplishments/Planned Program ($ in Millions)

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S13: *SCI BS/MED RSH INF DIS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	6.200	5.758	5.829	0.000	5.829
Prevention/Treatment of Parasitic (symbiotic relationship between two organisms) Diseases: In FY09, applied established medicinal chemistry techniques and computer modeling for Structure-Based Drug Design (SBDD) to discover candidate drugs to prevent or treat malaria infection. Employed bioinformatics to identify genes and proteins to help in the discovery of malaria vaccine components. In FY10, apply new tools for discovery of promising compounds as potential leads to new classes of anti-malarial drugs and for potential vaccine components. In FY11, will continue iterative approaches for the discovery, design and synthesis of promising new anti-malarial drug compounds and potential vaccine components. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	0.930	1.474	1.724	0.000	1.724
Bacterial Threats: In FY09, identified proteins and other components produced by diarrheal organisms for their role in disease and possible use as a vaccine component. Studied bacterial disease factors affecting the health and illness in selected overseas populations at potential candidate vaccine test sites. In FY10, assess and improve selected proteins and other components identified from diarrheal causing bacteria as potential components of candidate vaccines. Conduct exploratory studies to evaluate methods to prevent wound infection from combat injuries. In FY11, will develop further knowledge of the epidemiology (study of factors affecting the health					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S13: *SCI BS/MED RSH INF DIS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
and illness of populations) of diarrhea and wound infections in military personnel. Will assess basic wound management measures (concentrated oxygen, nutritional supplements and wound cleansing) to minimize the need for antimicrobials (a substance that kills or inhibits the growth of microbes such as bacteria, fungi, or viruses) and reduce antimicrobial resistance. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Viral Threats Research: In FY09, conducted basic research to understand hemorrhagic viral diseases and other lethal viruses of military importance. Assessed emerging viral threats for their potential to impact military operations and to determine whether any identified new threat requires further study. In FY10, conduct basic research to better understand the biological basis of disease and protection in humans from naturally occurring viruses of military importance. Develop a better understanding of which parts of the immune system are needed to provide a protective response in humans. In FY11, will continue to study and evaluate the basis of disease and how the immune system reacts to diseases of interest. *FY 2009 Accomplishments:* FY 2009	1.794	1.763	1.764	0.000	1.764

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S13: *SCI BS/MED RSH INF DIS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Diagnostics and Disease Transmission Control: In FY09, explored the biology of disease carrying insects and methods of control to expand medical diagnostic and disease surveillance capabilities with a focus on providing new approaches. Completed preparation of the new Preventive Medicine Units (PMU) mosquito identification guides for SOUTHCOM and PACOM regions, and evaluated novel methods for vector control. In FY10, conduct studies on the diversity, description and classification of medically-important insects, including mosquitoes, ticks and sand flies as the scientific foundation for a web-based guide to identification. Explore new designs for devices to collect insects, and will assess medical threats from disease-carrying insects in deployed areas. In FY11, will conduct mosquito identification within US Northern Command region using DNA markers to identify specimens. Will conduct research leading to a new generation of detection assays for diagnosis of Rickettsial and lethal virus infectious agents within insect vectors. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.823	1.335	1.335	0.000	1.335

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Small Business Innovative Research/Small Business Technology Transfer Program *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.151	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	10.747	10.481	10.652	0.000	10.652

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S13: *SCI BS/MED RSH INF DIS*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S14: *SCI BS/CBT CAS CARE RS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
S14: *SCI BS/CBT CAS CARE RS*	6.067	6.505	6.818	0.000	6.818	7.049	7.725	7.860	7.990	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds basic research to understand the basic mechanisms of severe trauma to advance treatment and surgical procedures to save lives and improve medical outcomes for the Soldier. Experimental models are developed to support in-depth trauma research studies. It includes studies of predictive indicators and decision aids for life support systems; studies to heal and repair burned or traumatically injured tissue, Traumatic Brain Injury (TBI), sight, and face trauma; and transplant technology. Such efforts will minimize lost duty time from and provide military medical capabilities for far-forward medical/surgical care of injuries as well as post-evacuation restorative and rehabilitative care.. Starting in FY10, S19 (T-Medical/Soldier Status) funding is merged into project S14. Research conducted in this project focuses on the following six areas:(1) Hemorrhage (bleeding) Control, Blood, and Resuscitative Fluids: Conduct studies of genetic pathways and metabolic mechanisms associated with bleeding to understand the relationships between the human immune processes and blood clotting in trauma. In FY10 and FY11, funding shifts to the Damage Control Resuscitation area.(2) Damage Control Resuscitation: Conduct studies of genetic pathways and metabolic mechanisms associated with blood clotting to understand the relationships between the human immune processes and bleeding in trauma; this research area starts in FY10.(3) Combat Trauma Therapies: Conduct studies of trauma to tissues and organs, and ways to mitigate and/or repair this damage. Research will address cellular repair/ growth mechanisms to treat Traumatic Brain Injury (TBI), eye and facial/maxillary (jaw bone) trauma, and burns.(4) Combat Casualty Bioinformatics and Simulation: Conduct basic research to develop improved training simulators and approaches for novel patient monitoring solutions using computational biology (interdisciplinary field that applies computer science, applied mathematics, and statistics to address solutions to biology problems). In-house modeling and simulation research ended in FY08 and is now conducted by the Program Executive Office, Simulation, Training, and Instrumentation (PEO-STRI). The bioinformatics area will be funded by the Combat Critical Care Engineering research area in FY101. (5) Combat Critical Care Engineering: Conduct basic science studies of vital sign responses to trauma as predictors of medical outcomes and as a basis for developing life saving interventions. This research area starts in FY101.(6) Clinical and Rehabilitative Medicine: Conduct basic studies of mechanisms of tissue growth and traumatic injury to gain an understanding that will allow us to assist the healing or transplantation process; this research area starts in FY10.Promising results identified in this project are further matured under PE 0602787A, project 874.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the US Army Institute of Surgical Research (USAISR), Fort Sam Houston, TX; and the Armed Forces Institute of Regenerative Medicine (AFIRM), Fort Detrick, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.393	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S14: *SCI BS/CBT CAS CARE RS*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Hemorrhage Control, Blood, and Resuscitative Fluids: In FY09, utilized more definitive procedures to locate the exact gene(s) involved in animals that demonstrated survival to assist in identifying new forms of treatment for severe hemorrhage. In FY10 and FY11, this work will be funded under the Damage Control Resuscitation area. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Damage Control Resuscitation In FY10, extend survival studies to determine the biochemical and genetic relationships between blood clotting and inflammation -- factors causing death following severe bleeding. In FY11, will investigate genetic components of the response to hemorrhage with specific strains of rats. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	1.058	0.962	0.000	0.962

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3	5.674	1.890	2.038	0.000	2.038
Combat Trauma Therapies: In FY09, expanded Penetrating Ballistic-type Brain Injury (PBBI) studies to a larger animal model; continued exploring cellular mechanisms of tissue growth through Armed Forces Institute of Regenerative Medicine (AFIRM); and began basic science exploration of a single dose wound healing therapeutic. In FY10, realign Armed Forces Institute of Regenerative Medicine (AFIRM) and vision restoration to the Clinical and Rehabilitative Medicine program area; conduct PBBI protein and gene regulation and neuroprotection mechanism studies; investigate PBBI biomarkers as surrogate markers to show effectiveness of neuroprotection drugs; refocus dental disease research to repair of maxillofacial bone and soft tissue injury repair; and begin research in eye trauma to understand the cellular and neuronal mechanisms of eye injuries. In FY11, will continue gene regulation and neuroprotection mechanism studies including those to understand cellular mechanisms of cell death; characterization of a polytrauma model; and discovery of novel pharmaceuticals to mitigate TBI brain hypothermia; will investigate new therapies based upon dentally derived stem cells for traumatic dental wound healing and repair; and will explore causes of low vision from head trauma. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 Clinical and Rehabilitative Medicine: In FY10, begin research in eye trauma to understand the cellular and neuronal mechanisms of eye injuries; and through AFIRM explore different innovative regenerative tissue strategies, including scaffold-like tissue mats containing blood vessels, cell based therapies to augment regenerative tissue, approaches that yield a pool of responding cells that can be cued biologically to specific cell types, and biomaterials that direct cell growth. In FY11, and AFIRM will continue the iterative process of exploring innovative regenerative tissue strategies and advancing promising approaches to the applied research phase. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	3.432	3.818	0.000	3.818
Program #5 Small Business Innovative Research/Small Business Technology Transfer Programs	0.000	0.125	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	6.067	6.505	6.818	0.000	6.818

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT S15: *SCI BS/ARMY OP MED RSH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
S15: *SCI BS/ARMY OP MED RSH*	9.374	7.083	8.839	0.000	8.839	9.381	10.338	10.531	10.723	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds basic research on physiological and psychological factors limiting Soldier effectiveness and on the characterization of health hazards generated by military systems and resulting as a consequence of military operations. This includes research on the neurobehavioral aspects of post traumatic stress and suicide, and developing concepts for medical countermeasures to prevent or mitigate the effects of muscle and bone injury and to reduce the effects of sleep loss and other stressors on Warfighter performance. The hazards of exposure to directed energy, repetitive use, fatigue, heat, cold, and altitude are also investigated under this project. Research conducted in this project focuses on the following six areas: (1) Injury Prevention and Reduction: Conduct research on the body's effects from non-ionizing radiation and directed energy and the physiological mechanisms of musculoskeletal injury. (2) Physiological Health: Conduct research on the physiological mechanisms of sleep, fatigue, and nutrition on Soldier performance and well-being. (3) Environmental Health and Protection: Conduct research on the physiological mechanisms of exposure to extreme heat, cold, altitude and other environmental stressors. (4) Network Sciences: Conduct research on the fundamental processes of interactions at the molecular and cellular level. In FY10, the funding for Network Science Initiative effort transfers to project T64.(5) Computational Biology: Conduct research, using tools that combine biology, computer sciences and mathematics, to solve biological problems that would be difficult or impossible to solve solely through testing in traditional laboratory experiments, animal models or human trials. Research in this area starts in FY11.(6) Psychological Health and Resilience: Conduct research into the basic mechanisms of psychological resilience (i.e., mental toughness and the ability to overcome traumatic events) and post-concussion related mental and physical challenges. Studies also include determination of suicide risk and protective factors and treatment for Post-Traumatic Stress Disorder (PTSD). Promising results identified in this project are further matured under PE 0602787A, project 869.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; and the US Army Research Institute of Environmental Medicine (USARIEM), Natick, MA.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.296	1.304	1.392	0.000	1.392
Injury Prevention and Reduction: In FY09, investigated the process by which inheritable information from a gene, such as the DNA sequence, is made into a functional gene product or a protein, and how cellular interactions with the environment affect the nature of bone-marrow derived stem cell treatment for laser eye injury; and investigated the effects of hormone levels on cell control of muscle and bone tissue to enhance tissue repair. In					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY10, investigate hormone and cell-level adaptations in skeletal muscle in response to military-relevant training and injury to include mechanisms of skeletal muscle repair, regeneration, and adaptation; explore how bone components are associated with stress fracture risk.; identify laser eye injury thresholds in an animal model for single short duration pulses and repetitive pulse exposures for small and large retinal spot sizes to enhance risk assessment tools for eye protection. In FY11, will identify specificity of hormonal fatigue markers in Soldiers during states of physical exertion and energy status and investigate responses to physical fatigue to prevent musculoskeletal injury; will examine dose-response relationships to blood and tissue changes and model results for visible and infrared wavelengths as a risk assessment tool for laser eye injury. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Physiological Health: In FY09, refined the individual components to establish a more robust fatigue performance prediction model. In FY10, investigate the extent individual resilience generalizes across various types of sleep loss; explore the relative effects of countermeasures for reversing deficits caused by fatigue; investigate and model optimal recovery sleep and recycle rate following missions; and identify healthy weight management strategies to improve Soldier health and retention. In FY11, will investigate the extent to which the recuperative value of recovery sleep and the rate of recuperation can be enhanced through use of medication; will identify the	2.784	2.367	2.237	0.000	2.237

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
nutritional strategies required to sustain health in the modern training environment; will explore the impact of micronutrient status on performance and immune function during military training. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Environmental Health and Protection: In FY09, initiated a rodent animal model of classic heat stroke and examine the efficacy of a novel treatment intervention to enhance long-term recovery and return to duty. In FY10, explore rodent models of heat stroke to evaluate and enhance long-term recovery and return to duty; investigate dose response of medication countermeasures for the efficacy of preventing altitude illness versus probability and severity of adverse side-effects. In FY11, will explore molecular mediators of tissue, organ and skeletal muscle injury associated with exertional heat injury and/or stroke in the rodent model; and will expand the investigation of dose response of medication countermeasures for the efficacy of preventing altitude illness at moderate altitude (3,000 meters). *FY 2009 Accomplishments:* FY 2009	3.305	1.267	1.239	0.000	1.239

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Network Sciences / Computational Biology: In FY09, developed mathematical models to predict host-pathogen protein-protein interaction networks, and metabolic models to predict phenotypical (the genetically and environmentally determined physical appearance of an organism) responses induced by external stimuli. In FY10, the funding for this effort transfers to project T64. Computational Biology: In FY11, will conduct computational biology modeling to advance development of protein-protein interaction models for the prediction of host-pathogen interaction networks. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.989	0.000	0.923	0.000	0.923

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #5	0.000	2.080	3.048	0.000	3.048
Psychological Health and Resilience: In FY10, investigate a behavioral screening tool to induce and evaluate PTSD-like symptoms in rodents; investigate potential correlations between anti-depressant medication use and suicidal behaviors; investigate neuropsychological performance tests/batteries as a diagnostic for concussion in Soldiers; identify factors that predict or correlate severity of post-concussion symptoms. In FY11, will induce and evaluate PTSD-like symptoms in rodents for potential drug and behavioral intervention to treat combat-related PTSD; will further explore associations of completed and attempted suicides with the use of anti-depression medication; and will investigate the predictive value of neuropsychological and neurological measures for prediction of likelihood and/or severity of subsequent post-concussion symptoms. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6	0.000	0.065	0.000	0.000	0.000
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	9.374	7.083	8.839	0.000	8.839

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
S19: *T-MED/SOLDIER STATUS*	0.729	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

The purpose of this program is to perform research contributing to superior combat casualty care for troops through faster diagnosis and treatment while allowing on-site health care providers to consult with specialists worldwide. This work will focus on advancing the means to determine soldier physiological status and aiding medical diagnosis and treatment. A significant thrust area will work to ascertain the sensors most relevant to determine change in soldier physiological status.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.729	0.000	0.000	0.000	0.000

In FY09, developed algorithms and completed analysis to analyze real-time beat-to-beat electric signals from the body as it approaches shock in controlled human studies. Compared changes in these signals with other changes to determine if these changes in signal provide an early indicator of progression to circulatory shock and therefore represent a simple algorithm for the triage of battlefield casualties. In FY10, this Project is consolidated with Project S14.

FY 2009 Accomplishments:
FY 2009

FY 2010 Plans:
FY 2010

Base FY 2011 Plans:
FY 2011 Base

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.729	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*	25.085	20.573	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Defense Research Sciences.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	3.186	3.182	0.000	0.000	0.000
Perpetually Assailable and Secure Information System (PASIS). In FY09 this Congressional Interest Item project developed technologies that directly impact the Army's and DoD's capabilities, including secure information processing, transmission and storage, and educates and trains scientists and engineers in the areas of information assurance, reliable software engineering, and network science. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	1.595	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Technology Commercialization and Management Network. This Congressional Interest Item project developed policy-based parameters for the flow of information in a tactical environment. The various echelons involved in any command and control operation requires that information be disseminated up and down the spectrum, often involving both classified and unclassified environments. This effort facilitated the information distribution while maintaining the fidelity and security of the data. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Cyber Threat Analytics. In FY09, this Congressional Interest Item project conducted research to accelerate the ability of organizations to defend against large scale network threats by creating the underlying technologies to enable next-generation privacy-preserving digital threat analysis centers. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	2.392	2.388	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Flexible Electronics Research Initiative. In FY09 this Congressional Interest Item project developed flexible electronics materials. The materials enabled improved organic light emitting diode and thin film transistor performance. The devices were integrated with flexible active matrix backplanes from the Flexible Display Center. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.595	1.592	0.000	0.000	0.000
Program #5 UT-Tyler Organic Semiconductor Modeling and Simulation. In FY09, this Congressional Interest Item developed modeling and simulation for organic electronics. The modeling results were used to design and advance electronic devices fabricated at University of Texas Dallas and the Flexible Display Center.	1.192	0.875	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Global Military Operating Environments. This Congressional Interest Item developed technologies for characterizing critical natural environments for support of high op tempo military operations world-wide. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.991	0.000	0.000	0.000	0.000
Program #7	1.194	0.756	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Nanocrystal Source Display. In FY09, this Congressional Interest Item developed novel quantum dot light emitting devices. The QD devices are being advanced for improved efficiency and stability. The device will be integrated with active matrix backplanes from the Flexible Display Center. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 Fuel Logistics Reduction Through Enhanced Engine Performance. This Congressional Interest Item project developed a "bottoming device", for diesel engines. It is designed to capture the normally wasted heat from the exhaust and use it to generate additional engine power. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.194	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #9 Nanostructured Materials for Photovoltaic Applications. This Congressional Interest Item conducted research to understand the fundamental science and engineering necessary to develop efficient and robust organic, inorganic and hybrid photovoltaic systems with a focus on dye-sensitized solar cells to generate photovoltaic systems for evaluation of energy conversion. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.592	0.000	0.000	0.000	0.000
Program #10 Center for Advanced Energy Storage Research and Technology. This Congressional Interest Item conducted research on electrical energy storage using an experimental test bed. The results will be applicable to a number of military APU applications including the use of solar energy, wind energy, and other intermittent power sources.	1.592	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army **RDT&E Project Justification**		**DATE:** February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #11 Sustainable Alternative Energy for DoD. In FY09 this Congressional Interest Item project developed methods for generating JP-8 Diesel fuel from bio waste, including tree pulp and other vegetation materials. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	2.389	1.990	0.000	0.000	0.000
Program #12	1.193	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Urban Patterns and Signatures to Support Counter-Insurgency Operations. This Congressional Interest Item project created and exploited opportunities for new understanding of the urban battlespace to better anticipate, discover and track adversary actions before and during combat. Line-of-sight and non-line-of-sight sensor technologies have emerged that allow persistent surveillance of urban areas and complex terrain. This, along with the added dimensionality that new sensing approaches can bring, points to the potential for monitoring and baselining the signature space of the cluttered, "noisy" urban environment. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #13 Toxic Particles. In FY09 this Congressional Interest Item project conducted research to determine the effects of nanoparticles on DNA and their potential carcinogenicity in human lung cells, including studying how surface composition modulates these effects. *FY 2009 Accomplishments:* FY 2009	0.795	1.592	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #14 High Frequency Devices and Circuits for Nanotubes and Nanowires. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.433	0.000	0.000	0.000
Program #15 Lightweight Polymer Designs for Soldier Combat Optics. This is a Congressional Interest Item.	1.193	0.796	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #16 Fighting Drug Resistant Infections. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.992	0.000	0.000	0.000	0.000
Program #17	0.000	2.388	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T14: *BASIC RESEARCH INITIATIVES - AMC (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Secure Open Systems Initiative. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #18 Bioactive Polymers and Coating Systems for Protection Against Bio-Threats. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	3.581	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Accomplishments/Planned Programs Subtotals	25.085	20.573	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T22: *SOIL & ROCK MECH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T22: *SOIL & ROCK MECH*	2.208	2.299	2.358	0.000	2.358	2.426	2.481	2.531	2.581	Continuing	Continuing

A. Mission Description and Budget Item Justification

This basic research project correlates the effects of the nano- and micro-scale behavior on the macro-scale performance of geological and structural materials to provide a foundation for the creation of future revolutionary materials and to revolutionize the understanding the sensor data within a heterogeneous geological systems. This research encompasses geologic and structural material behavior, structural systems, and the interaction with dynamic and static loadings. Research includes: underlying physics and chemistry that controls the mechanics and electromagnetic behavior of geological and structural materials, new techniques that provide measurements at the fundamental scale, and fundamental theories for relating nano- and micro-scale phenomena to macro-scale performance. This research provides the basis for applied research in PE 0602784A (Military Engineering Technology), project T40 (Mobility/Weapons Effects Technology), that supports the civil engineering technologies for adaptive protection, scalable weapons effects, near surface computational testbed, and austere entry and maneuver for the future force. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.208	2.286	2.358	0.000	2.358
Military Engineering Basic Research: In FY09, produced a simulation capability for a full, dynamic micro-scale air-water-solid system to examine soil moisture in porous media. Developed an initial modeling and experimental capability for the multi-scale structuring of cementitious materials for enhanced impact and penetration resistance applications. In FY10, develop a model for ultra high strength fiber reinforced concrete (FRC) subjected to highly dynamic loading conditions (e.g., blast, impact, and penetration events). Gain an understanding of the rate effects in high performance concrete to determine if mesoscale models under development inherently generate the strain rate effects seen in macroscopic concrete response. In FY11, will develop a mathematical techniques to create continuum models for engineering-level analysis at coarser scales using discrete variables from nanoscale models express discrete variables from nanoscale models in terms of continuum models that can be used in engineering models at coarser scales.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T22: *SOIL & ROCK MECH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.013	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.208	2.299	2.358	0.000	2.358

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T22: *SOIL & ROCK MECH*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T23: *BASIC RES MIL CONST*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T23: *BASIC RES MIL CONST*	1.688	1.761	3.839	0.000	3.839	1.901	1.970	2.005	2.042	Continuing	Continuing

A. Mission Description and Budget Item Justification

This basic research project supports facilities research initiatives. The project is focused on forming an explicit and mathematically robust set of algorithms for geometrical reasoning; assessing the conceptual feasibility of applying nanoparticle technology to real-time sensors, thermal conductivity, and high strength materials; and developing novel and advanced concepts for mitigating the effect of chemical and biological agents in built structures. These efforts provide basic research leading to improved design in a range of facilities to optimize facility mission performance, enhance facility security, reduce design and construction errors and omissions, reduce resource requirements, and reduce the environmental burdens over the facility's life. This project provides leap-ahead technologies to solve military-unique problems in the planning, programming, design, construction, and sustainment of deployed facilities, and energy and utility infrastructure. This project supports exploratory development efforts in PE 0602784A (Military Engineering Technology), projects T41 (Military Facilities Engineering Technology) and project T45 (Energy Technology Applied to Military Facilities). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.688	1.733	3.839	0.000	3.839
Facilities Research: In FY09, conducted validations to support the development of next generation nanotechnology for facilities, sensor coatings, and constitutive models for micro-particle dispersion. Investigated the phenomena that govern the synthesis and properties of carbon nanotube coatings. Also investigated light-triggered release of biocides from liposome photosensitive polymers to neutralize biological contaminants. Finalized the complex interactions between a forest edge and an acoustic wave, including the dependence on acoustic ground impedance, microclimate, and biomass structure. In FY10, investigate mechanisms for on-demand release of biocides and free radicals to determine photolytic degradation phenomena. Develop a fundamental understanding of the use of electrophoresis in producing new composite materials for present and future military applications. In FY11, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to the next generation nanotechnology research initiatives of military interest. Also,					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T23: *BASIC RES MIL CONST*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
will complete investigation of electric field effects on chemical reactions in confined nanoporous geometries. Will initiate basic research to explore characteristics of natural materials with exceptional mechanical properties in order to develop the foundational understanding that will lead to advances in blast and ballistic protection, base sustainment, and readiness through engineered material models. Will explore atomistic- and poly-crystalline-level mechanical properties of materials such as graphene or carbon nanotube (CNT) - ceramic composites for use in optimal performance designs that scale to macro-system levels. The goal will be to discover the properties and relationships the lead to a means to create new bio-inspired composite materials that are lighter and better performing. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009	0.000	0.028	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T23: *BASIC RES MIL CONST*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	1.688	1.761	3.839	0.000	3.839

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T24: *Signature Physics and Terrain State Basic Research*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T24: *Signature Physics and Terrain State Basic Research*	1.451	1.513	1.573	0.000	1.573	1.616	1.660	1.693	1.727	Continuing	Continuing

A. Mission Description and Budget Item Justification

This basic research project increases knowledge in the areas of terrain state and signature physics. It provides the knowledge base for understanding and assessing environmental impacts critical to battlespace awareness. Projects include fundamental material characterization, investigation of physical and chemical processes, and examination of energy/mass transfer applicable to predicting state of the terrain, which control the effects of the environment on targets and target background signatures and mobility in support of the materiel development community. The terrain state area of terrestrial sciences investigates weather-driven terrain material changes and sensing/inferring subsurface properties. The signature physics area of terrestrial sciences focuses on understanding the dynamic changes to electromagnetic, acoustic and seismic signatures, and energy propagation in response to changing terrain state and near surface atmosphere. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.451	1.510	1.573	0.000	1.573
Terrain State and Signature Physics: In FY09, investigated the variance in disturbed and undisturbed soil physical, thermal, and optical properties to establish physical parameters that govern the signature response and variance in changing environmental conditions, thus optimizing below surface target detection in prevailing environmental conditions. In FY10, observe, characterize, and model the variation of forward scattering at near to grazing angles for both vertical and horizontal polarization to determine if significant geometric roughness will deteriorate, rather than not affect, the forward scattering of RF energy; investigate the controlling influences of radio signal energy loss in deserts and thus poor depth penetration into low clay soils through examination of gypsum and carbonates by determining the complex permittivity spectra and attenuation rates at clay through sand size. Test hypothesis that urban ambient sound and vibration signals can be characterized as a baseline for actionable warnings for future sensor arrays. In FY11, will investigate the topography and morphology of a high					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T24: *Signature Physics and Terrain State Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
relief mountain basin as a major factor driving the spatial distribution of snow melt onset as measured by passive microwave sensors. Devise a calculation method for sound wave propagation and coherence over random spatial variations in terrain surface elevation and ground properties (such as permeability, porosity, grain size, and water content) and identify the characteristics and significance of random terrain effects on wave scattering. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	0.003	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T24: *Signature Physics and Terrain State Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	1.451	1.513	1.573	0.000	1.573

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T25: *Environmental Science Basic Research*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T25: *Environmental Science Basic Research*	5.980	7.917	8.106	0.000	8.106	8.234	8.562	8.719	8.870	Continuing	Continuing

A. Mission Description and Budget Item Justification

This basic research project investigates fundamental scientific principles and phenomena necessary to ensure efficient development of the technologies needed to address Army sustainment issues in the restoration, compliance, conservation, and non-industrial pollution prevention areas. These efforts include: investigating and monitoring contaminated sites, including chemical contamination and unexploded ordnance (UXO) detection/discrimination; better characterization of contaminants through improved risk-based assessment; destruction, containment, or neutralization of organics in water, soil, and sediments resulting from military activities; adhering to applicable federal, state, and local environmental laws and regulations; monitoring and controlling noise generation and transport; protecting and enhancing natural and cultural resources; reducing pollution associated with military activities; and the study of ecosystem genomics and proteomics in support of the Army's new Network Science initiative. The project supports applied research under PE 0602720A (Environmental Quality Technology), project 048 (Industrial Operations Pollution Control Technology), project 835 (Military Medical Environmental Criteria), and project 896 (Base Facilities Environmental Quality). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Department of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.838	3.702	3.923	0.000	3.923
Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants: In FY09, defined the equilibrium expressions of major tungsten reactions under relevant geochemical conditions and elucidated tungsten toxicity mechanisms related to intracellular phosphorylation reactions. Combined computational and toxicological approaches to assess basis of environmental risk. In FY10, complete new computational chemistry equations to predict solubility and other physical characteristics of munitions constituents (MC). and establish biological models of soil invertebrate neurotransmission networks as affected by less-than-lethal doses of RDX. Construct computational chemistry models of the physiological reaction of bacteria to explosives contaminants. Investigate the use of engineered proteins as cell-based toxicology sensors of MCs. Explore the use of endophytes					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T25: *Environmental Science Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
(microorganisms living inside plants) as biosensors of MC contamination. In FY11, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to the environmental and ecological fate of contaminants of military interest. Continue investigations of degradation and transformation mechanisms of insensitive munitions and emerging contaminants. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Remediation of Explosives, Energetics, and UXO: In FY09, defined and quantified the effect of disturbance on the sorption and transformation properties of explosives in soils. Quantified surface and vadose zone phenomena such as the role of colloidal transport in migration of explosives. In FY10, complete investigations of degradation of and by nanomaterials. Investigate the chemical composition of metal-rich granules (MRG) produced by soil invertebrates when exposed to MC to reduce uncertainty factors in environmental risk assessment. Elucidate the potential for abiotic and biotic degradation of new insensitive explosives to determine their potential for transport in soils and environmental affects. In FY11, will continue to establish a base of understanding of the physical, chemical, and biological phenomena specific to the remediation of explosives and energetics on training ranges.	1.561	2.302	2.360	0.000	2.360

Exhibit R-2A, PB 2011 Army **RDT&E Project Justification**		**DATE:** February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T25: *Environmental Science Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Training Land Natural Resources: In FY09, identified the complex interactions between forest edge and an acoustic wave (such as artillery) incorporating relevant descriptive parameters into appropriate computational techniques allowing noise impact visualization. Completed determination of responses and impacts of multigenerational RDX exposure. In FY10, define the fundamental properties of pollination networks on Army ranges. Investigate environmentally benign bioadhesion resistant coatings (modification of surface microstructure) as a means to reduce transport of invasive species. In FY11, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigations, and rehabilitation. Investigate the mechanisms of accumulated oxidative stress affects on altered animal behavior and survival to provide a model of linking animal responses across large spatial and temporal scales for landscape, river, coastal and climate management. *FY 2009 Accomplishments:* FY 2009	0.605	0.721	0.735	0.000	0.735

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T25: *Environmental Science Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Network Science: In FY09, identified and defined mechanisms controlling the genetic networks associated with ovarian hormone production. A model ecological system was used to develop numerical-mechanistic descriptions of how learning and environmental heterogeneity contribute to adaptation in hunter prey relationships. Investigated the theories/algorithms of animal learning and communication on the propagation of information affecting the survival of individuals in a hunter prey network in static versus dynamic heterogeneous hunter/ prey environments. In FY10, identify metabolic network control structures that govern the degradation / transformation of RDX. Determine the relationship of complex biological network architecture to fragility in hormone production. In FY11, will continue to establish a basic understanding of physical, chemical, and biological phenomena specific to network science applications. Will evaluate alternative compositions of heterogeneity in population vigilance affording resilient/adaptive behavior at reduced cost. Will develop cognitive elements to dynamically elicit the emergence of desired composition in heterogeneity. Will define the network structure involving steroidogenesis genes using time series analysis. Will develop approaches using genetic tools to perturb network dynamics by gene silencing or over expression. *FY 2009 Accomplishments:* FY 2009	0.976	1.006	1.088	0.000	1.088

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T25: *Environmental Science Basic Research*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.186	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	5.980	7.917	8.106	0.000	8.106

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T25: *Environmental Science Basic Research*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T61: *Basic Research Initiatives - MRMC (CA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T61: *Basic Research Initiatives - MRMC (CA)*	2.392	4.775	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Medical Basic Research Initiatives.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.392	1.592	0.000	0.000	0.000
Combat Mental Health Initiative. In FY09 this Congressional Interest Item collected data from a random sampling of Ohio National Guard members for a study to better understand why some people develop Post Traumatic Stress Disorder (PTSD) and other do not. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	0.000	3.183	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T61: *Basic Research Initiatives - MRMC (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Vision Integrating Strategies in Ophthamology and Neurochemistry (VISION). This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	2.392	4.775	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T63: *ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T63: *ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH*	1.453	1.224	1.463	0.000	1.463	1.457	1.935	1.969	2.001	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds basic research in technical areas that will expand the autonomous capabilities, utility, and portability of small robotic systems for military applications, with a focus on enhanced intelligence, biomimetic functionality, and robust mobility, to permit these systems to serve as productive tools for dismounted Soldiers. The ability of the Warfighter to command a suite of small unmanned systems (air, ground, and hybrid vehicles) will reduce exposure of the Soldier to harm and will improve the efficiency by which a dismounted unit achieves tactical objectives such as securing a targeted zone. Example missions requiring enhanced autonomy, manipulation, and man-portability include rapid room clearing and interior structure mapping; detection of human presence, chemical/biological/nuclear/radiological/explosive (CBNRE), and booby-traps; surveillance; and subterranean passage detection and exploration. Because of their relatively small size, light weight, and service in dismounted environments, small unmanned systems have unique challenges in perception, autonomous processing, mobility mechanics, propulsive power, and multi-functional packaging that transcend similar challenges associated with large unmanned systems. The Army Research Lab will conduct research in related disciplines, including machine perception, intelligent control, biomimetic robotics, manipulator mechanics, and propulsive power and drives to foster the development of technologies for lightweight, small-volume, environmentally-harsh robotics applications. Machine perception research includes the exploration of lightweight ultra-compact sensor phenomenology and the maturation of basic machine vision algorithms that enable small unmanned systems to more fully understand their local environment. Intelligent control research includes the maturation of autonomous processing capabilities and the advancement of artificial intelligence techniques that lead to reliable autonomous behavior in a large-displacement, highly-dynamic environment and permit unmonitored task performance. Research in biomimetic robotics and manipulator mechanics includes the advancement of mechatronic and biomimetic appendages to enable agile high-speed locomotion, dexterous task-performance, and environmental-manipulation; and the maturing of nonlinear control algorithms to support robust, stable mobility. Propulsion power and drives research includes investigations of engine cycles and alternative hybrid energy conversion techniques to provide compact, lightweight, quiet, low-emission, high-density power sources that support highly-portable unmanned systems capable of performing long-endurance missions. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Defense of Defense Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed internally by the Army Research Laboratory (ARL), Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.453	1.190	1.463	0.000	1.463

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T63: *ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Robotics autonomy and human robotic interface research: In-house research with a focus on enabling robust autonomous mobility for small robotic systems, including autonomous operations in Global Positioning System (GPS) denied areas, planning, behaviors, intelligent control, and the interface of perception technologies to accomplish Army missions in the area of unmanned systems. In FY09, developed small staring Laser Detection and Ranging (LADAR) and super-resolution LADAR techniques to provide a small lightweight perception capability; studied hybrid-electric propulsion systems with appropriate size, weight, and logistics to provide the necessary power for high energy mobility combined with a silent-drive, silent-watch capability; developed autonomous processing techniques and algorithms for navigation, mapping, object recognition, and intelligent decision making to address increasingly complex dismounted scenarios; conducted validations utilizing advanced mechanical and biomimetic components to advance technologies that support high ground speeds, robust maneuvering, and efficient stair and obstacle climbing capabilities. In FY10, develop dexterous manipulation systems with high density sensors and intelligent control algorithms to support complex task performance such as opening doors and moving objects or impediments. These manipulation systems are to be studied statically and in combination with highly mobile robots. In FY11, new combinations of advanced sensor data will be fused in real time to provide enhanced dynamic situation awareness for small robotic systems, increasing the speed and agility of operation. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T63: *ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #2	0.000	0.034	0.000	0.000	0.000
Small Business Innovative Research/Small Business Technology Transfer Programs					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					
Base FY 2011 Plans: FY 2011 Base					
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	1.453	1.224	1.463	0.000	1.463

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T64: *SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
T64: *SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE*	0.000	1.279	1.278	0.000	1.278	1.177	1.271	1.294	1.318	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds research to conduct studies through a modernized systematic approach that uses iterative computer simulation with mathematical modeling and biological information to analyze and refine biological studies. The information gained provides a better understanding of the overall biological system and its molecular network of interactions, which leads to improved early strategic decision-making in development of preventive and treatment solutions to diseases. This approach establishes a model for application of systems biology processes and knowledge of biological networks to discover medical products that prevent and/or treat diseases or medical conditions. This more complex, yet integrated approach to studying biological systems could potentially reduce both the time and expense of medical product development for the Army. Funding for this research is in project S15 prior to FY10. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the US Army Medical Research and Material Command (MRMC), Fort Detrick, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.000	1.243	1.278	0.000	1.278
Network Sciences Initiative: In FY09, this research was funded in project S15. In FY10, complete development of mathematical models, which predict host-pathogen (infectious agent or germ) networks. These mathematical models will be used to predict environmentally-produced observable responses induced by external stimuli at the molecular (genomic, proteomic, metabolomic) level; and establish and test mathematical and computational models that address identified gaps in network biology. In FY11, will validate these models in the laboratory in animal models.					
FY 2009 Accomplishments: FY 2009					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T64: *SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.036	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	0.000	1.279	1.278	0.000	1.278

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT T64: *SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification											DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	87.485	99.400	91.161	0.000	91.161	96.143	110.107	117.552	125.908	0	818.917
D55: *University Research Initiative*	74.577	78.012	75.911	0.000	75.911	76.405	84.881	90.335	96.703	Continuing	Continuing
D58: *URI ACTIVITIES (CA)*	8.920	14.524	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
D66: *MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)*	3.988	4.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
V72: *MINERVA*	0.000	2.487	15.250	0.000	15.250	19.738	25.226	27.217	29.205	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this program element (PE) is to support Army efforts in the Multidisciplinary University Research Initiative (MURI) program, the Defense University Research Instrumentation Program (DURIP) and the Presidential Early Career Awards for Scientists and Engineers (PECASE) program by funding basic research in a wide range of scientific and engineering disciplines pertinent to maintaining the U.S. land combat technology superiority. Army MURI program efforts involve teams of researchers investigating high-priority; transformational topics that intersect more than one traditional technical discipline (e.g. Intelligent Luminescence for Communication, Display, and Identification). For many complex problems, this multidisciplinary approach serves to accelerate research progress and expedite transition of results to application. The DURIP provides funds to acquire major research equipment to augment current, or devise new, research capabilities in support of Army transformational research. The PECASE program funds single-investigator research efforts performed by outstanding academic scientists and engineers early in their independent research careers. Project D58 funds for specific congressional special interest items.The cited work is consistent with the Department of Defense Research and Engineering Strategic Basic Research Plan, the Army Science and Technology Master Plan, the Army Modernization Strategy. Work on this project is performed extramurally by the Army Research Laboratory (ARL), Research Triangle Park, NC.

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification	DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	89.632	88.421	94.161	0.000	94.161
Current President's Budget	87.485	99.400	91.161	0.000	91.161
Total Adjustments	-2.147	10.979	-3.000	0.000	-3.000
• Congressional General Reductions		-8.021			
• Congressional Directed Reductions					
• Congressional Rescissions		0.000			
• Congressional Adds		19.000			
• Congressional Directed Transfers					
• Reprogrammings	0.363	0.000			
• SBIR/STTR Transfer	-2.510	0.000			
• Adjustments to Budget Years	0.000	0.000	-3.000	0.000	-3.000

Change Summary Explanation

FY10 Congressionally directed increases.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
D55: *University Research Initiative*	74.577	78.012	75.911	0.000	75.911	76.405	84.881	90.335	96.703	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to support the Multidisciplinary University Research Initiative (MURI), the Defense University Research Instrumentation Program (DURIP) and the Presidential Early Career Awards for Scientists and Engineers (PECASE) program. The MURI program funds university basic research in a wide range of scientific and engineering disciplines pertinent to maintaining US land combat technology superiority. Army MURI efforts involve teams of researchers investigating high-priority, transformational topics that intersect more than one traditional technical discipline (e.g. Intelligent Luminescence for Communication, Display, and Identification). For many complex problems, this multidisciplinary approach serves to accelerate research progress and expedite transition of results to application. The DURIP provides funds to acquire major research equipment to augment current, or devise new, research capabilities in support of Army transformational research. The PECASE program funds single-investigator research efforts performed by outstanding academic scientists and engineers early in their independent research careers. The cited work is consistent with the Department of Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work on this project is performed by the Army Research Laboratory (ARL) located in Research Triangle Park, NC.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	60.820	56.788	58.453	0.000	58.453
Multidisciplinary University Research Initiative (MURI). In FY09, MURI topics were Disruptive Fibers for Flexible Armor, Network-based Hard/Soft Information Fusion, Tailored Stress-Wave Mitigation, Integrated Quantum Circuits, Adaptive Structural Materials, Transformational Optics, Emergent Phenomena at Complex Oxide Interfaces, Application of Systems Biology to Regenerative Medicine, Mechanisms of Bacterial Spore Germination, Opportunistic Sensing, and Cyber Situation Awareness. In FY10, the program supports MURI, with 10 new awards planned that are critical to the Army's future operating capabilities. In FY11, support for MURI awards made in prior years will continue and 9 new MURI awards critical to future operating capabilities will be initiated. Effective transition mechanisms include collaboration among principal investigators, participation by 6.2/6.3 program managers in MURI program reviews, and communication of the MURI research results to the Army Research Laboratory, the Research, Development, and Engineering Centers, and industry.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Presidential Early Career Awards for Scientists and Engineers (PECASE): Supports PECASE investigators started in prior years. In FY09, selected fifteen new investigators for PECASE awards, an increase of twelve over prior year number of awards. In FY10, continued with fifteen new awards.In FY11, will continue support for prior year PECASE awards and select 12 additional PECASE awardees. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.938	2.837	4.291	0.000	4.291

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #3 Defense University Research Instrumentation Program (DURIP): In FY09, DURIP funded competitive grants for research instrumentation. In FY10 and FY11, fund competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	11.819	13.001	13.167	0.000	13.167
Program #4 The Minerva Research Initiative (MRI) is a university-based social science research program initiated by the Secretary of Defense. It focuses on areas in the social sciences of strategic importance to U.S. national security policy. It seeks to increase the Department's intellectual capital in the social sciences and improve its ability to address future challenges and build bridges between the Department and the social science community. Minerva will bring together universities, research institutions, and individual scholars and support multidisciplinary and cross-institutional projects addressing specific topic areas determined by the Department. Proposals have been solicited that address the following topics: (1) Chinese Military and Technology Research and Archive	0.000	3.202	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Programs, (2) Studies of the Strategic Impact of Religious and Cultural Changes within the Islamic World, (3) Iraqi Perspectives Project, (4) Studies of Terrorist Organization and Ideologies, (5) New Approaches to Understanding Dimensions of National Security, Conflict, and Cooperation. Within the Army there were four awards initiated in FY09 which are continuing in FY10. In FY11 this effort is consolidated under PE 61103, Project V72. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	2.184	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	74.577	78.012	75.911	0.000	75.911

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
D58: *URI ACTIVITIES (CA)*	8.920	14.524	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for University Research Initiatives.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.595	0.000	0.000	0.000	0.000
Low Temperature Vehicle Perfomance Research. This Congressional Interest Item conducted basic research on very low temp behavior of military diesel engines. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	1.595	1.591	0.000	0.000	0.000
Hi-tech Eyes for the Battlefield. In FY09 this Congressional Interest Item project developed a novel, lightweight, and adaptive image sensor architecture that derives its performance not from the size of the optical elements but					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
from the power of the signal processing and the adaptability of its parts. The program developed independent control of the instantaneous fields of view from an array of micro-imagers using signal processing and a two-dimensional array of micro-mirrors. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Nanosystems Through Optical Biosensors. This Congressional Interest Item project conducted research on the application of nanotechnology to the detection and manipulation of biological materials (i.e. biohazard sensing) and the development of nanoengineered materials and systems for advanced energy production (i.e. fuel cell membranes). *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.595	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Electrofluidic Chromatophores for Adaptive Camouflage. This Congressional Interest Item developed reflective display elements based on electro-wetting. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.743	0.000	0.000	0.000	0.000
Program #5 Columbia College Chicago Construct Program. In FY09 this Congressional Interest Item developed interactive simulations to train individuals to solve problems as a team, making the move from solo effort to teamwork involving knowledge and skills that can be developed systematically, used methods of movie and video game production.	0.797	1.592	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Open Source Intelligence for Force Protection and Intelligence. In FY09 this Congressional Interest Item project supported the collection, data mining, and data distribution of open source information that can be used to achieve a tactical advantage. Currently, this technology supports the US Border agencies, but is being extended such that it can address military requirements across the globe. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.595	0.796	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #7 Antennas for Unmanned Aerial Vehicles. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.995	0.000	0.000	0.000
Program #8 Science, Technology, Engineering, Mathematics (STEM) at Coppin State University. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.796	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #9 Laboratory for Engineered Human Protection (LEHP). This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.591	0.000	0.000	0.000
Program #10 Collaboration Skills for Time Critical Teams. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009	0.000	1.591	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #11 Cooperative Developmental Energy Program. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.592	0.000	0.000	0.000
Program #12 Manufacturing Lab for Next Generation Engineers. This is a Congressional Interest Item.	0.000	1.592	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #13 Molecular Electronics for Flash Memory Protection. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	2.388	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	8.920	14.524	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D58: *URI ACTIVITIES (CA)*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D66: *MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
D66: *MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)*	3.988	4.377	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Medical University Research Initiatives.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.994	1.592	0.000	0.000	0.000
Burn and Shock Trauma Institute. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	1.994	0.000	0.000	0.000	0.000
DoD International Diabetes Research Initiative. This is a Congressional Interest Item.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D66: *MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Military Family Coping Patterns. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.398	0.000	0.000	0.000
Program #4	0.000	2.387	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D66: *MEDICAL UNIVERSITY RESEARCH INITIATIVES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Battlefield Exercise and Combat Related Spinal Cord Injury Research. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	3.988	4.377	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT V72: *MINERVA*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
V72: *MINERVA*	0.000	2.487	15.250	0.000	15.250	19.738	25.226	27.217	29.205	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to support the Minerva Research Initiative (MRI), a university-based social science research program initiated by the Secretary of Defense in FY09 to develop a fundamental understanding of the perceptions, attitudes and beliefs of foreign cultures. The overall goals of the initiative are to foster basic social science research on topics of U.S. national strategic importance; to increase the Department's intellectual capital in the social sciences; and to build bridges between the Department and the academic social science community.In FY11, this project consolidates efforts that were initiated under PE 61103, Project D55. Existing grants on the studies of the strategic impact of religious and cultural change in the Muslim world; Iraqi perspectives; Studies of terrorist organizations and ideologies; and new approaches to understanding dimensions of national security, conflict and cooperation from that project will be continued in FY11.The cited work is consistent with the Director, Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan, as well as the requirements of the Army Culture and Foreign Language Strategy.Work in this project will be executed by the Army Research Office.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.000	2.418	12.000	0.000	12.000
Minerva Research Initiative: In FY10, solicited topics focusing on social science and cultural issues affecting US military warfighting capabilities, the relationship of foreign military and technology capabilities, national and military implications of foreign religious and cultural changes, foreign perspectives of US policy and strategy, terrorist organizations and ideologies, and other issues related to the national security implications of conflict and cooperation. Expand in-house capabilities in order to manage these new areas of social science research within the Department of Defense.In FY 11, will extend research areas to new topics, such as new theories of deterrence and the national security implications of energy and climate change. Will continue to develop in-house social science capabilities necessary to integrate results from the extramural program into the planning, programming and management processes of the DoD as well as to tap university-based expertise in cutting edge social scientific research areas.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT V72: *MINERVA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 In FY11, will continue research initiated under PE 0601103, Project D55 conducting studies of the strategic impact of religious and cultural change in the Muslim world; Iraqi perspectives; Studies of terrorist organizations and ideologies; and new approaches to understanding dimensions of national security, conflict and cooperation. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.000	3.250	0.000	3.250

Exhibit R-2A, PB 2011 Army **RDT&E Project Justification**		**DATE:** February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*	**PROJECT** V72: *MINERVA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #3	0.000	0.069	0.000	0.000	0.000
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.000	2.487	15.250	0.000	15.250

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2, PB 2011 Army **RDT&E Budget Item Justification**										**DATE:** February 2010	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*							
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	121.326	115.338	98.087	0.000	98.087	99.355	109.073	111.335	113.489	0	866.090
F17: *NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE*	0.000	4.954	5.030	0.000	5.030	4.761	5.195	5.321	5.347	Continuing	Continuing
H04: *HBCU/MI CENTERS - TRADOC BATTLELABS*	2.646	2.732	2.776	0.000	2.776	2.826	2.877	2.927	2.974	Continuing	Continuing
H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*	10.724	8.543	9.672	0.000	9.672	11.214	12.494	12.712	12.918	Continuing	Continuing
H09: *ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)*	4.242	4.519	5.077	0.000	5.077	4.884	5.490	5.586	5.677	Continuing	Continuing
H50: *Network Sciences CTA*	6.975	2.645	3.289	0.000	3.289	2.908	3.301	3.395	3.487	Continuing	Continuing
H53: *Army High Performance Computing Research Center*	3.386	3.426	3.706	0.000	3.706	3.955	4.467	4.847	5.319	Continuing	Continuing
H54: *Micro-Autonomous Systems Technology (MAST) CTA*	7.422	8.014	8.050	0.000	8.050	7.445	8.290	8.434	8.570	Continuing	Continuing
H56: *Adv Decision Arch Collab Tech Alliance (CTA)*	5.771	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
H59: *UNIV CENTERS OF EXCEL*	5.078	5.506	5.580	0.000	5.580	6.356	7.431	7.543	7.647	Continuing	Continuing
H62: *Institude for Advanced Technology (IAT)*	5.963	6.403	5.506	0.000	5.506	5.623	6.741	6.859	6.970	Continuing	Continuing
H64: *MATERIALS CENTER*	2.734	2.823	2.869	0.000	2.869	2.920	2.971	3.023	3.072	Continuing	Continuing
H73: *Automotive Research Center (ARC)*	2.863	2.926	2.947	0.000	2.947	2.994	3.049	3.102	3.153	Continuing	Continuing

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*							
J08: *INSTITUTE FOR CREATIVE TECHNOLOGY*	7.457	7.750	7.878	0.000	7.878	8.022	8.167	8.310	8.444	Continuing	Continuing
J12: *Institute for Soldier Nanotechnology (ISN)*	9.782	10.211	10.487	0.000	10.487	10.787	10.891	11.081	11.261	Continuing	Continuing
J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*	24.419	25.665	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
J14: *ECYBERMISSION*	4.481	5.246	5.330	0.000	5.330	5.426	5.522	5.619	5.710	Continuing	Continuing
J15: *NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC*	7.669	8.104	8.072	0.000	8.072	8.217	8.363	8.510	8.647	Continuing	Continuing
J16: *NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE*	2.902	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
J17: *VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE*	1.968	2.033	2.066	0.000	2.066	2.104	2.141	2.178	2.213	Continuing	Continuing
J22: *NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER*	4.844	3.838	9.752	0.000	9.752	8.913	11.683	11.888	12.080	Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) supports future force capabilities by providing research that supports enabling technologies for future force capabilities. Broadly, the work in this project falls into three categories: Collaborative Technology Alliances (CTAs), University Centers of Excellence (COE), and paradigm-shifting centers - University-Affiliated Research Centers (UARCs). The Army formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs involve partnerships between industry, academia, and the Army Research Laboratory (ARL) to incorporate the practicality of industry, the expansion of the boundaries of knowledge from universities, and Army scientist to shape, mature, and transition technology. CTAs have been competitively established in the areas of Micro Autonomous Systems Technology (MAST), Network Sciences, Robotics and Cognition and Neuroergonomics. This PE includes the Army's COE, which focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, such as rotorcraft, automotive, microelectronics, materials, and information sciences. COEs couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in information sciences, materials science, electronics, automotive, and rotary wing technology. Also included is eCYBERMISSION, the Army's national web-based competition to stimulate interest in science, math, and technology among middle and high school students. This PE also includes the four Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary

Exhibit R-2, PB 2011 Army RDT&E Budget Item Justification	DATE: February 2010
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effort. The Institute of Advanced Technology funds basic research in electromagnetic and hypervelocity physics. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies, focusing on enabling network centric-technologies, will broaden the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence address critical research areas for Army Transformation. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this PE is managed by: the Army Research Lab (ARL) in Adelphi, MD; the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) in Warren, MI; the Simulation and Training Technology Center (STTC) in Orlando, FL; and the US Army Research Institute for the Behavioral and Social Sciences (ARI) in Arlington, VA.

B. Program Change Summary ($ in Millions)

	FY 2009	FY 2010	FY 2011 Base	FY 2011 OCO	FY 2011 Total
Previous President's Budget	130.291	96.144	99.016	0.000	99.016
Current President's Budget	121.326	115.338	98.087	0.000	98.087
Total Adjustments	-8.965	19.194	-0.929	0.000	-0.929
• Congressional General Reductions		-6.606			
• Congressional Directed Reductions					
• Congressional Rescissions		0.000			
• Congressional Adds		25.800			
• Congressional Directed Transfers					
• Reprogrammings	-5.342	0.000			
• SBIR/STTR Transfer	-3.623	0.000			
• Adjustments to Budget Years	0.000	0.000	-0.929	0.000	-0.929

Change Summary Explanation

FY10 Congressionally directed increases.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT F17: *NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
F17: *NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE*	0.000	4.954	5.030	0.000	5.030	4.761	5.195	5.321	5.347	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Neuroergonomics Collaborative Technology Alliance (CTA), a competitively selected industry and university consortium, to leverage world-class research in support of future force and Army transformation needs. Escalating levels of complexity and uncertainty on the current and future battlefield present conditions which have never existed before now. Solution strategies and approaches must be developed or tailored. The emerging field of neuroergonomics, which seeks to understand the brain at work and to leverage that understanding to optimize system design, offers tremendous potential for providing the solutions needed to meet the needs of Army forces in the future. This CTA addresses the solution strategies and approaches needed to design systems to fully exploit investments in revolutionary technological advances in areas such as robotics, microelectronics, and computer and network information systems. These technologies present significant opportunities to enhance Army mission capabilities, but impose significant burdens on the human brain, which will ultimately limit Soldier-system effectiveness, sustainability, and survivability. The technical barriers associated with this project include: immature knowledge base to guide the neuroergonomic approach to human-system integration; inadequate capabilities to sense and extract information about brain activity in dynamic, operational environments; lack of valid measures to robustly and uniquely characterize operationally-relevant cognitive performance; lack of techniques for integrating advanced understandings of brain activity into systems designs, including real-time use of measures of cognitive behavior as system inputs and the capability to account for individual differences in maximizing Soldier-system performance. This CTA conducts an intensive and accelerated program to formulate, validate, and transition basic research findings through multi-dimensional approaches (e.g., genetics, computational modeling, neuroimaging, and performance) focused in three areas: maximal effectiveness of information transfer between the system and Soldier; identification of mental states, traits, and experiences that impact commander-level decisions; individualized, real-time measurements and analysis of cognitive processing under operationally-relevant stressors. This Neuroergonomics Collaborative Technology Alliance begins in FY10. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD. Funding was restructured from the Advanced Decision Architecture Collaborative Technology Alliance in PE 0601104A, project H56.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	0.000	1.400	1.540	0.000	1.540

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT F17: *NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Maximize effectiveness of information transfer between system and Soldier. In FY10, investigate perceptual-motor interactions, including those between sensory-perceptual channels and motor systems; explore the complex effects of information quality and quantity on physical and cognitive performance. In FY11, will explore models of information presentation, including multi-modal and adaptive displays; will examine the effects of information systems on physical and cognitive performance. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Identify mental states, traits, and experiences that impact commander-level decisions. In FY10, explore the neural representations of command-level decision making through identification of information representation; examine factors leading to successful or faulty decisions, including biases, heuristics, implicit versus explicit knowledge, context and stressor. In FY11, will examine how the nervous system filters large-scale, multi-dimensional data sets for decision making; will identify individual differences in neural processing underlying successful and unsuccessful decision making. *FY 2009 Accomplishments:* FY 2009	0.000	1.440	1.540	0.000	1.540

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Individualize real-time measurement and analysis of cognitive processing under operationally-relevant stressors. In FY10, identify key individual differences and stressors and investigate their impact on neural processing and cognitive performance; explore the appropriate neuro-sensing approaches for assessment in operational environments. In FY11, will explore methods for state detection and signal processing techniques for signal integration; will develop static algorithms that account for the variability in individual differences and/or environmental stressors on performance. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.975	1.950	0.000	1.950

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT F17: *NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #4	0.000	0.139	0.000	0.000	0.000
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	0.000	4.954	5.030	0.000	5.030

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H04: *HBCU/MI CENTERS - TRADOC BATTLELABS*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H04: *HBCU/MI CENTERS - TRADOC BATTLELABS*	2.646	2.732	2.776	0.000	2.776	2.826	2.877	2.927	2.974	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project transitions advances resulting from basic research to technology demonstration as rapidly as possible. Centers of Excellence have proven effective in harnessing a critical mass of university research expertise and focusing their intellectual capabilities on Army unique science and technology problems. This project takes that approach one step further by partnering the university researchers at Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) with Army Training and Doctrine Command (TRADOC) Battle Labs to gain first hand perspective of the end-user's needs. Through these centers, the Army user begins the collaboration with university researchers from the outset of the research. These Centers of Excellence will join with Army and industrial partners to accelerate the transition from research phase to actual technology demonstration. In addition, these Centers of Excellence will recruit, educate, and train outstanding students and post doctoral researchers in science and technology areas relevant to Army Transformation. This project was previously funded in PE 0601104A, project H59 (University Centers of Excellence) and is being transferred into a distinct project for visibility and management. The cited work is consistent with the Director, Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work on this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.646	2.656	2.776	0.000	2.776
HBCU/MI Centers of Excellence for Battlefield Capability Enhancements (BCE): The centers are: Tuskegee University (Flexible Extremities Protection); NCA&T State University (Environmentally-stable Flexible Displays), and (Human-centric Command and Control Decision Making: predictive modeling of group situational awareness); Tennessee State University (Sensor Fusion); and Prairie View A&M University (Beyond-Line-of-Sight Lethality).In FY09, culminated the first five year BCE effort. Emphasis on transitioning technologies to advanced/applied research occurred and collaborations with TRADOC Battle Labs helped accelerate technology transitions to the battlefield to include devised enhanced protection capability of final fabric designs, delivery of deployable decision support programs for test command groups, designed and fabricated hybrid semiconductor devices on flexible substrates and evaluated their environmental stability; showed full data-fusion for large-scale					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
sensor networks; and showed protocols for wireless sensor network. In FY10, initiate the next five year BCE effort. Once new centers of Excellence for Battlefield Capability Enhancements are selected, efforts in these areas will continue in FY10 and FY11. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	0.076	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	2.646	2.732	2.776	0.000	2.776

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*	10.724	8.543	9.672	0.000	9.672	11.214	12.494	12.712	12.918	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center led by the University of California-Santa Barbara, and two major supporting partners, the California Institute of Technology and the Massachusetts Institute of Technology. The ICB is the Army's primary conduit for leveraging biotechnology for: 1) advanced sensors; 2) new electronic, magnetic, and optical materials; and 3) information processing and bioinspired network analysis. The objective is to perform sustained multidisciplinary basic research supporting technology to provide the Army with biomolecular sensor platforms with unprecedented sensitivity, reliability, and durability; higher-order arrays of functional electronic and optoelectronic components capable of self-assembly and with multi-functions; and new biological means to process, integrate, and network information. These sensor platforms will incorporate proteomics (large scale study of proteins) technology, DNA sequence identification and detection tools, and the capability for recognition of viral pathogens. A second ICB objective is to educate and train outstanding students and post doctoral researchers in revolutionary areas of science to support Army Transformation. The ICB has many industrial partners, such as IBM and SAIC, and has strong collaborations with Argonne, Lawrence Berkley, Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia National Laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army Medical Research and Materiel Command (MRMC) laboratories.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	7.722	7.074	8.453	0.000	8.453
Institute for Collaborative Biotechnologies In FY09, defined a biocatalytically derived route to low-cost fuel and fuel-cell feedstock using microbes to produce fuels directly from biomass including novel cellulose enzymes to break down biomass; characterized and further developed microfluidic chip-based bioseparation technology; researched new bio-inspired nanoparticles to yield optimal signal enhancement in microfluidic channel biomolecular sensors; investigated bio-templated ultra-lightweight batteries for micro-unmanned air vehicles. In FY10, translate discoveries of the mechanisms by which lightweight biological composites dissipate					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
energy and resist fracture into new approaches for blast-resistant materials and structures; develop a blood-based assay for specific markers of 9 traumatic brain injuries (TBI); develop decentralized bio-inspired algorithms for information processing and control by networks of autonomous agents in the presence of unexpected and unfriendly environments. In FY11, will devise a platform that integrates surface enhanced Raman spectroscopy technologies into a free surface fluidic explosives detection system with an open surface microchannel system featuring controlled flow velocities; will build multi-scale mathematical models that describe coral reproduction accounting for the response to global and local signals; will develop optimized materials as implantable, biodegradable tissue scaffolds for eventual application to battlefield trauma; will develop viral templates for the deposition of iridium oxide nanowire films as the catalyst for the synthesis of hydrogen for fuel cell applications. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Neuroscience: In FY09, researched the emerging area of cognitive neuroscience, examining functional magnetic resonance imaging (fMRI) techniques coupled with electroencephalogram (EEG) results designed to increase understanding of fast decision making processes, memory retrieval, categorization, aptitudes for specific tasks and other brain functions. Investigated the use of other potential brain imaging techniques such as positron emission tomography (PET) and magnetoencephalography (MEG) to enhance understanding of brain function. Studied	3.002	1.229	1.219	0.000	1.219

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
and characterized individual differences in brain strategy. Researched methods within neuroscience to provide optimal control for human/machine interfaces. In FY10, extend brain mapping to evaluate Army personnel with field experience for decision making, executive function and memory performance. Partner with the Institute for Creative Technologies (ICT) to design, develop and implement standard virtual human-agent interaction contexts and scenarios in order to create standard test-bed scenarios for determining the human interactional efficacy of virtual human agents. In FY11, will use EEG and fMRI methods to understand the neural underpinnings leading to successful perceptual discrimination. Will improve the characterization of neural data developed in this research effort using methodologies in network dynamics, optimal control and complex systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009	0.000	0.240	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H05: *INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	10.724	8.543	9.672	0.000	9.672

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H09: *ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H09: *ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)*	4.242	4.519	5.077	0.000	5.077	4.884	5.490	5.586	5.677	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a collaborative effort between the competitively selected industry and university consortium, the Robotics Collaborative Technology Alliance (CTA), and the Army Research Laboratory (ARL) for the purpose of leveraging world-class research in support of the future force and Army transformation needs. This project conducts basic research in areas that will expand the capabilities of intelligent mobile robotic systems for military applications with a focus on enhanced, innate intelligence, ultimately approaching that of a dog or other intelligent animal, to permit unmanned systems to function as productive members of a military team. Research is conducted in machine perception, including the exploration of sensor phenomenology, and the investigation of basic machine vision algorithms enabling future unmanned systems to more fully understand their local environment for enhanced mobility and tactical performance; intelligent control, including the advancement of artificial intelligence techniques for robot behaviors permitting future systems to autonomously adapt, and alter their behavior to dynamic tactical situations; and understanding the interaction of humans with machines focusing upon intuitive control by Soldiers that minimizes cognitive burden. The program will conduct both analytic and validation studies. Research products will be transitioned to the companion applied technology program, PE 0602618A, project H03, for integration and evaluation in test bed platforms and will form the scientific basis for new technology that will migrate into Army and Joint advanced and system development programs to provide highly capable unmanned systems for the future force. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	4.242	4.392	5.077	0.000	5.077
Autonomous systems: Explore opportunities enabling revolutionary, autonomous, highly mobile systems for the future force. Research focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations In FY09, focused on techniques for fusion of the key perception algorithms to enable an unmanned vehicle to maneuver with a high degree of autonomy in urban environments; examined perception based navigation, especially for indoor and GPS denied environments; explored approaches for autonomous activity recognition; evaluated the performance of both					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H09: *ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
perception and behavior algorithms in varied tactical environments. Conducted research to explore human robot interaction, dynamic scene understanding and contextual situational awareness. In FY10, expand research to include a more complete understanding of control and interaction between humans and robots through non-verbal cues and natural language; autonomous understanding and retention of salient features and activities to promote learning and adaptation to dynamic, unknown environments; and novel structural and control techniques to enable more dexterous manipulation. In FY11, will research expanded abilities to perceive and understand activities, including intent, consistent with complex urban environments and begin to investigate concepts underlying the planning and coordinated response by multiple heterogeneous robots. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009	0.000	0.127	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H09: *ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	4.242	4.519	5.077	0.000	5.077

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H50: *Network Sciences CTA*	6.975	2.645	3.289	0.000	3.289	2.908	3.301	3.395	3.487	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a competitively selected university and industry consortium, the Communication and Networks Collaborative Technology Alliance (CTA) that was formed to leverage commercial research investments to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. The future force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The objectives include designing communications systems for survivable wireless mobile networks; providing signal processing for communications-on-the-move; secure jam-resistant communications; and tactical information protection. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of -the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of communications and networks technology to PE 0602783A (Computer and Software Technology). The results of this work will significantly affect future force communications and networking formulation efforts. The Communications and Networks CTA ended in FY09. In FY10, a portion of this program shifts to in-house efforts in PE 0601102A/project H48. The remainder of the program is re-focused in FY10 on the Network Sciences CTA to more strongly emphasize Information Assurance and Network Science as defined by the December 2005 National Research Council Board on Army Science and Technology study. Since the International Technology Alliance on Network and Information Sciences (PE 0601104A/project J15) was established in 2006, joint planning of the research programs prevents redundancies and leverages accomplishments from both programs.The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.717	0.000	0.000	0.000	0.000
Survivable Wireless Mobile Networks: This work performs research in dynamically self-configuring wireless network technologies that enables secure, scalable, energy-efficient, and reliable communications for command on-the-move. Devise techniques to model, design, analyze, predict, and control the performance of mobile ad hoc networks. In FY09, designed networking techniques for sensing the networking operating environment, identified the best networking functional components, and dynamically composing protocols for superior performance.					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Signal Processing for Communication-on-the-Move: This effort performs research in signal processing techniques to enable reliable low-power multimedia communications among highly mobile users under adverse wireless conditions. In FY09, designed optimal channel-adaptive distributed multiple access techniques to provide high capacity, interference-robust, multiple access networks for communications-on-the-move. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	1.600	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #3 Secure Jam-Resistant Communication: This effort performs research on secure, jam-resistant, multi-user communications effective in noisy and cluttered and hostile wireless environments enabling low probability of detection/intercept. In FY09, designed signal separation techniques to mitigate packet collisions and improved signal detection for improved network performance. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.021	0.000	0.000	0.000	0.000
Program #4 Tactical Information Protection: This work performs research in scalable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY09, designed resilient clustering algorithms to provide a dynamic detection hierarchy to support detection and localization of attackers under mobile conditions.	1.637	0.000	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #5 Network Sciences Collaborative Technology Alliance (NS CTA): Beginning in FY10, this new CTA focuses on two new research areas: Information Networks and Social/Cognitive Networks; and builds upon successes of the Communications & Networks CTA for Communications Networks and Integration. The vision for the NS CTA is to develop a fundamental understanding of the ways that information, social/cognitive, and communications networks can be designed, composed, and controlled to dramatically increase mission effectiveness and ultimately enable humans to effectively exploit information for timely decision-making. Information Networks research develops the fundamental understanding of autonomous network activities and its linkage to the physical & human domains as related to human decision making within the networked command & control (C2) structure. Social/Cognitive Networks research is developing the fundamental understanding of the interplay of the various aspects of the social & cognitive networks with information & communications. Communications Networks research is developing the foundational techniques to model, analyze, predict, and control the behavior of secure tactical communication networks as an enabler for information and C2 networks. Integration is focused on achieving an integrated Information Networks, Social/Cognitive Networks, Communications Networks research program that significantly enhances the fundamental understanding of the underlying science of networks. In FY10, establish the Network Sciences CTA in support of the Network Science & Technology Research Center	0.000	2.571	3.289	0.000	3.289

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
(PE 0601104A/project J22). Research includes modeling to understand network centric organizations & develop mobile ad hoc network simulation & emulation technologies to evaluate networks in organizations. In FY11, will design evaluations for the verification & validation of models of trust in network supported decision making. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	0.074	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	6.975	2.645	3.289	0.000	3.289

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H53: *Army High Performance Computing Research Center*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H53: *Army High Performance Computing Research Center*	3.386	3.426	3.706	0.000	3.706	3.955	4.467	4.847	5.319	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports critical research at the Army High Performance Computing Research Center (AHPCRC). Research at the AHPCRC is focused on the Lightweight Combat Systems Survivability, computational nano- and bio-sciences, computational battlefield network and information sciences including evaluating materials suitable for armor/anti-armor and sensor applications, defense from chemical and biological agents, and associated enabling technologies requiring computationally intensive algorithms in the areas of combat systems survivability, battlefield network sciences, chemical and biological defense, nanoscience and nanomechanics, and computational information sciences, scientific visualization enabling technologies that support the future force transition path. This project also supports the Robotics Collaborative Technology Alliance which explores new opportunities to enable revolutionary autonomous mobility of unmanned systems for the Future Force. This research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618A, project H03 (Robotics Technology). The project will also address research focusing on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. The cited work is consistent with the Director, Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	3.386	3.330	3.706	0.000	3.706
AHPCRC. In FY09, implemented interdisciplinary methods to evaluate lightweight fabric structure systems; investigated computational approaches to analyze very large-scale networks for mobile network applications; explored advanced simulations to develop new materials for military vehicles and equipment, improved wireless battlefield communication, advanced the detection of chem/bio attacks and stimulate innovations in supercomputing; designed a common infrastructure model for a wide class of interdisciplinary applications; explored new scalable programming models for emerging multi-core computing architectures. In FY10, enhance lightweight fabric structure systems; enhance innovative scalable algorithms to analyze very large-scale complex mobile network simulation applications; develop new scalable multi-scale computational approaches for					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H53: *Army High Performance Computing Research Center*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
micro-systems design, implement computational bio- and nano-science scalable algorithms. In FY11, will validate lightweight fabric structure systems, implement and evaluate new and novel programming models on heterogeneous systems; implement computational approaches to analyze very large-scale mobile network simulation applications; implement new multi-scale computational approaches for micro-systems design, advanced scalable algorithms for material sciences, computational bio- and nano-sciences; stimulate innovations in algorithms for new multi-core hybrid computing architectures. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.096	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H53: *Army High Performance Computing Research Center*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	3.386	3.426	3.706	0.000	3.706

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H54: *Micro-Autonomous Systems Technology (MAST) CTA*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H54: *Micro-Autonomous Systems Technology (MAST) CTA*	7.422	8.014	8.050	0.000	8.050	7.445	8.290	8.434	8.570	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance (CTA), a competitively selected industry-university consortium which leverages world-class research necessary to address future force and Army Transformation needs. The CTA links a broad range of government technology agencies, as well as industrial and academic partners with the Army Research Laboratory (ARL). The MAST CTA focuses on innovative research in four main technical areas related to the coherent and collaborative operation of multiple micro autonomous platforms: microsystem mechanics, processing for autonomous operation, microelectronics, and platform integration. Payoff to the warfighter will be advanced technologies to support future force requirements in situational awareness. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, and to make available to the Alliance state-of-the-art facilities and equipment at the participating organizations. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	7.422	7.790	8.050	0.000	8.050
Micro Autonomous Systems Technology CTA. In FY09, performers investigated key technologies and techniques for autonomous navigation of microplatforms, low power and low bandwidth communication for collaborative behavior, low power sensing, low power processing, low Reynolds numbers aeromechanics, and ambulation of micro-ground platforms. Performed a capabilities analysis of microsystems and of a system of microsystems as an aid in microsystem design. Developed tools for microsystem design. In FY10, define information flow architecture for a candidate robotic platform, implement small group collaborative tactical behaviors, investigate tradeoffs in distributed processing and communications for perception and navigation, and incorporate sensing and processing into energy efficient architectures. Investigate novel concepts and develop initial models and prototypes in microelectronics for navigation, communication, information processing, and energy harvesting and sensing for micro-autonomous systems. In FY11, extramural partners will perform					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
modeling of multiple robotic platform architectures, explore autonomous tactical behaviors in realistic 3-D environments, and design holistic sensing, processing, actuation architectures, and transition processing algorithms to the Army. Will investigate contractor developed models and technologies for future implementation. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	0.224	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H54: *Micro-Autonomous Systems Technology (MAST) CTA*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	7.422	8.014	8.050	0.000	8.050

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H56: *Adv Decision Arch Collab Tech Alliance (CTA)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H56: *Adv Decision Arch Collab Tech Alliance (CTA)*	5.771	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a collaborative effort between the competitively selected industry and university consortium, the Advanced Decision Architecture (ADA) Collaborative Technology Alliance (CTA), and the Army Research Laboratory (ARL). These technologies will provide for real-time situational awareness (SA), distributed commander-staff-subordinate collaboration and planning, and execution monitoring in high-tempo, high-stress battlefield environments at speeds that permit operating inside the enemy's decision cycle. This project will conduct an intensive and accelerated program to formulate, validate, and transition basic research to provide solutions for the many requirements for understanding SA, expert decision making, team collaboration, the ability to display information in a way that facilitates knowledge assimilation on the battlefield, and visualization and decision support architectures. Research is conducted in four areas: cognitive process modeling and measurement, analytical tools for collaborative planning and execution, user adaptable interfaces, and auto-adaptive information presentation. The technical barriers associated with this project are: human-computer interface in an information rich environment; display configuration; real time visualization; information presentation; and control coupling This CTA accelerates the transition of advanced decision architecture technology to PE 0602716A (Human Factors Engineering Technology) and PE 0602783A (Computer and Software Technology). The ADA CTA ends in FY09 and this program will be re-focused to emphasize individual Soldier, squad, and platoon level tools and information and knowledge fusion. Research partnerships will be established with the Institute for Creative Technology (PE 0601104A, project J08) and the Flexible Display Center (PE 0602705A, project H17). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD. The Advanced Decision Architecture CTA ends in FY09 and beginning in FY10 funding will be transferred to PE 0601104A/project F17, for the Neuroergonomics CTA.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	1.357	0.000	0.000	0.000	0.000
Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers).In FY09, validated software agent architecture for enhancing the performance of human teams using advanced artificial intelligence techniques including context-sensitive information sharing, automated development of shared situation awareness and recognition-primed decision support, a naturalistic decision making (NDM) technique					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
used by experienced decision makers to quickly scan an array of displays or information and "instantly" know the best course of action to pursue. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Analytical tools for collaborative planning and execution: Create tools that effectively support teams in coordinating and collaborating to achieve mission success across the spectrum of operations.In FY09, devised theoretical foundations and empirical findings on the design of collaborative systems to make Soldiers more effective as sensors in the Brigade and Below Battlefield Awareness Network environment and to enhance Soldier-automation collaboration. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	1.301	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 User-adaptive interfaces: Explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning, and decision-making. In FY09, validated functional model of the capabilities of new sensor/network technologies as they could contribute to perceptual awareness including concepts such as trust. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.843	0.000	0.000	0.000	0.000
Program #4 Auto-adaptive information presentation: Investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY09, devised a distributed system for real-time target tracking of multiple entities in an area under surveillance exploiting a reasoning-based approach to include diagrammatic reasoning, domain knowledge, and algorithmic solutions.	1.270	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	5.771	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H59: *UNIV CENTERS OF EXCEL*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H59: *UNIV CENTERS OF EXCEL*	5.078	5.506	5.580	0.000	5.580	6.356	7.431	7.543	7.647	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the International Technology Centers (ITCs), the Foreign Technology (and Science) Assessment Support (FTAS) program, and a Basic Research Center for Network Science located at the United States Military Academy. The nine ITCs located in Australia, the United Kingdom, Canada, France, Germany, Japan, Chile, Argentina, and Singapore support the Army's goals of providing the best technology in the world to our Warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC "technology finds" are submitted as technology information papers (TIPs) to various Army S&T customers including the Army Research Laboratory (ARL), the Research Development and Engineering Centers (RDECs) of the Research Development and Engineering Command (RDECOM), RDECOM technology Integrated Process Teams, the Rapid Equipping Force (REF), and others for evaluation and consideration for further research and development. The ITC TIPs also serve as input into the international section of the Army S&T Master Plan. The FTAS program builds upon the TIPs submitted by the ITCs. In some cases the TIP is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to fund basic research in these technology areas identified by the TIPs as having potential relevance to the Army's S&T plan. The research will provide information useful in making an early assessment of the technology's potential contributions to the Army's S&T strategy. In FY09, this project funds a Basic Research Center in Network Science at the United States Military Academy (USMA) to further the theoretical understanding and develop the engineering design principles leading to the development of a science about networks and how they operate. Work in this project is coordinated with and complementary to the work at the Network Science and Technology Research Center funded under PE 0601104A/project J22. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by RDECOM HQ and the Army Research Laboratory (ARL)in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	4.077	4.391	4.593	0.000	4.593
International Technology Centers (ITC): In FY09, the ITCs improved upon execution of their international technology search process by focusing on critical technology capability gaps based upon direct face-to-face feedback with the RDECOM Commanding General and RDECOM center and lab directors. In FY09 the ITC Atlantic began design of a SharePoint tool to improve the linkage between requirements and tech search results.					

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H59: *UNIV CENTERS OF EXCEL*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
In FY10, the ITCs are working to make progress in several main areas of foreign technology identification and support to international collaboration including: unmanned systems, Counter-Improvised Explosive Devices, active protection, and power and energy and the ITC Atlantic will replicate the SharePoint tool to the other ITCs. In FY11 the ITCs will enhance and refine their technology search capabilities using feedback from their customers, i.e. RDECs, PMs and labs to focus on near and long term capabilities. FTAS Program: During FY09, two of the four FY07 FTAS projects were completed and have shown to have successfully advanced technology programs for ARL and CERDEC. In FY09 6 new projects with technology originating in 5 different countries were initiated from TIPs received. In FY10, six FY09 FTAS projects will be completed for ARL AMRDEC, ARDEC, TARDEC and CERDEC. In FY11, will continue to solicit projects and build on the success of the FTAS Program. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Basic Research Center in Network Science at the United States Military Academy (USMA): In FY09, efforts were conducted to further the theoretical understanding and develop the engineering design principles leading to the development of a science about networks. The Center made progress in several main areas of study including: dynamics, spatial location, and information propagation in networks, through better understanding	1.001	0.983	0.987	0.000	0.987

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H59: *UNIV CENTERS OF EXCEL*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
of the relationship between the architecture of a network and its function. Science was leveraged to develop the backbone of the Army's future fighting force with fundamental knowledge to support the Army's Basic Research Program in Network Science developed and enhance the education of the Corps of Cadets in these matters. Performed modeling and analysis of very large networks using tools, abstractions, and approximations that allow reasoning about large-scale networks, as well as techniques for modeling networks characterized by noisy and incomplete data. In FY10, contributing to and facilitating the Army transformation to network-centric operations (NCO), and promote the professional development of the United States Military Academy (USMA) faculty in the physical, mathematical, engineering, biological, behavioral, and social sciences relevant to network science. The goal is the creation of tools that allow the design and synthesis of networks to obtain desired properties, and, to increase the level of rigor and mathematical structure in network science. In FY11, the center will abstract common concepts across fields, perform evaluations and measurements of network structure, to allow enhancement of the robustness and security of networks; advance scientific and technological knowledge needed to support NCO and contribute to the tactics, techniques and procedures using the existing USMA knowledge of present/contemplated Army doctrine, world geo-political circumstances, and the Army as an organization. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3	0.000	0.132	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	5.078	5.506	5.580	0.000	5.580

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*				PROJECT H62: *Institude for Advanced Technology (IAT)*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H62: *Institude for Advanced Technology (IAT)*	5.963	6.403	5.506	0.000	5.506	5.623	6.741	6.859	6.970	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT) at the University of Texas, to conduct basic research in electromechanics and hypervelocity physics in support of electromagnetic (EM) guns. Of particular interest are EM power, EM launchers, EM integrated launch packages, and hypervelocity terminal ballistics. Advanced computational models are devised and/or applied to solve complex problems in each of these areas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power. The sponsored research provides the scientific underpinning for EM gun pulsed power including switching; addresses technical barriers associated with EM gun launcher life; and researches advanced technologies for hypervelocity target defeat. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapon systems development with applications for anti-armor, artillery, air defense, and the future force. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is monitored and guided by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	**FY 2010**	**Base FY 2011**	**OCO FY 2011**	**Total FY 2011**
Program #1	2.568	2.850	2.683	0.000	2.683
Pulsed Power: In FY09, provided technology for large-scale solid state converters. In FY10, analyze methods to increase energy density of pulsed alternators. Evaluate the design options for moderate-sized advanced pulsed power system tests of new concepts, especially including battery-inductor arrangements, for Army EM gun applications to define their operating system characteristics. In FY11, will analyze advanced pulsed power concepts that are reduced in size and weight and will identify gaps in understanding of pulsed power research.					
FY 2009 Accomplishments: FY 2009					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Launch: In FY09, examined thermal management of EM launchers. In FY10, investigate techniques to increase rail life and show higher muzzle energy railgun operation with integrated launch packages that contain realistic flight bodies. Update theories for elevated temperature railgun operation based on experiments and simulations. In FY11, will incorporate FY10 investigation results into advanced rail and armature design. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.647	1.660	1.391	0.000	1.391
Program #3	1.748	1.714	1.432	0.000	1.432

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H62: *Institude for Advanced Technology (IAT)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Electromagnetic Lethality. In FY09, completed and validated numerical model of armature physics including gouging and transition; examined coupled high density/reactive materials during target interaction at hypervelocity. In FY10, study target effects of novel penetrator concepts for precision fires and other high velocity impact conditions. Study target effects of novel penetrator concepts for precision fires and other high velocity impact conditions. In FY11, will initiate theory critical evaluations that determine the lethality potential of novel concepts. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.179	0.000	0.000	0.000

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H62: *Institude for Advanced Technology (IAT)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	5.963	6.403	5.506	0.000	5.506

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H64: *MATERIALS CENTER*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H64: *MATERIALS CENTER*	2.734	2.823	2.869	0.000	2.869	2.920	2.971	3.023	3.072	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project concentrates scientific resources on materials research for lightweight vehicle protection and is executed through Cooperative Research Agreements (CRAs). The effort funds collaborative research in three Materials Science and Engineering Research Areas (MSERAs): (1) Composite Materials Research; (2) Advanced Metals and Ceramics Research; and (3) Polymer Materials Research. Each MSERA pursues thematic research thrusts that address topics pertinent to lightweight vehicle protection and that are aligned with the Army's strategic materials research vision enabling long-term synergistic collaboration between the Army Research Laboratory (ARL) scientists and university researchers. The Materials Cooperative Research Agreements provide for mutual exchange of personnel and sharing of research facilities with the University of Delaware, Johns Hopkins University, Rutgers University, Drexel University, and Virginia Polytechnic Institute and State University. Lightweight, multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymer, and hybrid systems are emphasized. This project is closely coordinated with ARL in-house materials research projects (PE 0601102A, project H42) to promote effective and efficient transfer of fundamental scientific research addressing lightweight protective material requirements for the future force. The center accelerates the transition of technology to PE 0602105A (Materials Technology). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.734	2.744	2.869	0.000	2.869
Materials Research for vehicle protection In FY09, utilized multifunctional composites to validate potential composite weight reductions; characterized and quantified performance of newly synthesized energy absorbing polymers; and validated effects of armor ceramic processing and materials selection on mechanical properties. In FY10, examine high rate deformation mechanisms for ceramics and other advanced materials; examine the role of defects; characterize materials using advanced microscopy methods; and develop microstructure-processing relationships for severely plastically deformed materials. In FY11, will research the relationship between microstructures of nanoscale composites and observations of high rate deformation; and examine the dynamic response of multifunctional materials systems.					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.079	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	2.734	2.823	2.869	0.000	2.869

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C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H73: *Automotive Research Center (ARC)*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
H73: *Automotive Research Center (ARC)*	2.863	2.926	2.947	0.000	2.947	2.994	3.049	3.102	3.153	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project significantly enhances the Army's transformation to the future force by the application of novel, high payoff technologies that can be integrated into Army ground platforms. The Center of Excellence for Automotive Research is part of the basic research component of the National Automotive Center (NAC), a business group within the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center of Excellence for Automotive Research is an innovative university/industry/government consortium leveraging commercial technology for potential application in Army vehicle systems through ongoing and new programs in automotive research, resulting in significant cost savings and performance enhancing technological opportunities. The research performed in this project contributes to formulating and establishing the basic scientific and engineering principles for these technologies. Efforts are fully coordinated and complementary to those performed by the NAC and TARDEC under PE 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University. Key industry partners include all major US automotive manufacturers and suppliers. The Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies and advances state-of-the-art modeling and simulation for the Army's future ground vehicle platforms. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed by TARDEC, Warren, MI.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.863	2.848	2.947	0.000	2.947
Automotive Research Center (ARC): In FY09, extended the applicability of the advanced automotive models to future Army ground vehicle requirements to address elevated temperatures, increased terrain severity, ultra-reliability and general new global embedded constraints. Performed new extended model validations of these broadened areas of Army ground vehicle automotive models, using advanced instrumentation and efficient state-of-the-art data analysis procedures. In FY10, exploring and developing mobility and propulsion models for unmanned ground vehicles; developing more detailed vehicle thermal management models for hybrid electric tactical ground vehicles; and studying the feasibility of advanced materials for reducing Army ground vehicle					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
weight while meeting survivability needs with a focus on improved fragmentation protection models. In FY11, will explore advanced automotive propulsion concepts that will potentially improve the fuel economy and mobility of military ground vehicles including novel hybrid electric architectures; will investigate the feasibility of advanced materials for reducing Army ground vehicle weight while meeting survivability needs; and will assess the impact of alternative diesel and jet fuels on advanced automotive and heavy-duty diesel engines combustion characteristics. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.078	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	2.863	2.926	2.947	0.000	2.947

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J08: *INSTITUTE FOR CREATIVE TECHNOLOGY*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J08: *INSTITUTE FOR CREATIVE TECHNOLOGY*	7.457	7.750	7.878	0.000	7.878	8.022	8.167	8.310	8.444	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports simulation and training technology research at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, and distance learning. The ICT actively engages industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable entertainment technologies into military systems. The ICT also works with creative talent from the entertainment industry to adapt concepts of story and character to increase the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences. In developing a true synthesis of the creativity, technology, and capability of industry and the research and development community it is revolutionizing military training and mission rehearsal by making it more effective in terms of cost, time, range of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by performing basic research in modeling and simulation in accordance with the core competencies for the ICT University Affiliated Research Center (UARC). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.874	2.850	3.050	0.000	3.050
Immersive Environments: Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training, modeling, and simulation solutions. Research includes investigation of techniques and methods to address the rapid development of synthetic environments that can be used for mission rehearsal, assessment, and training of military operations. In FY09, investigated the use of emerging technologies, such as wide-field head mounted displays and interactive soundscapes to create immersive environments; investigated approaches for a social simulation framework comprised of multi-resolution models of groups and individuals. In FY10, develop semi-automatic environment setup and alignment system that will allow rapid setup and configuration of immersive environments. In					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY11, will investigate methods of interaction between multiple real and virtual humans in virtual immersive environments. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Graphics and Animations: Research will improve computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations. Research into auditory aspects of immersion will provide the sound stimulus for increasing the realism for military training and simulation devices. In FY09, explored concepts for facial and body animation controlled by avatars in real time and investigate methods for development of virtual speakers in immersive environments; investigated approaches for holographic displays. In FY10, investigate technologies for near-photo real, life-like characters; investigate methods for metadata tagging of historical art assets. In FY11, will develop tools for rapidly creating virtual characters that can be animated based on real people. *FY 2009 Accomplishments:* FY 2009	1.668	1.730	1.732	0.000	1.732

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Techniques and Human-virtual Human Interaction - Conduct basic research to investigate methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans. In FY09, assessed adequacy of virtual human models against models of human behavior and used feedback to guide further research. Developed tools and techniques to speed creation and adaptation of virtual humans. In FY10, investigate technologies for enabling virtual humans to sense a person's gestures or facial expressions. Develop new virtual human cognitive architecture to model complex human mental processes within virtual humans. In FY11, will investigate techniques for allowing multiple real people to interact with multiple virtual humans. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	2.915	2.953	3.096	0.000	3.096

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.217	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	7.457	7.750	7.878	0.000	7.878

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J12: *Institute for Soldier Nanotechnology (ISN)*	9.782	10.211	10.487	0.000	10.487	10.787	10.891	11.081	11.261	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports sustained multidisciplinary nanotechnology research for the Soldier at the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN emphasizes revolutionary materials research for advanced Soldier protection and survivability. The ISN works in close collaboration with the Army Research Laboratory (ARL), the Army's Natick Soldier Center (NSC), and other Army Research Development and Engineering Command (RDECOM), as well as several major industrial partners including Raytheon and DuPont, in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support research to devise nanotechnology-based solutions for the Soldier. This research emphasizes revolutionary materials research toward an advanced uniform concept. The future uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, biomedical monitoring, performance enhancement, and extremities protection. The objective is to lighten the Soldier's load through system integration and multifunctional devices while increasing survivability. The new technologies will be compatible with other Soldier requirements, including Soldier performance, limited power generation, integrated sensors, communication and display technologies, weapons systems, and expected extremes of temperature, humidity, storage lifetimes, damage, and spoilage. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Lab (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.485	2.498	2.651	0.000	2.651
Nanomaterials: Conduct research in light-weight, multifunctional nanostructured fibers and materials. In FY09, used Monte Carlo simulation methods to optimize 2-D and 3-D structural configurations for simultaneous control of light and sound propagation and reflection; fabricated desired structures by interference lithography and tested the resulting materials for the directional dependence of energy flow. Devised mechanically robust initiated chemical vapor deposition coatings fully compatible with electro-spun mats that provided high surface area and a diversity of substrate materials. In FY10, nanostructures are being prepared with unique, controlled sizes and shapes for sensing light; development is continuing of microfluidic reactors for the synthesis of					

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
complex, engineered nanostructured quantum dots; engineering and functionalization of carbon nanotubes (CNTs) to enhance ability of CNTs to generate photocurrents following absorption in the infrared and visible spectra;, development of an acoustic fiber having acoustic wave detection and modulation capabilities is also occurring. In FY11, models will be used with evaluations to characterize the absorption and emission properties of nanoparticles; toward the development of photodetector arrays, development of design rules for optimized incorporation of quantum dots into organic and inorganic thin film structures; initiate development of technology for the controlled assembly of large-scale ordered CNT arrays; a library of new responsive thermoplastic elastomers containing attached field responsive groups will be developed for the generation of electro-actuating, chemically responsive or temperature/light responsive contractile fibers or porous fabrics. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Blast Effects on Soldier: Conduct research in Battle Suit Medicine and Blast and Ballistic Protection. In FY09, explored relation of molecular structural features to resultant toughness, including high strain rate testing; development of polymeric nanostructures by synthesis of high molecular weight conducting polymers resulting in superior molecular actuation; determined critical biosensory signatures of inflammatory reaction for integration into multiplexed microfluidic sensing system; developed methodologies to quantitatively assess	4.811	4.941	5.185	0.000	5.185

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
the mechanical properties of hard nanostructured biocomposites and to measure local property gradients and heterogeneity. In FY10, develop models predicting transdermal transport in skin and investigate various transport pathways and mechanisms; designing of nanosized micellar structures formed as a block copolymer thin film on surfaces and interfaces for non-invasive drug delivery; tethering of amplified fluorescent polymers for pre-symptomatic biosensing system via polymeric nanocoatings deposited by chemical vapor deposition; portable electro-microfluidic devices for real-time medical monitoring, modeling and simulation of the next-generation of "induced charge electro-osmosis" nanoscale fluid flow regimes; flexible armor based on grapheme chainmail structures. In FY11, will synthesize controlled release films using layer-by-layer technique; use transfer printing of grapheme-carbon nanotube multilayers to build stacked, alternate laminates of grapheme chainmail structures; evaluate mechanical properties of superelastic alloys as a function of their nano-scale dimensions and at blast application rates; conduct novel nanomechanical impact loading experiments to map hydrated-tissue mechanical properties and impact penetration resistance in the absence and presence of protective materials. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Soldier Protection: Conduct research on Soldier Survivability and Protection and Nanosystems Integration.In FY09, explored chemical sensing based upon nanoelectronic building blocks; to improve the function of	2.486	2.486	2.651	0.000	2.651

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
cell-based biosensors, switchable surfaces were created to facilitate the patterned adhesion of various cell types allowing control of the spatial location of multiple cell types relative to each other; derivatization of hyperbranched poly-electrolytes designed for virucidal applications and the incorporation of these coatings onto surfaces using layer-by-layer techniques. In FY10, strategy for electrical contacts for optoelectronic fibers; testing of virucidal coatings for activity and toxicity and elucidation of mechanism of virucidal action; demonstrate amplifying fluorescent chemical sensing devices with plasmon-mediated electrical transduction to produce resistivity-based chemical sensing. In FY11, will prepare optoelectronic fiber materials with electrical contacts; extend the optical resolution limits of current chemical microscopy methods providing chemically specific mapping of surfaces with a lateral resolution of 5 nm; production of a new class of nanoscale materials whose macroscopic optical properties change in the presence of specific chemical analytes; establish approaches enabling seamless integration of multiple detection functions on the single fiber level as well as the level of fiber assembly; continued long-term development of laser-to-uniform free-space optical communication system including development of multi-material optical detector fibers, the incorporation of these fibers into a larger fabric and the hardware/software needed for interfacing the receiver fabric to a data acquisition system. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #4	0.000	0.286	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	9.782	10.211	10.487	0.000	10.487

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*	24.419	25.665	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for University and Industry Initiatives.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.392	3.182	0.000	0.000	0.000
Nanotubes Optimized for Lightweight Exceptional Strength Composite Materials. In FY09 this Congressional Interest Item exploited novel properties and fabrication opportunities associated with nano-based "Bucky-paper" technology, which includes enhancing flame retardance of polymer composites, low energy displays, and novel, low energy bimorph actuator mechanism development. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2	1.196	1.193	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Visualization for Training and Simulation in Urban Terrains. In FY09 this Congressional Interest Item project focused on refining the visualization and simulation capabilities so that they would be more realistic and could be used in war game scenarios and troop training simulations. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #3 Center for Information Assurance. This Congressional Interest Item project focused on information assurance techniques for sensor networks in a tactical environment *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.797	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #4 Florida Collaborative Development of Advanced Materials for Strategic Applications. This Congressional Interest Item project utilized new nanotechnology infrastructure and recent technological nano-materials breakthroughs to enable the research and development of novel property-specific nanoscale materials. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.196	0.000	0.000	0.000	0.000
Program #5 Nanosensor Stagegate Accelerator. This Congressional Interest Item project accelerated research, development and deployment of innovative nanoscale-enabled products that support the Army's transition to a lighter, more agile and more effective force, as well as applications in the aerospace, energy and transportation sectors. *FY 2009 Accomplishments:* FY 2009	1.197	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #6 Development of Enabling Chemical Technologies for Power from Green Sources. In FY09 this Congressional Interest Item explored molecular structure, assembly, and physical properties, and their impact on performance. Specific research efforts included: 1) molecular design and synthesis, 2) physical characterization of molecules and marcomolecules, 3) bulk materials characterization at soft-hard interfaces, 4) device fabrication and characterization, and 5) theoretical modeling. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.195	1.194	0.000	0.000	0.000
Program #7	0.797	0.398	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Manufacturing and Industrial Technology Center. In FY09 this Congressional Interest Item established an Advanced Manufacturing Training Center at Tallahassee Community College. Provided manufacturing and technology training that combined effective uses of technology to prepare students for success in science and technology-based professions. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #8 Nanoscale Biosensor Research. In FY09 this Congressional Interest Item conducted research on newly discovered nanoscale materials and used visualization techniques to image and manipulate them at the scale of the individual atom using the nanoscale ferroelectric, magnetic and quantum dot material fabrication facilities at the University of Arkansas. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	2.492	2.984	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #9 MEMS Antenna for Wireless Comms/UAVs. In FY09 this Congressional Interest Item developed Micro-Electro-Mechanical Systems (MEMS) based electronically steered antenna by leveraging Radio Frequency MEMS switch technology currently under development by industry and government. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	2.392	2.387	0.000	0.000	0.000
Program #10 Center for Education in Nanoscience and Nanotechnology. This Congressional Interest Item project provided infrastructure for undergraduate education in nano-technology at the University of Northern Iowa.	0.638	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #11 Novel Methods for Detecting and Inhibiting Corrosion. This Congressional Interest Item performed modeling and formulation studies to better understand the degradation and failure of Army coating systems. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.356	0.000	0.000	0.000	0.000
Program #12	0.797	0.000	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Center for Nanoscale Bio-Sensors as a Defense Against Biological Threats to America. This Congressional Interest Item conducted research on nanoscale materials for application as biological sensors. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #13 Academic Support and Research Compliance for Knowledge Gathering. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	1.994	1.990	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #14 Large Area Monitoring Network (LAMNET). This effort established a program at Western KY University, dedicated to computer network intrusion detection and an ancillary test range that allows for the deployment and testing of new technologies ensuring faster insertion into operational capabilities. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	5.980	0.000	0.000	0.000	0.000
Program #15 Ink-Based Desktop Electronic Material Technology. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base	0.000	1.592	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
OCO FY 2011 Plans: FY 2011 OCO					
Program #16 Army Material Degradation. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.637	0.000	0.000	0.000
Program #17 Center for Hetero-Functional Materials. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.796	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #18 ARL-ONAMI Center for Nanoarchitectures for Enhanced Performance. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.796	0.000	0.000	0.000
Program #19 High Performance Computing in Biomedical Engineering and Health Sciences. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009	0.000	1.194	0.000	0.000	0.000

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B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #20 Intelligent Network-Centric Sensor Development Program. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	1.194	0.000	0.000	0.000
Program #21 Materials Processing and Application Development Center of Excellence for Industry. This is a Congressional Interest Item.	0.000	1.194	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2009 Accomplishments: FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #22 Advanced Polymer Systems for Defense Applications - Power Generation, Protection and Sensing. This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	2.387	0.000	0.000	0.000
Program #23	0.000	2.547	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
DoD Diabetes Research and Development Initiative (DRDI). This is a Congressional Interest Item. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	24.419	25.665	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J14: *ECYBERMISSION*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J14: *ECYBERMISSION*	4.481	5.246	5.330	0.000	5.330	5.426	5.522	5.619	5.710	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports eCYBERMISSION, a nation-wide, web-based, science, technology, engineering and mathematics (STEM) competition designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide. The project supports Army Transformation by providing a pool of technologically literate citizenry that potentially grow to become future Soldiers and civilians for the Army workforce of tomorrow. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan, the Department of Defense Basic Research Plan, and the President's initiative for education. Work in this project is executed by the U. S. Army Research, Development and Engineering Command (RDECOM).

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	4.481	5.099	5.330	0.000	5.330
FY09: Sustained eCYBERMISSION and implemented enhancements as necessary based on lessons learned from previous years. Increased team participation. FY10: Continues to seek increased participation from existing levels and to increase geographic diversity and sustains eCYBERMISSION and implements enhancements based on lessons learned from previous years. FY11: Will continue to seek increased participation from existing levels and to increase geographic diversity and will sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J14: *ECYBERMISSION*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.147	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	4.481	5.246	5.330	0.000	5.330

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J14: *ECYBERMISSION*

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J15: *NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J15: *NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC*	7.669	8.104	8.072	0.000	8.072	8.217	8.363	8.510	8.647	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science research in the areas of network theory, system-of-systems security, sensor processing and delivery, and distributed coalition planning and decision making. The focus is on enhancing distributed, secure, and flexible decision-making to improve coalition operations, and developing the scientific foundations for complex and dynamic networked systems-of-systems to support the complex human, social, and technical interactions anticipated in future coalition operations. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) established a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences in FY06. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. This program supports the future force transition path of the Transformation Campaign Plan (TCP). The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL) at Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	7.669	7.877	8.072	0.000	8.072
Network and information science basic research for US/UK coalition operations information.In FY09, investigated models, theory, and algorithms for creating self-organizing wireless networks inspired by highly adaptive biological systems. Investigated cognitive and socio-cultural factors on coalition command processes and coalition networks to enhance situational awareness and decision-making. Established and validated analytic frameworks, leading to tradeoffs between sensing, computing, communications, and actuation, for classes of wireless sensor networks. In FY10, devise efficient robust resource usage algorithms for operations without centralized control, and with inaccurate knowledge of operating conditions for enhanced network capabilities. Investigate trust models to ensure distributed sensor data fusion under uncertainty. Devise agent reasoning					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J15: *NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
models and agent interaction models & algorithms to allow for effective agent support for human ad hoc teams in time stressed environments. In FY11, will establish theoretical foundations for policy specification with formal representations at various levels of abstraction. Will devise mathematical models to represent mappings between events, sensor monitored information, and end-uses; optimal compression of information flows based on human cognition metrics. Will design reasoning algorithms to enable the creation of agents that promote trust among teammates and manage differing levels of trust. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010	0.000	0.227	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J15: *NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Base FY 2011 Plans: FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	7.669	8.104	8.072	0.000	8.072

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification			DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J16: *NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE*	

COST ($ in Millions)	FY 2009 Actual	FY 2010 Estimate	Base FY 2011 Estimate	OCO FY 2011 Estimate	Total FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J16: *NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE*	2.902	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts basic research in nano and micro technologies to improve the performance and effectiveness of portable electronic equipment for the warfighter. This will be accomplished by reducing power and weight while increasing real-time interactivity of vital information content between the warfighters and their environment. The Center for Nanotechnology and Microelectronics (CNAM) is a university research effort focusing on the development and application of nanotechnology that can be integrated with microelectronic systems while not duplicating existing nanoelectronics research programs. The objective is to accelerate the deployment of nanotechnology for military applications by focusing on applications where nanotechnology complements rather than replaces microelectronics. The research program will concentrate on four technology areas focused on resolving key issues associated with military applications of microelectronics and power electronics. Research thrusts include: 1) Thermal Management - the removal of heat from electronics and power electronics is the primary limit on the performance of small devices. Nanotechnology may improve the performance of thermal management systems by enhancing the cooling properties of materials, interfaces, and fluids for microelectronics; 2) Hybrid nano/micro structures and devices - bottom-up self-assembly of nanoscale components onto/into microelectronic platforms can lead to electronic components that integrate nanoscale optical interconnects, produce significantly less waste heat, and integrate on-board sensing; 3) Nanotechnology-enhanced transparent electronic materials - transparent materials can be used for microelectronics, increasing the designers flexibility in integrating microelectronics into other systems; 4) Active Cooling - nanotechnology-based active cooling technology such as high efficiency thermoelectric coolers and nano-enhanced adsorption/ desorption cooling can, in theory, cool microelectronics to temperatures below ambient or even to cryogenic temperatures, thus improving performance. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	2.902	0.000	0.000	0.000	0.000
Research thrusts include thermal management, hybrid nano/microstructures and devices, nanotechnology-enhanced transparent electronic materials, and active cooling for improved portable warfighter electronic equipment In FY09, implemented thermal management techniques that provided improved thermal conductivity and studied methods to functionalize the thermal interfaces to improve heat transfer; fabricated novel nano-					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J16: *NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
electronics for low power sensors and systems; studied nanotechnology-enhanced electronic materials that provide superior electrical capabilities; researched advanced nanotechnology-enhanced cooling techniques including thermoelectric and adsorption/desorption. This effort ended in FY2009. *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	2.902	0.000	0.000	0.000	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification									DATE: February 2010		
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*				PROJECT J17: *VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J17: *VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE*	1.968	2.033	2.066	0.000	2.066	2.104	2.141	2.178	2.213	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is for Vertical Lift Research Center of Excellence to couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. Work will provide research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project is performed extramurally by the Aeroflightdynamics Directorate of the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) (located at the NASA Ames Research Center, Moffett Field, CA).

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	**FY 2010**	**Base FY 2011**	**OCO FY 2011**	**Total FY 2011**
Program #1	1.968	1.976	2.066	0.000	2.066
Vertical Lift Research Center of Excellence: In FY09, developed light-weight high-flexibility rotorcraft shafts using flexible matrix composites and active bearing controls; and developed efficient and affordable joining concepts for high-stiffness, light-weight composites. In FY10, design and fabricate robust wind tunnel testing system for rotating icing environment tests; build and test active trailing edge flaps rotor configurations for reducing rotor vibrations, power, and noise; investigate the performance improvements in the tip/casing region of ducted fan systems; and demonstrate health monitoring capability of hybrid carbon-fiber/carbon-nanotube epoxy composites. In FY11, will develop a method to describe nonlinear propagation path of rotor noise, will develop a methodology for airfoil design that accounts for unsteady aerodynamics, will use validated 3-D model to explore helical gear vibration, and will compute induced power for typical rotor configurations and compare with measured data.					
FY 2009 Accomplishments: FY 2009					

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J17: *VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
FY 2010 Plans: FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Program #2 Small Business Innovative Research/Small Business Technology Transfer Programs *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO	0.000	0.057	0.000	0.000	0.000
Accomplishments/Planned Programs Subtotals	1.968	2.033	2.066	0.000	2.066

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J17: *VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE*

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2A, PB 2011 Army RDT&E Project Justification										DATE: February 2010	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*				PROJECT J22: *NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER*			
COST ($ in Millions)	**FY 2009 Actual**	**FY 2010 Estimate**	**Base FY 2011 Estimate**	**OCO FY 2011 Estimate**	**Total FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J22: *NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER*	4.844	3.838	9.752	0.000	9.752	8.913	11.683	11.888	12.080	Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the establishment of the Network Science and Technology Research Center (NSTRC). The NSTRC will be competitively awarded and managed by the Army Research Laboratory (ARL). ARL researchers, with partners at other sites, will collaborate in a virtual center environment. There will be an effort undertaken to include additional partners such as universities, industry, and other government agencies. Network Science is the study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena. As such, network science may be seen as the cornerstone for future military operations and the conduct of network-centric warfare. The mission of this center will be to strengthen the theoretical underpinnings of network science; conduct basic research on how and why biological and social (non-physical) networks function and determine their applications to military networks; to manage the activities in network science research, technology development, and network experimentation for the Army; to focus science and technology investments to enable network-centric operations and warfare; to focus applied science and technology to enable social networks important to Army operations; and to enable the development of network science applications and facilitate their transition to Army and Joint operations. Network science, technology, and evaluations encompasses all information and information exchange, visualization, collaboration, manipulation, protection, restoration, transport, services, data storage, and application layers, including the knowledge that human use of networks is a critical component. Establishment of the center will require a phased approach cable of supporting development of fundamental network theory and network technologies, and carry out the assessment of impacts upon human performance; the integration of new technologies and social networks into capabilities; and experimentation as a means to test and confirm fundamental theories and predictive models and/or characterize new technologies and operational concepts while also being capable of promoting training of personnel when applicable. Unlike the Training and Doctrine Commands on-going efforts within their centers, schools, and battle-labs, the focus of the NSTRC will be to develop the framework to perform research important to the Army in the areas of modeling, simulation and testing of very large networks, command and control of joint/combined networked forces, impact of network structure on organizational behavior, security and information assurance of networks, swarming behavior, and managing network complexity. It will also have a significant focus on and investment in the discovery and foundational aspects of the science of networks both human engineered and biologically evolved. Work is this project is coordinated with and complementary to the work at the United States Military Academy (USMA) Basic Research Network Science Center funded under PE 0601104/project H59. The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan. Work in this project will be primarily preformed extramurally with a small intramural effort by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J22: *NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Program #1	4.844	3.730	9.752	0.000	9.752
Network Science and Technology Research Center (NSTRC): Research in the broad area of network sciences technology is performed at various government agencies, industries and universities across the country and is coordinated through the Network Sciences Collaborative Technology Alliance, PE 0601104A/project H50. The future Army will have to take advantage of a multitude of new technologies to network the force and create a decisive warfighting advantage. The challenges will be to select, on the basis of their technical merit and applicability, those technologies best able to resolve identified technology shortfalls. In FY09, established the NSTRC capability through a multitude of geographically diverse, interdisciplinary researchers working collaboratively on military network research issues, using shared or existing resources, and exploiting advances in computing, communications, collaboration, and other information technologies to make research and technology development efficient and seamless. In FY10, develop diagnostic models and methods to advance the science of social/cognitive networks. Establish a synergistic framework for physics-based and human-based information fusion. Develop models of mobile ad hoc networking to define interactions and behavior among information networks. In FY11, will study cross-domain issues to develop trust models that will support networks of humans connected through wireless mobile ad hoc networks.					
FY 2009 Accomplishments: FY 2009					
FY 2010 Plans: FY 2010					
Base FY 2011 Plans: FY 2011 Base					
OCO FY 2011 Plans: FY 2011 OCO					
Program #2	0.000	0.108	0.000	0.000	0.000

Exhibit R-2A, PB 2011 Army RDT&E Project Justification		DATE: February 2010
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J22: *NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER*

B. Accomplishments/Planned Program ($ in Millions)

	FY 2009	FY 2010	Base FY 2011	OCO FY 2011	Total FY 2011
Small Business Innovative Research/Small Business Technology Transfer Program *FY 2009 Accomplishments:* FY 2009 *FY 2010 Plans:* FY 2010 *Base FY 2011 Plans:* FY 2011 Base *OCO FY 2011 Plans:* FY 2011 OCO					
Accomplishments/Planned Programs Subtotals	4.844	3.838	9.752	0.000	9.752

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.