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**Department of Defense  
Fiscal Year (FY) 2013 President's Budget Submission**

February 2012



**Army**

*Justification Book*

***Research, Development, Test & Evaluation, Army***

**RDT&E - Volume I, Budget Activity 1**

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FY 2013 RDT&E Program  
President's Budget 2013

Exhibit R-1

Summary

06-Jan-2012

Summary Recap of Budget Activities		Thousands of Dollars				
		FY2011	FY2012	FY2013	FY2013 OCO	FY2013 Total
Basic research		388,660	456,200	444,071	0	444,071
Applied Research		825,021	946,836	874,730	0	874,730
Advanced technology development		804,783	1,132,838	890,722	0	890,722
Advanced Component Development and Prototypes		930,583	544,328	610,121	19,860	629,981
System Development and Demonstration		3,968,785	3,238,656	3,286,629	0	3,286,629
Management support		1,400,358	1,097,294	1,153,980	0	1,153,980
Operational system development		1,437,782	1,339,540	1,664,534	0	1,664,534
Total	RDT&E, Army	9,755,972	8,755,692	8,924,787	19,860	8,944,647

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Appropriation: 2040 A RDT&E, Army

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Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2011	FY2012	FY2013	FY2013 OCO	FY2013 Total
Basic research								
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	21,095	21,031	20,860		20,860
2	0601102A	01	DEFENSE RESEARCH SCIENCES	190,019	213,604	219,180		219,180
3	0601103A	01	UNIVERSITY RESEARCH INITIATIVES	84,445	80,850	80,986		80,986
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	93,101	140,715	123,045		123,045
Total: Basic research				388,660	456,200	444,071	0	444,071
Applied Research								
5	0602105A	02	MATERIALS TECHNOLOGY	28,730	50,679	29,041		29,041
6	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	46,491	43,453	45,260		45,260
7	0602122A	02	TRACTOR HIP	14,126	14,207	22,439		22,439
8	0602211A	02	AVIATION TECHNOLOGY	40,869	44,539	51,607		51,607
9	0602270A	02	ELECTRONIC WARFARE TECHNOLOGY	16,939	15,765	15,068		15,068
10	0602303A	02	MISSILE TECHNOLOGY	48,092	67,079	49,383		49,383
11	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	17,542	20,002	25,999		25,999
12	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	19,907	20,900	23,507		23,507
13	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	61,893	64,205	69,062		69,062
14	0602618A	02	BALLISTICS TECHNOLOGY	60,595	59,121	60,823		60,823
15	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	10,555	4,869	4,465		4,465
16	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	7,630	8,231	7,169		7,169
17	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	41,368	54,727	35,218		35,218
18	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	63,186	62,862	60,300		60,300
19	0602709A	02	NIGHT VISION TECHNOLOGY	39,131	55,116	53,244		53,244
20	0602712A	02	COUNTERMINE SYSTEMS	18,507	32,728	18,850		18,850
21	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	20,583	21,767	19,872		19,872
22	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	21,704	20,804	20,095		20,095
23	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	24,914	26,075	28,852		28,852
24	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	6,599	8,577	9,830		9,830
25	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	73,346	80,190	70,693		70,693

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26	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	18,982	18,917	17,781		17,781
27	0602786A	02	WARFIGHTER TECHNOLOGY	26,972	46,261	28,281		28,281
28	0602787A	02	MEDICAL TECHNOLOGY	96,360	105,762	107,891		107,891
Total: Applied Research				825,021	946,836	874,730	0	874,730
Advanced technology development								
29	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	36,122	52,896	39,359		39,359
30	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	114,036	102,810	69,580		69,580
31	0603003A	03	AVIATION ADVANCED TECHNOLOGY	55,492	62,095	64,215		64,215
32	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	65,495	76,955	67,613		67,613
33	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	125,677	145,914	104,359		104,359
34	0603006A	03	COMMAND, CONTROL, COMMUNICATIONS ADVANCED TECHNOLOGY	7,823	5,304	4,157		4,157
35	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLOGY	7,694	10,282	9,856		9,856
36	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	48,698	69,852	50,661		50,661
37	0603009A	03	TRACTOR HIKE	7,761	8,142	9,126		9,126
38	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	14,788	17,907	17,257		17,257
39	0603020A	03	TRACTOR ROSE	11,872	12,577	9,925		9,925
40	0603105A	03	MILITARY HIV RESEARCH	25,738	22,760	6,984		6,984
41	0603125A	03	COMBATING TERRORISM - TECHNOLOGY DEVELOPMENT	9,424	22,172	9,716		9,716
42	0603130A	03	TRACTOR NAIL		4,271	3,487		3,487
43	0603131A	03	TRACTOR EGGS		2,257	2,323		2,323
44	0603270A	03	ELECTRONIC WARFARE TECHNOLOGY	18,973	23,640	21,683		21,683
45	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	76,272	90,458	71,111		71,111
46	0603322A	03	TRACTOR CAGE	9,661	10,299	10,902		10,902
47	0603461A	03	HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM		227,790	180,582		180,582
48	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	26,089	31,491	27,204		27,204
49	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	8,236	7,674	6,095		6,095
50	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	71,723	42,348	37,217		37,217
51	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	15,417	15,934	13,626		13,626
52	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	23,617	36,458	28,458		28,458

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53	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECHNOLOGY	24,175	30,552	25,226		25,226
Total: Advanced technology development				804,783	1,132,838	890,722	0	890,722
Advanced Component Development and Prototypes								
54	0603305A	04	ARMY MISSILE DEFENSE SYSTEMS INTEGRATION	11,156	24,386	14,505		14,505
55	0603308A	04	ARMY SPACE SYSTEMS INTEGRATION	29,845	9,763	9,876		9,876
56	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	14,686	19,596	5,054		5,054
57	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	2,337	4,572	2,725		2,725
58	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	35,849	40,314	30,560		30,560
59	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	200,312	65,417	14,347		14,347
60	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	26,847	13,903	10,073	19,860	29,933
61	0603766A	04	TACTICAL ELECTRONIC SURVEILLANCE SYSTEM - ADV DEV	19,610	5,856	8,660		8,660
62	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT	4,975		10,715		10,715
63	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY - DEM/VAL	3,622	5,023	4,631		4,631
64	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	200,732	185,819	278,018		278,018
65	0603790A	04	NATO RESEARCH AND DEVELOPMENT	4,879	4,839	4,961		4,961
66	0603801A	04	AVIATION - ADV DEV	8,058	7,218	8,602		8,602
67	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	62,999	12,706	14,605		14,605
68	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION AND ANALYSIS	20,801	5,250	5,054		5,054
69	0603807A	04	MEDICAL SYSTEMS - ADV DEV	27,247	35,543	24,384		24,384
70	0603827A	04	SOLDIER SYSTEMS - ADVANCED DEVELOPMENT	51,415	18,030	32,050		32,050
71	0603850A	04	INTEGRATED BROADCAST SERVICE	939	1,494	96		96
72	0604115A	04	TECHNOLOGY MATURATION INITIATIVES	3,000	10,165	24,868		24,868
73	0604131A	04	TRACTOR JUTE		15,584	59		59
74	0604284A	04	JOINT COOPERATIVE TARGET IDENTIFICATION - GROUND (JCTI-G) / TECHNOLOG		15,287			
75	0604319A	04	INDIRECT FIRE PROTECTION CAPABILITY INCREMENT 2-INTERCEPT (IFPC2)			76,039		76,039
76	0604775A	04	DEFENSE RAPID INNOVATION PROGRAM	101,265				
77	0604785A	04	INTEGRATED BASE DEFENSE (BUDGET ACTIVITY 4)			4,043		4,043
78	0305205A	04	ENDURANCE UAVS	100,009	43,563	26,196		26,196

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Total:    Advanced Component Development and Prototypes				930,583	544,328	610,121	19,860	629,981
System Development and Demonstration								
79	0604201A	05	AIRCRAFT AVIONICS	70,926	119,573	78,538		78,538
80	0604220A	05	ARMED, DEPLOYABLE HELOS	69,922	82,363	70,277		70,277
81	0604270A	05	ELECTRONIC WARFARE DEVELOPMENT	196,428	34,233	181,347		181,347
82	0604280A	05	JOINT TACTICAL RADIO	755				
83	0604290A	05	MID-TIER NETWORKING VEHICULAR RADION (MNVr)			12,636		12,636
84	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	24,322	7,405	5,694		5,694
85	0604328A	05	TRACTOR CAGE	17,914	26,552	32,095		32,095
86	0604601A	05	INFANTRY SUPPORT WEAPONS	73,008	83,395	96,478		96,478
87	0604604A	05	MEDIUM TACTICAL VEHICLES	3,578	3,957	3,006		3,006
88	0604609A	05	SMOKE, OBSCURANT AND TARGET DEFEATING SYS - ENG DEV	5,146				
89	0604611A	05	JAVELIN		9,930	5,040		5,040
90	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	2,829	55,426	3,077		3,077
91	0604633A	05	AIR TRAFFIC CONTROL	9,559	22,900	9,769		9,769
92	0604641A	05	TACTICAL UNMANNED GROUND VEHICLE (TUGV)			13,141		13,141
93	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	1,918	19,981	20,217		20,217
94	0604661A	05	FCS SYSTEMS OF SYSTEMS ENGR & PROGRAM MGMT	471,559	298,589			
95	0604662A	05	FCS RECONNAISSANCE (UAV) PLATFORMS	18,792				
96	0604663A	05	FCS UNMANNED GROUND VEHICLES	200,000	35,966			
97	0604664A	05	FCS UNATTENDED GROUND SENSORS	1,451				
98	0604665A	05	FCS SUSTAINMENT & TRAINING R&D	598,673				
99	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	44,513	59,195	32,621		32,621
100	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	2,043	2,073	2,132		2,132
101	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	26,848	29,981	44,787		44,787
102	0604716A	05	TERRAIN INFORMATION - ENG DEV		1,594	1,008		1,008
103	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTELLIGENCE - ENG DEV	139,662	82,932	73,333		73,333
104	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	29,287	28,274	28,937		28,937
105	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	13,553	14,361	10,815		10,815

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106	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENG DEV	15,031	15,787	13,926		13,926
107	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT) CORE	26,699	22,205	17,797		17,797
108	0604798A	05	BRIGADE ANALYSIS, INTEGRATION AND EVALUATION			214,270		214,270
109	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	25,099	13,815	14,581		14,581
110	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	39,588	173,146	43,706		43,706
111	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	73,042	81,733	20,776		20,776
112	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPMENT - ENG DEV	33,262	27,132	43,395		43,395
113	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	37,707	76,248	104,983		104,983
114	0604814A	05	ARTILLERY MUNITIONS - EMD	25,467	37,592	4,346		4,346
115	0604817A	05	COMBAT IDENTIFICATION	2,893				
116	0604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWARE	57,264	93,846	77,223		77,223
117	0604820A	05	RADAR DEVELOPMENT		2,885	3,486		3,486
118	0604822A	05	GENERAL FUND ENTERPRISE BUSINESS SYSTEM (GFEBS)	13,094	793	9,963		9,963
119	0604823A	05	FIREFINDER	22,455	10,348	20,517		20,517
120	0604827A	05	SOLDIER SYSTEMS - WARRIOR DEM/VAL	20,122	61,350	51,851		51,851
121	0604854A	05	ARTILLERY SYSTEMS - EMD	99,937	120,032	167,797		167,797
122	0604869A	05	PATRIOT/MEADS COMBINED AGGREGATE PROGRAM (CAP)	450,584	389,630	400,861		400,861
123	0604870A	05	NUCLEAR ARMS CONTROL MONITORING SENSOR NETWORK	7,017	7,391	7,922		7,922
124	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	50,054	32,065	51,463		51,463
125	0605018A	05	INTEGRATED PERSONNEL AND PAY SYSTEM-ARMY (IPPS-A)	58,348	68,628	158,646		158,646
126	0605450A	05	JOINT AIR-TO-GROUND MISSILE (JAGM)	71,760	126,895	10,000		10,000
127	0605455A	05	SLAMRAAM	18,358	1,529			
128	0605456A	05	PAC-3/MSE MISSILE	121,475	88,909	69,029		69,029
129	0605457A	05	ARMY INTEGRATED AIR AND MISSILE DEFENSE (AIAMD)	246,691	270,180	277,374		277,374
130	0605625A	05	MANNED GROUND VEHICLE	312,269	448,679	639,874		639,874
131	0605626A	05	AERIAL COMMON SENSOR	101,171	31,435	47,426		47,426
132	0605812A	05	JOINT LIGHT TACTICAL VEHICLE (JLTV) ENGINEERING AND MANUFACTURING D			72,295		72,295
133	0303032A	05	TROJAN - RH12	3,578	3,916	4,232		4,232
134	0304270A	05	ELECTRONIC WARFARE DEVELOPMENT	13,134	13,807	13,942		13,942

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	Total:		System Development and Demonstration	3,968,785	3,238,656	3,286,629	0	3,286,629
			Management support					
135	0604256A	06	THREAT SIMULATOR DEVELOPMENT	25,367	26,117	18,090		18,090
136	0604258A	06	TARGET SYSTEMS DEVELOPMENT	8,362	11,229	14,034		14,034
137	0604759A	06	MAJOR T&E INVESTMENT	40,671	49,359	37,394		37,394
138	0605103A	06	RAND ARROYO CENTER	19,763	20,352	21,026		21,026
139	0605301A	06	ARMY KWAJALEIN ATOLL	190,005	145,377	176,816		176,816
140	0605326A	06	CONCEPTS EXPERIMENTATION PROGRAM	17,101	28,755	27,902		27,902
141	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	232,092				
142	0605601A	06	ARMY TEST RANGES AND FACILITIES	399,931	311,650	369,900		369,900
143	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	68,118	70,116	69,183		69,183
144	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	42,320	43,414	44,753		44,753
145	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	4,568	18			
146	0605606A	06	AIRCRAFT CERTIFICATION	4,938	5,621	5,762		5,762
147	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	6,983	7,171	7,402		7,402
148	0605706A	06	MATERIEL SYSTEMS ANALYSIS	18,863	19,638	19,954		19,954
149	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	5,285	5,436	5,535		5,535
150	0605712A	06	SUPPORT OF OPERATIONAL TESTING	68,481	68,678	67,789		67,789
151	0605716A	06	ARMY EVALUATION CENTER	60,694	63,202	62,765		62,765
152	0605718A	06	ARMY MODELING & SIM X-CMD COLLABORATION & INTEG	3,787	3,415	1,545		1,545
153	0605801A	06	PROGRAMWIDE ACTIVITIES	71,984	82,923	83,422		83,422
154	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	49,579	55,286	50,820		50,820
155	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS AND SAFETY	42,474	57,054	46,763		46,763
156	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MGMT SUPPORT	3,084	4,953	4,601		4,601
157	0605898A	06	MANAGEMENT HQ - R&D	15,845	17,530	18,524		18,524
158	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	63				
	Total:		Management support	1,400,358	1,097,294	1,153,980	0	1,153,980

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Operational system development								
159	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	19,016	66,641	143,005		143,005
160	0607665A	07	BIOMETRICS ENTERPRISE	65,781	45,511			
161	0607865A	07	PATRIOT PRODUCT IMPROVEMENT			109,978		109,978
162	0102419A	07	AEROSTAT JOINT PROJECT OFFICE	399,477	327,338	190,422		190,422
163	0203347A	07	INTELLIGENCE SUPPORT TO CYBER (ISC) MIP	2,283				
164	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	23,812	29,500	32,556		32,556
165	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	187,207	36,150	253,959		253,959
166	0203740A	07	MANEUVER CONTROL SYSTEM	24,648	42,347	68,325		68,325
167	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAMS	121,084	149,469	280,247		280,247
168	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	688	822	898		898
169	0203758A	07	DIGITIZATION	6,103	8,016	35,180		35,180
170	0203759A	07	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2)	3,748				
171	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	23,415	53,015	20,738		20,738
172	0203808A	07	TRACTOR CARD	14,340	42,487	63,243		63,243
173	0208053A	07	JOINT TACTICAL GROUND SYSTEM	12,005	27,586	31,738		31,738
174	0208058A	07	JOINT HIGH SPEED VESSEL (JHSV)	3,041		35		35
175	0301359A	07	SPECIAL ARMY PROGRAM					
176	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES		2,850	7,591		7,591
177	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	12,232	15,684	15,961		15,961
178	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	123,136	160,491	120,927		120,927
179	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	32,525	12,085	15,756		15,756
180	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	12,606	23,899	14,443		14,443
181	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	38,049	26,508	31,303		31,303
182	0305208A	07	DISTRIBUTED COMMON GROUND/SURFACE SYSTEMS	125,404	31,649	40,871		40,871
183	0305219A	07	MQ-1 SKY WARRIOR A UAV	119,195	121,846	74,618		74,618
184	0305232A	07	RQ-11 UAV	1,547	1,935	4,039		4,039
185	0305233A	07	RQ-7 UAV	7,555	31,896	31,158		31,158
186	0305235A	07	MQ-18 UAV		7,500	2,387		2,387
187	0307665A	07	BIOMETRICS ENABLED INTELLIGENCE	2,069	15,018	15,248		15,248

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Department of the Army  
FY 2013 RDT&E Program  
President's Budget 2013

Exhibit R-1

Appropriation: 2040 A RDT&E, Army

06-Jan-2012

Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2011	FY2012	FY2013	FY2013 OCO	FY2013 Total
188	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	56,816	59,297	59,908		59,908
	Total:		Operational system development	1,437,782	1,339,540	1,664,534	0	1,664,534
Total:	RDT&E, Army			9,755,972	8,755,692	8,924,787	19,860	8,944,647

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Army • President's Budget Submission FY 2013 • RDT&E Program

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Army • President's Budget Submission FY 2013 • RDT&E Program

Program Element Table of Contents (by Budget Activity then Line Item Number)

*Budget Activity 01: Basic Research*  
*Appropriation 2040: Research, Development, Test & Evaluation, Army*

.....

Line Item	Budget Activity	Program Element Number	Program Element Title	Page
1	01	0601101A	In-House Laboratory Independent Research.....	1
2	01	0601102A	DEFENSE RESEARCH SCIENCES.....	17
3	01	0601103A	University Research Initiatives.....	106
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**Program Element Table of Contents (Alphabetically by Program Element Title)**

<b>Program Element Title</b>	<b>Program Element Number</b>	<b>Line Item</b>	<b>Budget Activity</b>	<b>Page</b>
DEFENSE RESEARCH SCIENCES	0601102A	2	01.....	17
In-House Laboratory Independent Research	0601101A	1	01.....	1
University Research Initiatives	0601103A	3	01.....	106
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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Army	<b>DATE:</b> February 2012
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APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				PE 0601101A: <i>In-House Laboratory Independent Research</i>							
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	21.095	21.031	20.860	-	20.860	21.609	22.009	22.359	22.647	Continuing	Continuing
91A: <i>ILIR-AMC</i>	15.714	16.275	16.062	-	16.062	16.504	16.847	17.118	17.320	Continuing	Continuing
91C: <i>ILIR-MED R&amp;D CMD</i>	3.520	2.813	2.839	-	2.839	2.886	2.935	2.984	3.032	Continuing	Continuing
91D: <i>ILIR-CORPS OF ENGR</i>	1.243	1.064	1.073	-	1.073	1.087	1.097	1.108	1.126	Continuing	Continuing
91E: <i>ILIR-ARI</i>	0.146	0.151	0.153	-	0.153	0.156	0.157	0.160	0.163	Continuing	Continuing
F16: <i>ILIR-SMDC</i>	0.472	0.728	0.733	-	0.733	0.976	0.973	0.989	1.006	Continuing	Continuing

**Note**

Not Applicable for this item

**A. Mission Description and Budget Item Justification**

This program element (PE) supports basic research at the Army laboratories through the In-House Laboratory Independent Research (ILIR) program. Basic research lays the foundation for future developmental efforts by identifying fundamental principles governing various phenomena and appropriate pathways to exploit this knowledge. The ILIR program serves as a catalyst for major technology breakthroughs by providing laboratory directors flexibility in implementing novel research ideas, by nurturing promising young scientists and engineers, and is used to attract and retain top doctoral degreed scientists and engineers. The ILIR program also provides a source of competitive funds for peer reviewed efforts at Army laboratories to stimulate high quality, innovative research with significant opportunity for payoff to Army warfighting capability.

This PE supports ILIR at the Army Materiel Command's (AMC) six Research, Development, and Engineering Centers (Project 91A); at the six Medical Research and Materiel Command (MRMC) laboratories (Project 91C); at the Corps of Engineer's seven laboratories at the US Army Engineer Research, and Development Center (ERDC) (Project 91D); at the Army Research Institute for the Behavioral and Social Sciences (ARI) (Project 91E); and at the Space and Missile Defense Command (SMDC) Technical Center (Project F16).

Work in the PE provides a foundation for applied research initiatives at the Army laboratories and research, development and engineering centers.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this PE is performed by the AMC, Aberdeen Proving Grounds, MD, MRMC, Ft. Detrick, MD, the ERDC, Vicksburg, MS, the ARI, Arlington, VA, and the SMDC, Huntsville, AL.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army				DATE: February 2012	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
2040: Research, Development, Test & Evaluation, Army		PE 0601101A: In-House Laboratory Independent Research			
BA 1: Basic Research					
B. Program Change Summary (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Previous President's Budget	21.780	21.064	20.692	-	20.692
Current President's Budget	21.095	21.031	20.860	-	20.860
Total Adjustments	-0.685	-0.033	0.168	-	0.168
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.482	-			
• Adjustments to Budget Years	-	-	0.168	-	0.168
• Other Adjustments 1	-0.203	-0.033	-	-	-



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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
91A: ILIR-AMC	15.714	16.275	16.062	-	16.062	16.504	16.847	17.118	17.320	Continuing	Continuing

**Note**

Not applicable for this item

**A. Mission Description and Budget Item Justification**

This 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 Assistant Secretary of Defense, Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Edgewood Chemical and Biological Center, Aberdeen Proving Grounds, MD within AMC, the Armaments Research, Development, and Engineering Center, Picatinny, NJ, the Tank and Automotive Research, Development, and Engineering Center, Warren, MI, the Natick Soldier Research, Development, and Engineering Center, Natick, MA, the Aviation and Missile Research, Development, and Engineering Center, Huntsville, AL, and the Communications and Electronics Research, Development, and Engineering Center, Ft. Monmouth, NJ.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Edgewood Chemical Biological Center	2.913	0.836	0.956
<b>Description:</b> Funds basic research in chemistry, biology, biotechnology, and aerosol for counter improvised explosive devices (IEDs), obscurants, and/or target defeat.			
<b>FY 2011 Accomplishments:</b> Conducted fundamental studies in surface science, specifically furthering the characterization of chemical and biochemical phenomena occurring at or near solid surfaces and interfaces; molecular programming techniques for bio-energy production; rational design of nano- biomolecular, abiotic structures; the interaction of matter and transfer of energy at the nanoscale and interfacial phenomena of particulate matter; and the controlled synthesis of nanomaterials to enable the controlled propagation of electromagnetic energy or to drive photonic behavior.			
<b>FY 2012 Plans:</b> Continue basic research efforts in the areas of rational molecular and nano-system design for the design of functional abiotic structures, reconfigurable self-organizing systems, novel nanoparticles and supramolecular self-assembly; Continue			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>	<b>PROJECT</b> 91A: <i>ILIR-AMC</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
investigations in synthetic biology using new molecular programming techniques for creating biofuels and materials. Will continue fundamental research in surface science in PE 0601102A, Project VR9, Surface Science Research.  <b>FY 2013 Plans:</b> Will continue to solicit on a yearly basis new efforts to further basic research in areas such as advanced materials and nanotechnologies, more powerful energetics including those with IM properties, counter terrorism technologies, power and energy systems, smaller more lethal warheads and composite materials.				
<b>Title:</b> Armaments Research, Development and Engineering Center  <b>Description:</b> Funds basic research in weapons component development, explosives synthesis/detection and area denial.  <b>FY 2011 Accomplishments:</b> Conducted further basic research into synthesizing more powerful explosives with insensitive munition (IM) properties, technologies for detection and neutralization of IEDs/explosives, sensors/sensor fusion for area denial, smaller more lethal warheads and composite materials.  <b>FY 2012 Plans:</b> Soliciting new efforts to further basic research in areas such as advanced materials and nanotechnologies, more powerful energetics including those with IM properties, counter terrorism technologies, power and energy systems, smaller more lethal warheads and composite materials.  <b>FY 2013 Plans:</b> Will continue to solicit on a yearly basis new efforts to further basic research in areas such as advanced materials and nanotechnologies, more powerful energetic including those with IM properties, counter terrorism technologies, power and energy systems, smaller more lethal warheads and composite materials.		1.739	1.680	1.682
<b>Title:</b> Tank-Automotive Research, Development and Engineering Center  <b>Description:</b> Funds basic research in ground vehicle technologies to include power, mobility, and unmanned systems.  <b>FY 2011 Accomplishments:</b> Developed reinforcement-based Learning and Control for Robots Using Ethical Behavior Frameworks; investigated photophysical response measurements for directed energy carbon-60 colloid materials; and used event-driven control strategies to couple remote dynamical systems.  <b>FY 2012 Plans:</b>		1.238	1.207	1.199

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Develop and investigate models for nanofluid coolants and lubricants; develop and investigate durability and blast models for composite materials, including carbon nanotube reinforced composite; and develop algorithms for bio-inspired object recognition for unmanned systems. <b>FY 2013 Plans:</b> Will continue to research models for nanofluid coolants and lubricants, will research functionally graded structures exposed to shock, will investigate statistical theories and algorithms for reliability based design optimization, and will research the combustion properties of JP-8, diesel and other fuels.				
<b>Title:</b> Natick Soldier Research, Development and Engineering Center <b>Description:</b> Funds basic research in food sciences, textiles, and lightweight materials with potential for individual protection. <b>FY 2011 Accomplishments:</b> Continued 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; furthered the understanding of fundamental principles, which govern Botulinum 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. <b>FY 2012 Plans:</b> Create zwitterionic 3-dimensional nanofibrous architectures for antifouling and food pathogen sensing; conduct fundamental studies on novel metal oxides for tuned optical response; and explore understanding of the lysis mechanisms of peptides for antimicrobial protection. <b>FY 2013 Plans:</b> Will develop novel biochemical functionalization strategies to tether bio-recognition elements and antibodies onto graphene; will investigate covalent and non-covalent methods for attachment of antibodies to native graphene; will measure physical and transport properties as well as demonstrate a functionalized graphene FET for analyte detection to identify visual information derived from the movements of individuals in crowds that specifies threatening or suspicious behaviors; will validate experimental paradigms; will conduct experiments to refine the use of immersive virtual reality technologies for use with Soldier-volunteers.		1.366	1.363	1.321
<b>Title:</b> Aviation and Missile Research, Development and Engineering Center: Missile Efforts <b>Description:</b> Funds basic research in guided missile and rocket systems, directed energy weapons, unmanned vehicles, and related components. <b>FY 2011 Accomplishments:</b>		2.317	2.246	2.241

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>		<b>PROJECT</b> 91A: <i>ILIR-AMC</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Experimentally demonstrated and evaluated performance of chaotic antenna arrays and electronic steering based on lag synchronization in chaotic circuits; experimentally demonstrated inhibition of absorption in opaque materials through a phase locking dynamic and theoretical and experimental investigations of nanoplasmonic switches.  <b>FY 2012 Plans:</b> Soliciting 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.  <b>FY 2013 Plans:</b> Will experimentally explore infrared emissivity / absorptivity enhancement of polar materials by surface phonon coupling; will analyze nonlinear effects in nanostructure devices; will experimentally investigate excitation.					
<b>Title:</b> Aviation and Missile Research, Development and Engineering Center: Aviation Efforts  <b>Description:</b> Funds basic research for aviation enabling technologies in the areas of aerodynamics, structural dynamics, and material science.  <b>FY 2011 Accomplishments:</b> Investigated the effectiveness of fluidic oscillators to control separation for bluff body flow and also initiated computational fluid dynamics and computational structural dynamics methods for accurate rotor stability analysis.  <b>FY 2012 Plans:</b> Investigate inflow dynamics and wake physics at high advance ratios and investigate dielectric barrier discharge plasma devices for reduced bluff body drag.  <b>FY 2013 Plans:</b> Will complete initial testing on trailed wake vorticity and spanwise loading; will complete Particle Image Velocimetry (PIV) data analysis for dynamic stall test case; and will complete project on high advance ratio theory including all reporting.			1.677	1.628	1.623
<b>Title:</b> Communications-Electronics Research, Development, and Engineering Center  <b>Description:</b> Funds basic research for communication and network enabling technologies in the areas of antenna design, network management, power generation and storage, and also sensors.  <b>FY 2011 Accomplishments:</b> Investigated new anode and cathode materials for electrochemical couples with increased kinetic properties; performed research on developing cost-effective metamaterial antenna fabrication concept; performed research and experimental validation of the derived theoretical limits of explosive ordnance interference cancelation systems intended to enable communications			1.536	1.481	1.485

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012		
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 Programs (\$ in Millions)			FY 2011	FY 2012	FY 2013
during jamming; performed experimental validation of new cognitive radio techniques for blind signal interception; investigated fundamental parameters affecting Shockley-Reed-Hall defect centers in narrow gap infrared (IR) semiconductors (e.g., III-V and II-VI epitaxial compounds); researched and investigated novel conducting polymers for use as explosive specific sensors and as low power displays; and explored new measurement methodologies (e.g., catholuminescence) for studying IR detector defects at the atomic level.  <b>FY 2012 Plans:</b> Perform research for developing cognitive algorithm and intelligent cognitive network with optimized managed resources, and flexible and reconfigurable radio frequency (RF) technologies; explore RF interaction of nano-tubes and metamaterial for wideband signal amplification and also electromagnetic radiation; explore control theory in addressing the uncertainty and latency in the cognitive ad-hoc network; perform research on sensor network scenarios that can perform blind signal sensing and classification of weak signals; investigate alternative separator and electrolytes for high energy/power electrochemical couples; concentrate on reducing the parasitic (non-electrochemical) reactions between synthesized separator and electrolyte and high energy electrode components; and investigate new metallic polymers for next generation infrared sensors.  <b>FY 2013 Plans:</b> Will perform research in III-V component detector materials, advanced non-contact biometrics, nano engineered methods for explosive detection, and novel semiconductor growth processes and process monitoring; will investigate novel electromagnetic polymer nanocomposites to gain a fundamental understanding of the underlying physics for potential antenna applications; will continue investigations into alternative separator and electrolytes for high energy/power electrochemical couples by concentrating on reducing the parasitic (non-electrochemical) reactions between synthesized separator and electrolyte and high energy electrode components and will initiate research into halogenated mixed metal oxides cathode material for advanced lithium electrochemical systems.					
<b>Title:</b> Peer Reviewed Proposal Efforts  <b>Description:</b> Funds peer reviewed proposals in basic research to provide increased quality and responsiveness in exploring new technological concepts that are highly relevant to Army needs. This funding also enhances recruitment, development, and retention of outstanding scientists and engineers engaged in high quality basic research for the Army, which provides a constant flow of new knowledge to Army laboratories.  <b>FY 2011 Accomplishments:</b> Conducted basic research efforts to develop and maintain a cadre of active research scientists who can distill and extend results from worldwide research in areas of interest to the Army.  <b>FY 2012 Plans:</b>			2.928	5.834	5.555

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>	<b>PROJECT</b> 91A: <i>ILIR-AMC</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Conducting basic research efforts aimed at developing and maintaining a cadre of active research scientists who can distill and extend results from worldwide research in areas of interest to the Army.			
<b>FY 2013 Plans:</b> 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 in areas of interest to the Army.			
<b>Accomplishments/Planned Programs Subtotals</b>		15.714	16.275
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
91C: ILIR-MED R&D CMD	3.520	2.813	2.839	-	2.839	2.886	2.935	2.984	3.032	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project fosters investigator-driven medical and force-health protection basic research initiatives performed at the six U.S. 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 Assistant Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy,.

Work in this project is performed by the Walter Reed Army Institute of Research, Silver Spring, MD; U.S. Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, MD; US Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD; U.S. Army Institute of Environmental Medicine, Natick, MA; U.S. Army Institute of Surgical Research, Fort Sam Houston, TX; U.S. Aeromedical Research Laboratory, Fort Rucker, AL; and the Telemedicine and Advanced Technology Research Center, Fort Detrick, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Independent Research Efforts	3.520	2.813	2.839
<b>Description:</b> Funds basic research in medical and force health protection.			
<b>FY 2011 Accomplishments:</b> Evaluated blocking transmission of leishmaniasis using paratransgenesis (introduction of a non-harmful organism that carries and introduces the genes to block transmission of leishmania to humans); Identified and characterized Shigella metabolism; Evaluated new approaches for bias correction in epidemiological studies; Evaluated host and wound adaptations in Acinetobacter baumannii, a cause of wound bacterial infections; Evaluated the effect of energy deprivation on molecular regulation and biomarkers of skeletal muscle degradation; Evaluated diminishing post-burn contracture (tightening of skin around a burn) using anti-complement and anti-inflammatory strategies; Evaluated epithelial cell induction of vasculogenesis (blood vessel formation); Evaluated Acute Respiratory Distress Syndrome due to bilateral pulmonary contusion (bruising of the lung caused by trauma to the chest with shock due to bleeding; Evaluated recombinant reovirus particles as environmentally stable oral vaccine vectors (capable of carrying genes of other organisms to illicit a protective immune response) against bioweapons; Evaluated engineered human blood vessels to study vascular leakage (increased blood vessel permeability) caused by hantaviruses; Studied host-derived therapeutic targets (destructive host responses to infection) during filovirus infection; Evaluated the efficacy effectiveness) of potential therapeutics for chemical warfare agent-induced airway epithelial cell damage and edema			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>	<b>PROJECT</b> 91C: <i>ILIR-MED R&amp;D CMD</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
using an in vitro screening model; Evaluated a systems biology platform for understanding host-pathogen interactions.  <b>FY 2012 Plans:</b> Investigate an in vitro and in vivo model systems to examine nutritional countermeasures for enhanced neuroprotection and stress resilience; Study the evolution of RNA genome viruses under immune system selective pressure to improve vaccine design: Theory, modeling, and validation; Investigate the use of recombinant reovirus particles as environmentally stable oral vaccine vectors against bioweapon threat agents; Enhance understanding the role of the Sap proteins (particular type of proteinase protein) in disease causing capability of microorganisms (pathogenesis); Investigate genetic determinants which contribute to the intracellular survival and replication of Burkholderia pseudomallei (a gram negative bacterium often associated with infections); Evaluate the basic science of filovirus (includes Ebola and Marburg viruses which cause serious often fatal hemorrhagic disease) neutralization and peptide entry inhibitors (proteins which inhibit infection; Study an in vitro screening model for evaluating the efficacy of potential therapeutics for chemical warfare agent-induced airway epithelial cell damage and edema.  <b>FY 2013 Plans:</b> 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.			
<b>Accomplishments/Planned Programs Subtotals</b>		3.520	2.813
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
91D: ILIR-CORPS OF ENGR	1.243	1.064	1.073	-	1.073	1.087	1.097	1.108	1.126	Continuing	Continuing

**Note**

Not applicable for this item

**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 US Army Engineer Research and Development Center (ERDC).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army ERDC, Vicksburg, MS.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Geospatial Research and Engineering/Military Engineering/Environmental Quality and Installations	1.243	1.064	1.073
<b>Description:</b> Funds basic research in the areas of geospatial research and military engineering as well as environmental quality and installations.			
<b>FY 2011 Accomplishments:</b> Investigated a set of theoretical algorithms for poly-disperse soil packings based upon historical granular research and using simulations to validate performance; and continued 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 contaminants in the environment.			
<b>FY 2012 Plans:</b> Complete basic research efforts for ultra-compact soils for soil mechanics systems; investigate vegetation photopigment decay for remote sensing of hazardous materials; and investigate DNA pattern formation upon non-directed assembly at a functionalized surface for Army relevant compounds.			
<b>FY 2013 Plans:</b> Will create a numerical physics-based model of dynamic geologic-material contact behavior with buried sensors; will create a methodology to rapidly characterize the near-ground atmospheric and instantaneous sound field between sensor nodes for a large			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory Independent Research</i>	<b>PROJECT</b> 91D: <i>ILIR-CORPS OF ENGR</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> region; and will compare experimental ground-penetrating radar data with models of the Maxwell Wagner process to understand if Maxwell Wagner processes are responsible for the variety of dielectric constants that appear in any soil at any water content.		<b>FY 2011</b>	<b>FY 2012</b>
		<b>FY 2013</b>	
<b>Accomplishments/Planned Programs Subtotals</b>		1.243	1.064
		1.073	
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
91E: ILIR-ARI	0.146	0.151	0.153	-	0.153	0.156	0.157	0.160	0.163	Continuing	Continuing

## Note

Not applicable for this item

## A. Mission Description and Budget Item Justification

This project provides funding for In-house Laboratory Independent Research (ILIR) in the Army Research Institute for Behavioral and Social Sciences (ARI). This project supports basic research in the Cognitive Sciences and 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, Arlington, VA.

## B. Accomplishments/Planned Programs (\$ in Millions)

<b>Title:</b> Army Research Institute	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> Funds basic research in cognitive, behavioral, and social sciences to improve Soldier recruiting, assignment and retention and providing fundamental knowledge for human performance and organizational behavioral research.	0.146	0.151	0.153
<b>FY 2011 Accomplishments:</b> Identified key training aspects of synthetic teammates in virtual worlds that promote training transfer to a team performance setting.			
<b>FY 2012 Plans:</b> Research focus on topics such as improving training in complex environments, leader and team performance, identifying attributes critical to Soldier recruiting, assignment and retention and providing fundamental knowledge for human performance and organizational behavioral research.			
<b>FY 2013 Plans:</b> Research will focus on topics such as improving classification & assignment mechanisms (right person, right job, right time), identifying innovative metrics for leader and teams performance, as well as contributing empirically based knowledge for human performance and behavioral research.			
<b>Accomplishments/Planned Programs Subtotals</b>	0.146	0.151	0.153

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>	<b>PROJECT</b> 91E: <i>ILIR-ARI</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory Independent Research</i>				<b>PROJECT</b> F16: <i>ILIR-SMDC</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
F16: <i>ILIR-SMDC</i>	0.472	0.728	0.733	-	0.733	0.976	0.973	0.989	1.006	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project provides In-house Laboratory Independent Research (ILIR) at the Space and Missile Defense Command (SMDC) 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 by identifying the fundamental principles governing various directed energy phenomena.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army SMDC, Huntsville, AL.

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> SMDC In-house Laboratory Independent Research (ILIR)  <b>Description:</b> Funds basic research to investigate laser propagation phenomenology for application in modeling and simulation and future directed energy weapons design.  <b>FY 2011 Accomplishments:</b> Used prior year data to develop more complex beam propagation experimentation to improve the beam propagation knowledge, codes, and algorithms for Adaptive Optics systems for directed energy weapons.  <b>FY 2012 Plans:</b> Conduct modeling and simulation studies and experiments for new laser technology and beam propagation concepts to enable understanding of next generation high energy laser systems.  <b>FY 2013 Plans:</b> Will continue to conduct laser beam propagation experiments and spectroscopic research to improve modeling and simulation capabilities and improve high energy laser systems design.	0.472	0.728	0.733
<b>Accomplishments/Planned Programs Subtotals</b>	0.472	0.728	0.733

**C. Other Program Funding Summary (\$ in Millions)**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601101A: <i>In-House Laboratory</i> <i>Independent Research</i>	<b>PROJECT</b> F16: <i>ILIR-SMDC</i>
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	190.019	213.604	219.180	-	219.180	226.586	227.763	232.331	237.623	Continuing	Continuing
305: ATR RESEARCH	2.332	2.429	2.204	-	2.204	2.281	2.386	2.397	2.621	Continuing	Continuing
31B: INFRARED OPTICS RSCH	2.664	2.783	2.836	-	2.836	2.861	2.893	2.926	2.895	Continuing	Continuing
52C: MAPPING & REMOTE SENS	2.774	2.910	2.233	-	2.233	2.259	2.288	2.312	2.344	Continuing	Continuing
53A: BATTLEFIELD ENV & SIG	3.272	3.430	3.534	-	3.534	3.572	3.621	3.583	3.642	Continuing	Continuing
74A: HUMAN ENGINEERING	6.793	8.006	8.265	-	8.265	8.413	8.642	8.816	8.880	Continuing	Continuing
74F: PERS PERF & TRAINING	5.359	6.755	7.094	-	7.094	7.219	7.338	7.458	7.583	Continuing	Continuing
F20: ADV PROPULSION RSCH	3.348	3.990	4.211	-	4.211	4.256	4.307	4.283	4.357	Continuing	Continuing
F22: RSCH IN VEH MOBILITY	0.561	0.587	0.606	-	0.606	0.612	0.621	0.630	0.642	Continuing	Continuing
H42: MATERIALS & MECHANICS	6.769	8.448	8.644	-	8.644	8.907	8.998	9.053	9.208	Continuing	Continuing
H43: RESEARCH IN BALLISTICS	8.078	9.049	9.103	-	9.103	9.383	9.546	9.607	9.769	Continuing	Continuing
H44: ADV SENSORS RESEARCH	9.405	9.989	10.219	-	10.219	10.347	10.658	10.943	11.127	Continuing	Continuing
H45: AIR MOBILITY	2.328	2.445	2.515	-	2.515	2.552	2.588	2.625	2.671	Continuing	Continuing
H47: APPLIED PHYSICS RSCH	4.861	5.079	5.222	-	5.222	5.270	5.535	5.980	6.001	Continuing	Continuing
H48: BATTLESPACE INFO & COMM RSC	13.309	15.701	21.519	-	21.519	22.557	23.177	23.446	23.752	Continuing	Continuing
H52: EQUIP FOR THE SOLDIER	1.055	1.103	1.135	-	1.135	1.146	1.157	1.172	1.189	Continuing	Continuing
H57: Single Investigator Basic Research	70.691	78.134	78.050	-	78.050	81.385	80.297	82.675	84.357	Continuing	Continuing
H66: ADV STRUCTURES RSCH	1.851	1.939	1.999	-	1.999	2.018	2.046	2.069	2.022	Continuing	Continuing
H67: ENVIRONMENTAL RESEARCH	0.946	0.995	1.020	-	1.020	1.031	1.054	1.065	1.084	Continuing	Continuing
S13: SCI BS/MED RSH INF DIS	10.355	10.883	12.099	-	12.099	12.265	12.389	12.182	12.471	Continuing	Continuing
S14: SCI BS/CBT CAS CARE RS	6.606	9.694	10.197	-	10.197	9.472	9.069	9.375	9.697	Continuing	Continuing
S15: SCI BS/ARMY OP MED RSH	8.602	6.310	5.683	-	5.683	6.692	6.666	6.522	6.590	Continuing	Continuing
T22: SOIL & ROCK MECH	4.243	4.918	4.034	-	4.034	4.579	4.780	4.978	5.056	Continuing	Continuing

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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army									DATE: February 2012		
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601102A: DEFENSE RESEARCH SCIENCES							
T23: BASIC RES MIL CONST	1.779	1.898	1.659	-	1.659	1.773	1.715	1.732	1.964	Continuing	Continuing
T24: Signature Physics and Terrain State Basic Research	1.543	1.613	1.495	-	1.495	1.601	1.539	1.547	1.656	Continuing	Continuing
T25: Environmental Science Basic Research	7.851	8.221	6.888	-	6.888	7.175	7.170	7.293	8.254	Continuing	Continuing
T63: ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH	1.411	1.854	1.956	-	1.956	1.991	2.025	2.059	2.094	Continuing	Continuing
T64: SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE	1.233	2.195	2.824	-	2.824	2.959	2.930	2.972	3.022	Continuing	Continuing
VR9: SURFACE SCIENCE RESEARCH	-	2.246	1.936	-	1.936	2.010	2.328	2.631	2.675	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This program element (PE) builds fundamental scientific knowledge contributing to the sustainment of US Army scientific and technological superiority in land warfighting capability and to solving military problems related to long-term national security needs, investigates new concepts and technologies for the Army's future force, and provides the means to exploit scientific breakthroughs and avoid technological surprises. This PE fosters innovation in Army niche areas (such as lightweight armor, energetic materials, night vision capability) 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 areas of high interest to the Army (e.g., 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 appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this PE is performed by: the US Army Research Laboratory (ARL), Adelphi, MD; the 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.



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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army				DATE: February 2012	
APPROPRIATION/BUDGET ACTIVITY		R-1 ITEM NOMENCLATURE			
2040: Research, Development, Test & Evaluation, Army		PE 0601102A: DEFENSE RESEARCH SCIENCES			
BA 1: Basic Research					
B. Program Change Summary (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total
Previous President's Budget	195.845	213.942	219.116	-	219.116
Current President's Budget	190.019	213.604	219.180	-	219.180
Total Adjustments	-5.826	-0.338	0.064	-	0.064
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.730	-			
• Adjustments to Budget Years	-	-	0.064	-	0.064
• Other Adjustments 1	-2.096	-0.338	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> 305: <i>ATR RESEARCH</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
305: <i>ATR RESEARCH</i>	2.332	2.429	2.204	-	2.204	2.281	2.386	2.397	2.621	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project fosters research for automatic target recognition (ATR) concepts 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 determining 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. Research in this project builds knowledge for several technology efforts including multi-domain smart sensors, third generation Forward Looking Infrared (FLIR), and advanced multi-function laser radar (LADAR).

Work in this project complements and is fully coordinated with the Armaments Research, Development, and Engineering Center (RDEC) (ARDEC); the Communications-Electronics Research, Development, and Engineering Center (CERDEC); and the Edgewood Chemical Biological Center (ECBC).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

<b>Title:</b> ATR Algorithms	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> Investigate new algorithms to improve aided/unaided target detection and identification.	1.344	1.413	1.300
<b>FY 2011 Accomplishments:</b> Developed restoration techniques for atmospheric turbulence distorted imagery and a new anomaly detection algorithm based on novel computational imaging methods.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> 305: <i>ATR RESEARCH</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>				
Research automatic machine perception algorithms that provide enhanced situational awareness; investigate fast algorithms for feature extraction and scene understanding from hyperspectral and multimodal data.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>FY 2013 Plans:</b> Will investigate methods for object and event detection and classification using multimodal and hyperspectral imaging sensors to support Data-to-Decision capabilities. Will conduct research for optimal sensor fusion and novel feature selection techniques to enhance Automatic Target Recognition (ATR) and biometric capabilities.				
<b>Title:</b> Tagging, Tracking and Locating (TTL)  <b>Description:</b> 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.		0.988	1.016	0.904
<b>FY 2011 Accomplishments:</b> Investigated and validated an enhanced capability in hyperspectral imaging and target detection for tracking and locating. Fabricated an RF tag sample and validated an enhanced capability in hyperspectral target detection for tracking & locating. Completed investigations for the MEMS and flexible ultrasonic tags.				
<b>FY 2012 Plans:</b> Research efforts in the areas of imaging and tagging for TTL enhancements and applications.				
<b>FY 2013 Plans:</b> Will investigate and design advanced algorithms, components, sensors, and techniques applicable to TTL. Will assess the use of inherent target signatures including hyperspectral signatures to provide enhanced TTL standoff capabilities. Will further investigate the application of nanotechnology and MEMS to TTL technologies. Will examine the development of advanced taggant technologies across the electromagnetic spectrum including ultraviolet, infrared, and radio frequency for enhanced range performance and covertness. Will advance flexible electronics and non-cooperative biometric identification for TTL applications.				
<b>Accomplishments/Planned Programs Subtotals</b>		2.332	2.429	2.204
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>D. Acquisition Strategy</b>				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	R-1 ITEM NOMENCLATURE PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	PROJECT 305: <i>ATR RESEARCH</i>

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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
31B: INFRARED OPTICS RSCH	2.664	2.783	2.836	-	2.836	2.861	2.893	2.926	2.895	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This project supports Army research in materials and devices for active and passive infrared (IR) imaging systems; radio frequency (RF) photonics for radar, communications, and electronic warfare applications; and laser technology for missile threat countermeasure protection. 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 lasers 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 Midwave IR 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. This research also is intended to lay the foundation for the development of integrated optoelectronic circuits using active and passive devices and components such as lasers, waveguides, and detectors in conjunction with fiber optic interconnects for the generation, distribution, processing, and control of microwaves and study the fundamental physics of signal processing and noise generation as well as the conversion between the time and frequency domains and the optical and electrical domains in these opto-electronic (OE) circuits/systems. 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. This work is coordinated with the Communications-Electronics Research, Development, and Engineering Center (CERDEC).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> IR Focal Plane Arrays, RF Photonics, and Infrared Countermeasures	2.664	2.783	2.836
<b>Description:</b> Conduct research into IR Focal Plane Arrays, RF Photonics, and IR countermeasures to increase situational awareness in open and complex terrain; improve target detection, identification, and discrimination; and enhance missile threat IR countermeasure (IRCM) protection.			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> 31B: <i>INFRARED OPTICS RSCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b><i>FY 2011 Accomplishments:</i></b> Applied fiber-optic RF-photonics techniques to the advancement of opto-electronic processing of military signals; developed nano-fabrication techniques in order to create a novel photonic waveguide structure that could be a substitute for a fiber optic cable ; investigated large area dual color Long Wave/Midwave Infrared detector arrays; investigated methods for the improvement of minority carrier lifetimes in the type II strained layer superlattice materials that resulting in improved FPA performance.</p> <p><b><i>FY 2012 Plans:</i></b> Conduct laser research for IR countermeasures including detailed studies on the thermal characteristics of Midwave Infrared (MWIR) lasers for IRCM; investigate environmental effects of RF-photonics devices and reduce their vibration and temperature sensitivity for improved reliability; continue development of nano-fabrication techniques to achieve chip-scale RF photonic devices; and investigate methodologies for quantum well infrared detector arrays to be fabricated up to 2K x 2K focal plane arrays.</p> <p><b><i>FY 2013 Plans:</i></b> Will advance investigations of environmental effects on RF photonic devices and reduce their vibration and temperature sensitivity for improved reliability; will experimentally validate the RF-Photonics time domain signal auto-correlation processor for signals intelligence applications; develop nano-photonics devices and nano-fabrication techniques for chip-scale opto-electronic integrated circuit devices with reduced size, weight and power, Will investigate plasmonic materials, metamaterials, photonic crystals and resonating materials on the quantum efficiency of Quantum Well Infrared Photodetectors (QWIPS); will extend the operating wavelength of III-V semiconductor devices, will explore materials properties for the Type II Strained Layer Superlattice and investigate novel growth approaches and novel growth structures that will result in cheaper IR focal plane arrays. Will investigate possible methods of improving power output of quantum cascade lasers with potential transition to infrared countermeasures applications.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>		2.664	2.783
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
52C: MAPPING & REMOTE SENS	2.774	2.910	2.233	-	2.233	2.259	2.288	2.312	2.344	Continuing	Continuing

## Note

Not applicable to this item

## A. Mission Description and Budget Item Justification

This project increases knowledge of 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 uses terrain and environmental data to improve situational awareness and enhance information dominance, leading to increased survivability, lethality, and mobility.

Work in this project provides theoretical underpinnings for PE 0602784A (Military Engineering Technology), Project 855 (Mapping and Remote Sensing).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Sensor Phenomenology and Spatial-Temporal Pattern Discovery	2.774	2.910	2.233
<b>Description:</b> Funding provided for the following research.			
<b>FY 2011 Accomplishments:</b> Explored the relationship of magnetic core nanomaterials and the stand-off recovery of these materials as sensors using Surface-Enhanced Raman Scattering (SERS); also, investigated social network concepts to better assess important interaction within and between our adversaries, directly relating objects, events, actions, and trajectories within a spatial-temporal domain.			
<b>FY 2012 Plans:</b> Investigate the effects of underground anomalies on the spectral properties of surface vegetation; create a specific mathematical boundary for determining if a trajectory is an outlier.			
<b>FY 2013 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> 52C: <i>MAPPING &amp; REMOTE SENS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Will investigate a multi-parameter soil metabolic index to understand environmental impacts on emerging biological sensing. Will construct primitives to aid in efficiently solving concurrent complex queries in hierarchically represented spatial-temporal data. Will validate new infrasound signal propagation models against collected data applicable to remote assessment of hostile activity.			
<b>Accomplishments/Planned Programs Subtotals</b>		2.774	2.910
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
53A: BATTLEFIELD ENV & SIG	3.272	3.430	3.534	-	3.534	3.572	3.621	3.583	3.642	Continuing	Continuing

**Note**

Not applicable for this item

**A. Mission Description and Budget Item Justification**

This project focuses on research to seek 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 Army will operate in very complex environments (e.g., urban, mountainous, forested and jungle terrain) requiring new approaches to understanding, characterizing, and depicting environmental phenomena and their effects on military systems, personnel and operations. 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 predictable, actionable, accurate and timely tactical environmental intelligence to battlefield commanders. This project focuses on producing the foundational environmental science research to characterize the atmospheric boundary layer and deliver novel capabilities and techniques including urban turbulence characterization for its effects on micro platforms and sensor payloads, high resolution urban wind flow modeling for more efficient and accurate prediction of the transport and dispersion of obscurants and chemicals, battlefield aerosol characterization for soldier health, characterization and detection of bio-warfare agent aerosols, environmental effects on acoustic and electromagnetic signal propagation in urban and other complex domains for improved target location and imaging, exploration of previously unexploited regions of the acoustic and electro-optic spectrum, and formulation of objective analysis tools that can assimilate on-scene all-source 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 mission planning and execution operations.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD & White Sands Missile Range, NM.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Research in optical and acoustical propagation in the atmosphere	1.936	2.032	2.090
<b>Description:</b> 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.			
<b>FY 2011 Accomplishments:</b> Developed acoustic propagation algorithms for complex urban domains accounting for multiple building structure effects; exploited broader frequency acoustic propagation including ultrasound; investigated and employed the capabilities of Two-dimensional			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Angular Optical Scattering and Ultra Violet-Laser Induced Fluorescence technologies for the characterization of hazardous particles in the atmosphere.  FY 2012 Plans: Characterize atmospheric propagation effects on emerging technologies including Terahertz spectroscopy and imaging systems; Perform investigations and analyses of environmental impacts on thermal and infrared polarimetric images; Investigate the use of high resolution, multi-spectra, Light Detection And Ranging techniques for the detection of atmospheric aerosols and trace gases; Investigate the effects of ozone and other atmospheric constituents on the fluorescence spectra and other properties of bioaerosols; Measure fluorescence and absorption cross sections of aerosolized bio-warfare simulants/agents using laser-induced fluorescence and photoacoustic spectroscopy; Investigate the use of active wind screens for infrasound sensors to reduce sensor footprint on the ground; Investigate whether the influence of acoustic waves on the ionosphere can be used for the detection of anomalous events.  FY 2013 Plans: Will investigate how bioaerosol properties change with different atmospheric conditions (sunlight, humidity, oxidizing agents, etc.) so that bioaerosol viability and detectability can be added to transport and dispersion models for force protection and mission planning; will measure spectrally resolved fluorescence and absorption cross sections of aerosolized bio-warfare simulants/agents to enable more accurate assessments of the capabilities of biowarfare agent detectors; will investigate Raman spectra of individual airborne bioparticles to provide increased capability for characterizing atmospheric particles, especially harmful particles, which are too small to detect with other techniques; will perform multidisciplinary theoretical investigations for the remote sensing of precursors to atmospheric events affecting Army Operations to enhance force protection; will establish functional relationships between mid-infrared (MidIR) and long-wave infrared (LWIR) polarimetric signatures as a function of atmospheric and meteorological conditions for improved target detection, classification, and identification. Will extend terahertz (THz) propagation modeling to include path radiance and water vapor background noise to add these performance effects and improve the design of emerging passive THz imaging technology; Will improve the fundamental theory for optical turbulence effects on short-exposure passive electro-optics and infrared imaging for new optimal designs for passive adaptive optics correction.				
Title: Predictive Modeling of the Boundary Layer  Description: Increase survivability and improve situational awareness for a variety of sensors optics and flying objects (projectiles, UAVs, etc&) through research to enhance accuracy of predictive modeling of the atmospheric boundary layer and improve the ability to function effectively in adverse conditions.  FY 2011 Accomplishments: Investigated ensemble modeling techniques leading to fine-scale battlefield probabilistic weather and effects forecasting; produced improved theory and characterization of atmospheric turbulence using sonic anemometer arrays for more realistic		1.336	1.398	1.444

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> 53A: <i>BATTLEFIELD ENV &amp; SIG</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>				
mechanical and optical turbulence models, developed biologically inspired approaches to improved environmental awareness and reactions for autonomous systems; and extended the Atmospheric Boundary Layer Environment (ABLE) microscale wind model from 2D to 3D using advances in high-performance modeling to improve wind flow predictions in complex and urban terrain .				
<b>FY 2012 Plans:</b> Verify and validate the 3D ABLE model against well established measured and modeled data from complex and urban domain; Investigate modeling techniques deriving probabilistic weather impacts forecasts for future decision support tools; and develop new approaches to adverse weather route optimization algorithms for air and ground applications.				
<b>FY 2013 Plans:</b> Will enhance the 3D ABLE models turbulence parameterizations to extend modeling of high resolution dynamic turbulent flow effects of complex terrain to improve urban hazard dispersion and wind effects on robotic air vehicles; Will improve characterization and simulation of urban turbulence effects and bio-inspired control corrections that will improve Nano and Micro Air Vehicle control, hover stability and wind gust rejection; Will investigate the improvements in using sub-km Weather Research & Forecasting-based Weather Running Estimate-Nowcast (WRE-N) forecast/local now-cast model output as initial conditions to improve the fidelity and accuracy of predictions from the boundary layer 3D ABLE model for high resolution meteorology in complex terrain.				
<b>Accomplishments/Planned Programs Subtotals</b>		3.272	3.430	3.534
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
74A: HUMAN ENGINEERING	6.793	8.006	8.265	-	8.265	8.413	8.642	8.816	8.880	Continuing	Continuing

**Note**

Not applicable for this item

**A. Mission Description and Budget Item Justification**

This project focuses research on improving Soldier-system performance in future force environments by focusing on key phenomena underlying Soldier performance such as auditory spatial orientation (perception of azimuth, elevation and distance of sounds) within uncertain, degraded acoustic conditions; extending and protecting auditory and cognitive performance; human performance in automated, mixed-initiative (human control-machine control) environments; communications in hearing-degraded conditions; visual scanning and target detection; Soldier emotion and fatigue states; integration across multiple sensory modalities; perceptual-motor behavior ; 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 and enable neuroengineering. 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 translational neuroscience, which is the transition of basic neuroscience research to relevant applications, research is carried out to examine leading edge methodologies and technologies to improve the measurement and classification of neural states and behavior in operationally-relevant environments, to examine the potential application of neuroscience theories to autonomous systems to improve Soldier-system interactions, to model the relationship between brain structure and cognitive performance for understanding individual differences and injury, and to assess how neural pathways implicated in functional processing can be enhanced through dynamic system interface technologies for improving in-theatre performance and training.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Research to characterize and enhance Soldier performance	2.065	1.951	2.022
<b>Description:</b> Characterize and enhance human auditory performance of the dismounted warrior in complex environments while protecting the hearing of the Soldier.			
<b>FY 2011 Accomplishments:</b>			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Conducted initial experiments to quantify the contributions of visual, auditory, tactile, kinesthetic and narrative factors to an individual Soldier's immersive experiences; developed measures to capture how individuals perceive the effectiveness/ contribution of immersion in simulation environments. <b>FY 2012 Plans:</b> Determine the effects of ear coverage, from wearing infantry helmets, on auditory localization for modeling of Soldier mission performance. <b>FY 2013 Plans:</b> Will investigate the sound characteristics of weapon firing signatures to enable Soldiers' future ability to identify the specific weapons being fired and location of attack.				
<b>Title:</b> Soldier performance <b>Description:</b> Characterize key issues underlying Soldier decision making such as computer modeling and social network analyses to investigate the quality of information flow in a defined command and control structure, investigations into situational understanding and prediction in uncertain environments, and identifying usability deficiencies and mismatches between battle command processes and technology enhancements. <b>FY 2011 Accomplishments:</b> Began development of cognitive models predictive of team decision making; worked on determining effects of information quality and presentation on Soldier system performance. <b>FY 2012 Plans:</b> Transfer lessons learned from the development of a cognitive model-based architecture for robotics control to the Robotics Collaborative Technology Alliance; continue studies which correlate electroencephalograph data with response times to perceptual stimulus events that will further the validation of the perceptual component of the cognitive model Adaptive Control of Thought-Rational (ACT-R). <b>FY 2013 Plans:</b> Will continue to transition cognitive model-based architecture knowledge for robotics control to the Robotics Collaborative Technology Alliance and the Army Research Laboratory Robotics Enterprise allowing enhancement of recon capability to the level of		2.180	2.205	2.570
<b>Title:</b> Translational Neuroscience <b>Description:</b> Integrating neuroscience with traditional approaches to understanding Soldier behavior to enable systems designs that maximize Soldier performance. Formerly titled Research in Neuroergonomics.		1.510	3.050	2.412

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> 74A: <i>HUMAN ENGINEERING</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p><b>FY 2011 Accomplishments:</b> Advanced state-of-the-art in data analytic capabilities to extract brain-relevant information from multi-dimensional data arrays obtained in operationally-relevant contexts; validated models of neural mechanisms underlying visual scanning and explored the neural processes underlying human interaction with autonomous systems.</p> <p><b>FY 2012 Plans:</b> Investigate closed loop interaction between emotional/fatigue state monitors and computer systems that adapt to the emotion/fatigue state of the user; develop normative models that account for the variability in individual differences on performance; explore functional connectivity of multivariate datasets for assessment of performance measures; investigate predictive metrics for neural processing and/or cognitive performance that are linked to particular cognitive differences among individuals.</p> <p><b>FY 2013 Plans:</b> Will investigate sensory and motor neural processes with respect to affect on Soldier-systems within dynamic environments; will examine validation techniques for measures of task performance in operational environments to develop future Soldier metrics; will evaluate efficacy of predictive metrics for neural processing and/or cognitive performance among individuals for quantifying cognitive loads.</p>					
<p><b>Title:</b> Cognition and Neuroergonomics</p> <p><b>Description:</b> 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.</p> <p><b>FY 2011 Accomplishments:</b> Explored models of information presentation, including multi-modal and adaptive displays; examined the effects of information systems on physical and cognitive performance; examined how the nervous system filters large-scale, multi-dimensional data sets for decision making; identified individual differences in neural processing underlying successful and unsuccessful decision making; identified key individual differences and stressors and investigated their impact on neural processing and cognitive performance; explored the appropriate neuro-sensing approaches for assessment in operational environments; explored methods for state detection and signal processing techniques for signal integration; developed static algorithms that account for the variability in individual differences and/or environmental stressors on performance.</p> <p><b>FY 2012 Plans:</b> Investigate closed loop interaction between emotional/fatigue state monitors and computer systems that adapt to the emotion/fatigue state of the user; Develop normative models that account for the variability in individual differences on performance;</p>			1.038	0.800	1.261

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> 74A: <i>HUMAN ENGINEERING</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> explore functional connectivity of multivariate datasets for assessment of performance measures; and investigate predictive metrics for neural processing and/or cognitive performance that are linked to particular cognitive differences among individuals.  <b><i>FY 2013 Plans:</i></b> Will explore neural representations and develop novel measures for assessing individual differences in decision making, cognitive performance, and/or anatomical structure; will explore network connectivity measures and patterns in both model simulations and empirical datasets.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		6.793	8.006	8.265
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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.				

# UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
74F: PERS PERF & TRAINING	5.359	6.755	7.094	-	7.094	7.219	7.338	7.458	7.583	Continuing	Continuing

## Note

Not applicable for this item.

## A. Mission Description and Budget Item Justification

This project fosters basic research in behavioral and social science 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; develop principles and potential methods for training and sustaining complex tasks arising from digital, semi-automated, and robotic systems requirements; determine potential methods for faster learning, improved skill retention, and adaptable transfer of training to new tasks; discern likely methods for developing leader adaptability and flexibility as well as for speeding the maturation process; discover and evaluate the basic cognitive principles that underlie effective leader-team performance; better understand the role of emotions in regulating behavior; and improve 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) focus 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.

Work in this project is complements and is fully coordinated with PE 0602785A (Project 790) and PE 0603007A (Project 792).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the US Army Research Institute for the Behavioral and Social Sciences (ARI), Arlington, VA.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Human Behavior	3.644	4.765	5.024
<b>Description:</b> Funding is provided to better select, classify, train, and/or develop Soldiers and leaders.			
<b>FY 2011 Accomplishments:</b>			



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> 74F: <i>PERS PERF &amp; TRAINING</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p>Conducted basic research in the areas of psychological measures of individual abilities, implicit and explicit learning, cognition, and social influence.</p> <p><b>FY 2012 Plans:</b> Conduct research in the areas of the leadership and team performance in complex environments; analyze the impact of training methods on learner performance; investigate how a neurophysiologic state (i.e., affect) influences perception; identify cognitive strategies of experts that can be used to develop efficient training protocols.</p> <p><b>FY 2013 Plans:</b> Will develop data-driven models to assess the impact of training methods on task performance; will identify approaches to enhance experiential learning for guided self-development; and will investigate tacit acquisition of cultural knowledge.</p>			
<p><b>Title:</b> Network-Human Science</p> <p><b>Description:</b> Funding is provided for better understanding individual, unit, and organizational behavior within the context of complex networked environments.</p> <p><b>FY 2011 Accomplishments:</b> Continued basic research on variables that influence the interaction of individuals and teams within distributed environments.</p> <p><b>FY 2012 Plans:</b> Conduct research to understand organizational dynamics and unit cohesion; conduct research on how language usage influences social dynamics; and analyze the influences of human performance in complex networked environments.</p> <p><b>FY 2013 Plans:</b> Will investigate organizational leadership as transmitted through social network links; will develop models of unit cohesion within multi-level organizational units.</p>		1.715	1.990
<b>Accomplishments/Planned Programs Subtotals</b>		5.359	6.755
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			
<b>E. Performance Metrics</b>			
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.			

# UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
F20: ADV PROPULSION RSCH	3.348	3.990	4.211	-	4.211	4.256	4.307	4.283	4.357	Continuing	Continuing

## Note

Not applicable for this item

## A. Mission Description and Budget Item Justification

This project fosters research to increase the performance of small air-breathing engines and power-trains to support improved system mobility, reliability, and survivability for air and/or ground vehicles; and ultimately serve to reduce the logistics cost burden for the future force. 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 and performs basic research in propulsion, as applicable to rotorcraft as well as 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.

Work in this project complements and is fully coordinated with PE 62211 (Aviation Technology).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) at Aberdeen Proving Grounds and the NASA Glenn Research Center, Cleveland, OH.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Thermal Materials	2.332	2.443	2.495
<b>Description:</b> 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.			
<b>FY 2011 Accomplishments:</b> Completed computational assessment of gear windage for various gear rotational conditions and compared with validation results to identify and mitigate power losses.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> F20: <i>ADV PROPULSION RSCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Investigate a modeling and simulation capability that will be used to predict and compare the automotive, thermal, and electromechanical performance of next-generation Army wheeled tactical and combat vehicle power train concepts; and investigate the design of more fuel efficient propulsion systems .			
<b>FY 2013 Plans:</b> Will determine loading and durability properties associated with hybrid ceramic bearings and hybrid composite gears for next generation Army wheeled tactical and combat vehicle power-train concepts.			
<b>Title:</b> Reliable Small Engines for Unmanned Systems <b>Description:</b> 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. <b>FY 2011 Accomplishments:</b> Evaluated potential for improving fuel consumption and reliability of heavy fuel engine concepts for small (<100 HP) system applications. <b>FY 2012 Plans:</b> Evaluate the performance of a representative Army unmanned vehicle engines at simulated altitude conditions . <b>FY 2013 Plans:</b> Will establish the capability to experimentally evaluate advanced heavy fuel injection spray characteristics under simulated engine conditions to optimize combustion performance in future engine concepts.		1.016	1.547
<b>Accomplishments/Planned Programs Subtotals</b>		3.348	4.211
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
F22: RSCH IN VEH MOBILITY	0.561	0.587	0.606	-	0.606	0.612	0.621	0.630	0.642	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: non-linear ground vehicle control algorithms, using off-road terrain characteristics; and instantaneous diesel engine optimizations, using advanced analytical and experimental procedures.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Tank and Automotive Research, Development and Engineering Center (TARDEC).

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Advanced Mathematical Algorithms for Improved Vehicle Efficiency	0.561	0.587	0.606
<b>Description:</b> Funding is provided for the following effort:			
<b>FY 2011 Accomplishments:</b> Continued developing JP-8 engineering models for combustion and ignition as a function of fuel ignition quality; continued exploring vehicle-human interaction dynamics; and studied better modeling techniques for vehicle-terrain interaction dynamics.			
<b>FY 2012 Plans:</b> Expand JP-8 ignition models to include wide varying ignition quality fuels; explore and develop robust multidisciplinary design optimization techniques with advanced materials for reducing ground vehicle weight while improving or maintaining ground vehicle mobility, reliability and survivability.			
<b>FY 2013 Plans:</b> Will research ignition under high pressure injection conditions, and analyze heat release data for synthetic JP-8 fuel; will research importance sampling techniques for accelerated testing for reliability quantification under stochastic input conditions; will explore			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: DEFENSE RESEARCH SCIENCES		<b>PROJECT</b> F22: RSCH IN VEH MOBILITY
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>				
quantification of model uncertainty with enhanced identifiability; and research mobility models for small robot terramechanics, i.e. the interaction of wheeled or tracked vehicles on various surfaces.		FY 2011	FY 2012	FY 2013
<b>Accomplishments/Planned Programs Subtotals</b>		0.561	0.587	0.606
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>D. Acquisition Strategy</b>				
N/A				
<b>E. Performance Metrics</b>				
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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H42: MATERIALS & MECHANICS	6.769	8.448	8.644	-	8.644	8.907	8.998	9.053	9.208	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project conducts 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 methodology 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.

Work in this project complements and is fully coordinated with PE 0602105A, Project H84 (Materials).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Microscopic/Nanostructural Materials	2.363	2.448	2.571
<b>Description:</b> Devise new materials and design capabilities, based upon fundamental concepts derived at the microscopic and nano-structural levels, for the future force.			
<b>FY 2011 Accomplishments:</b> Researched novel processing method concepts for improved armor ceramics; and characterized multifunctional materials systems seeking performance at minimum weight.			
<b>FY 2012 Plans:</b> Provide a theoretical basis for the selection of kinetically stabilizing alloying elements in nanocrystalline materials; and prove grain size stabilization in nanocrystalline metallic systems by experimental methods for better performing ceramic armor materials.			
<b>FY 2013 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H42: <i>MATERIALS &amp; MECHANICS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Will research novel composite materials that demonstrate self-healing capability using bio-engineered concepts emerging basic research; and will advance the principles of inverse materials design and apply to emerging material models for future armor designs			
<b>Title:</b> High Deformation Rate Materials  <b>Description:</b> Develop fundamental understanding necessary to design, process and characterize materials specifically intended for high loading rate applications.  <b>FY 2011 Accomplishments:</b> Performed research relating high rate properties and microstructures to ballistic property observations; and used model results of static and transient electric/magnetic/flow fields to identify new materials and mechanisms.  <b>FY 2012 Plans:</b> Model and experimentally determine property relationships in piezoelectric materials; and describe the chemical state of emerging high rate materials with a view toward optimizing materials properties for ballistic environments.  <b>FY 2013 Plans:</b> Will develop models to describe specific strengthening mechanisms for novel aluminum alloys and use to cast coupon-scale ingots for experimental validation; and develop synthesis, processing and characterization methods specifically designed for materials in extreme dynamic environments.		2.203	2.475
<b>Title:</b> Materials Research and Processing at Small Scale  <b>Description:</b> Elucidate and exploit unique structure, processing, and property relationships that occur in materials at small length scales and develop methods to tailor the physical, chemical and mechanical response of these materials to enable unprecedented performance improvements in materials properties.  <b>FY 2011 Accomplishments:</b> Determined the relationship between textile properties and fabrication methods; and characterized novel protective materials using state of the art microscopy tools.  <b>FY 2012 Plans:</b> Develop tools for the characterization of hierarchically structured materials for an understanding of the synthesis and mechanics of bio-inspired materials; and determine quantum effects on materials design to enable unprecedented performance improvements in materials properties.  <b>FY 2013 Plans:</b>		2.203	3.525
			3.064

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H42: <i>MATERIALS &amp; MECHANICS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Will develop novel polymeric materials which are thermally and chemically stable under extreme operating conditions; will investigate and develop modeling and simulation methods specifically designed for materials used in extreme dynamic environments.		<b>FY 2011</b>	<b>FY 2012</b>
		<b>FY 2013</b>	
<b>Accomplishments/Planned Programs Subtotals</b>		6.769	8.448
		8.644	
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A  <b>D. Acquisition Strategy</b> N/A  <b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H43: RESEARCH IN BALLISTICS	8.078	9.049	9.103	-	9.103	9.383	9.546	9.607	9.769	Continuing	Continuing

**Note**

Not applicable for this item

**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 (NL)/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.

Work in this project complements and is fully coordinated with PE 0602618A, project H80 (Survivability and Lethality Technology).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Aberdeen Proving Ground, Adelphi, MD, and Research Triangle Park, NC.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> National Advanced Energetics Initiative	2.575	2.949	2.913
<b>Description:</b> 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.			
<b>FY 2011 Accomplishments:</b> Linked 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.			
<b>FY 2012 Plans:</b> Investigate rapid energy release from new classes of materials subjected to extreme physical constraints and characterize through high performance computer models and experiments.			
<b>FY 2013 Plans:</b>			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Will extend quantum-mechanical-based models to enable prediction of key performance and vulnerability properties; will determine feasibility of non-traditional energetic materials containing stored structural energy (e.g. extended solids), and identify factors influencing stabilization for designing future disruptive energetic materials				
<b>Title:</b> Launch and flight of gun launched projectiles as well as missiles  <b>Description:</b> 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.  <b>FY 2011 Accomplishments:</b> Established a validation technique that directly probes and quantifies the fundamental mechanism responsible for brittle material ballistic performance; developed suitable post-ignition thermal and equation of state models for reactive material ignition products; and quantified the terminal ballistic effects of a variety of urban construction materials impacting the human body through extensive modeling and sub-scale experiments.  <b>FY 2012 Plans:</b> Explore non-linear aerodynamics of complex shapes to advance next generation extended range precision munitions; Investigate non-traditional modeling techniques for using on-board projectile flight information to enable affordable non-GPS guidance; and perform first generation mapping of the shock and blunt impact effects on the mechanical state of human bone and tissues and the effects on specified connective centers in the human brain.  <b>FY 2013 Plans:</b> Will develop and validate coupled computational fluid dynamics, flight dynamics, and rigid body dynamics techniques in a single computational model to predict non-linear aerodynamic behavior of maneuvering precision munitions; will characterize theoretically and experimentally coupled GPS and navigation concepts for the next generation of highly dynamic, spinning projectiles; will investigate the fundamental mechanical interaction of human brain tissue with shock waves that occur during ballistic events.		2.612	2.479	1.732
<b>Title:</b> Extramural research in non-lethal (NL) control methods  <b>Description:</b> Extramural research in non-lethal (NL) control methods to exploit potentially innovative approaches that offer unique battlefield and homeland defense capabilities.  <b>FY 2011 Accomplishments:</b>		0.925	0.996	1.262

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012			
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 Programs (\$ in Millions)				FY 2011	FY 2012	FY 2013
Developed 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. <b>FY 2012 Plans:</b> Focus on the development of new models for automated image analysis and understanding, with emphasis on crowd behavior analysis through examining the spatio-temporal pattern of crowd behavior as well as abnormal event detection in crowds for situation awareness and crowd control; study relationships between molecular structure, decomposition pathways, and potential energy surfaces for ground and excited electronic states of energetic compounds using laboratory-based spectroscopic and advanced electronic structure methods to enable more accurate predictions of the performance properties of speculative energetic compounds. <b>FY 2013 Plans:</b> Will study the decomposition pathways of energetic materials to elucidate the molecular decomposition behavior at the, individual molecule scale; will create new approaches and methods to reduce effects of complex noise and missing data for exploiting sparse hyperspectral and multimodal data ; establish novel approaches for scalable indexing and retrieval of large image datasets that are necessary for effective analysis and exploitation of knowledge databases.						
<b>Title:</b> Armor Research <b>Description:</b> Develop fundamental knowledge of mechanisms that can be exploited to ensure the next generation of lightweight and efficient armor technologies. <b>FY 2011 Accomplishments:</b> Formulated and validated explosive-free plate acceleration models and equation of state models into continuum mechanics codes; and used the mesoscale modeling approach to identify ceramic material microstructures that resulted in improved ballistic resistance. <b>FY 2012 Plans:</b> Evaluate novel reactive armor and electromagnetic armor mechanisms to include inferring real-time geometry of penetration into thick armor sections induced with electromechanical stresses. <b>FY 2013 Plans:</b> Will develop the capability to measure electromechanical stress in very small samples deforming at very high strain rates and explore the effects of high magnetic field on the stress response within these deforming solids; will develop fundamental underpinnings of the electrical conductivity within the shock cone that forms around hypervelocity penetrators.				1.966	2.625	3.196
Accomplishments/Planned Programs Subtotals				8.078	9.049	9.103

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H43: <i>RESEARCH IN BALLISTICS</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H44: ADV SENSORS RESEARCH	9.405	9.989	10.219	-	10.219	10.347	10.658	10.943	11.127	Continuing	Continuing

## Note

Not applicable for this item

## A. Mission Description and Budget Item Justification

This project supports 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 feature and information fusion in the concept of Data-to-Decisions (D2D), and battlefield acoustic signal processing algorithms. Research performed under this project also supports survivable sensor systems, organic thin film transistor technology and organic light emitting diode technology for affordable rugged flexible displays. This project also funds research in the development of biologically inspired materials for use as sensors as well as for power generation and storage; and physics-based multi-scale models for electronic, optical, mechanical, and chemical materials. Payoffs include high-data-rate military communications, 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 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, improved understanding of the physics and atomic properties of materials, and capabilities in hazardous material and event sensing.

Work in this project complements and is fully coordinated with research at the Armaments Research, Development, and Engineering Center (ARDEC); the Communications-Electronics Research, Development, and Engineering Center (CERDEC), the Natick Soldier RDEC (NSRDEC) and the Edgewood Chemical Biological Center (ECBC).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Adaptive, Active, and Intelligent Optical Systems	1.697	1.752	1.833

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> H44: <i>ADV SENSORS RESEARCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> Adaptive, active, and intelligent optical systems for high-data-rate military communications and directed energy applications.  <b>FY 2011 Accomplishments:</b> Devised target-in-loop (TIL) laser beam control techniques for Army long range and tactical scenario engagements.  <b>FY 2012 Plans:</b> Develop image processing software that includes super resolution, fusion, and adaptive optics for application to enhance laser communication technologies and validate image processing software in realistic battlefield conditions to improve real-time situational awareness through greater fidelity of battlefield imagery.  <b>FY 2013 Plans:</b> Will investigate and develop advanced Army battle-space tactical and long-range atmospheric laser communication and imaging technologies to achieve high bandwidth communication, high fidelity visualization, and allow utilization of advanced command and control techniques. Will develop novel processing techniques to extend the use of quantum imaging to tactical environments in order to improve battlefield communications.					
<b>Title:</b> Improving Sensor and Display Capabilities  <b>Description:</b> Create more survivable and secure sensors and displays; improve hazardous material monitoring; and investigate new magnetic sensor technologies for personnel and improvised explosive device (IED) detection.  <b>FY 2011 Accomplishments:</b> Optimized conducting organic materials for flexible display and electronics, investigate 3-D Synthetic Aperture Radar imaging using wide-angle simulation data of complex buildings for through-the-wall sensing research, developed conductive organic materials and thin film transistors and integrated into flexible electronic devices. Researched networked fusion concepts across distributed multimodal sensor nodes and developed novel magnetic sensors with enhanced performance. Fabricated and evaluated metamaterial inspired antennas based on theoretical simulations.  <b>FY 2012 Plans:</b> Fabricate and investigate metamaterial inspired antennas based on theoretical simulations; develop, apply and validate advanced computational models of 3-dimensional realistic ground surfaces to aid in defining theoretical performance limits of low frequency wideband radar technology for the detection of landmines and IEDs; research phenomenology of features associated with sensing human motion and concepts for fusion of new features to reduce false alarms; optimize conductive organic materials and high			2.571	2.685	2.775

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
stability Organic Light Emitting Diodes (OLEDs) for transition into OLED displays to include development of thin-film transistors and transparent electrodes for flexible electronics applications.  FY 2013 Plans: Will develop sensor fusion algorithms to enable the aggregation of data features into information within the context of D2D. Will develop theoretical understanding of metaferrires (using analytical and computer simulations) as an enabling technology for low-profile and embedded antenna enhancements. Will analyze and develop algorithms to exploit co-registered video and radar imagery to enhance detection of landmines and IEDs with reduced false alarms. Will enhance acoustic sensor and array performance through wind mitigation and adaptive algorithms for improved event classification. Will evaluate conductive organic materials and high stability OLEDs for transition into OLED displays and emerging sensor applications. Will develop 1/f noise resistant magnetic sensors to improve signal-to-noise ratio (SNR) and detection range for counter IED technologies.				
Title: Biologically-Inspired Sensing and Power Generation  Description: Investigate biological systems to develop biologically-inspired materials for use as sensors as well as for power generation and storage.  FY 2011 Accomplishments: Manipulated bacteria for improved remediation of energetic materials and generation of organic fuels, investigated electric properties of bio-assembled materials for battery applications, investigated mechanical properties of bio-inspired structural materials, and investigated the electronic properties of bio-assembled electronic structures.  FY 2012 Plans: Investigate methods to redesign cellular proteins to converge the signaling from different cellular receptors to a common output signal suitable for electronic device detection; manipulate bio-assembled electronic structures by controlled deposition of infrared (IR) sensitive materials and characterize the resulting complexes; complete characterization of 2-D assembly of nucleic acid templates in non-aqueous solvents for patterning of semiconductor seed particles for IR and photovoltaic devices; continue iterative modeling and experimental evaluation of models for remediation of energetics and generation of organic fuels to reflect new information collected from systems biology approaches.  FY 2013 Plans: Will evaluate biofilm contaminate-sensing genetic constructs against actual logistics fluid specimens for both JP-8 and potable water; will manipulate bio-assembled electronic structures by controlled deposition of infrared (IR) sensitive materials and characterize the resulting complexes; will transition to larger 2-D assemblies appropriate for traditional electronic manufacturing; and will analyze engineered strains against models for generation of organic fuels to evaluate information collected from systems biology approaches. Will investigate the improvement of advanced modeling techniques through the use of an iterative approach		2.227	3.052	3.068

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H44: <i>ADV SENSORS RESEARCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
of multi-scale modeling and increased biological characterization. Will examine genotype to phenotype relationship of laboratory bacterial cultures to determine a means for identification.			
<b>Title:</b> Multi-Scale Modeling for Novel Materials		2.910	2.500
<b>Description:</b> Explore and develop modeling techniques to support fundamental studies of materials to identify physics and atomic properties that define electronic properties and characteristics.			
<b>FY 2011 Accomplishments:</b> Performed fundamental studies of materials to identify and model physics and atomic interactions that define the electronic properties and characteristics, such as bandgap structure and control material deformation, progressive / catastrophic failure, and phase response across length scales; evolved interface physics between nano- and meso-scales up to the continuum; created new multi-scale experimental techniques and characterization methods to probe materials nano- and microstructure, including defects at interfaces, and response under extreme conditions. Developed scalable interdisciplinary data models to address spatial one-way coupling of software on massively parallel petaflop systems, and multi-core computing systems.			
<b>FY 2012 Plans:</b> Perform fundamental studies of materials to identify and model physics and atomic interactions that define the electronic, optical properties and characteristics, such as bandgap structure, carrier transport, diffusion rates, defects, control material deformation, progressive / catastrophic failure, and phase response across length scales. Develop interface physics between nano- and meso-scales up to the continuum; expand upon and create new multi-scale experimental techniques and characterization methods to probe materials nano- and microstructure, including defects and at interfaces, and response under extreme conditions; Develop web-based security scheme for external and internal project users; develop multi-scale computational science environment to facilitate coupling of different software; establish methods to support high performance computing users and software developers.			
<b>FY 2013 Plans:</b> Will conduct fundamental studies of materials to identify and model physics and atomic interactions that define their electronic and optical properties and characteristics. Will evolve interface physics between nano- and meso-scales up to the continuum; will expand upon and create new multi-scale experimental techniques and characterization methods to probe materials nano- and microstructure, including defects and at interfaces, and response under extreme conditions. Will evolve web-based security schemes for external and internal project users to foster multi-disciplinary collaboration; will examine multi-scale computational science environment to facilitate coupling of different software programs/algorithms; will advance methods to support high performance computing users and software developers.			
<b>Accomplishments/Planned Programs Subtotals</b>		9.405	9.989



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H44: <i>ADV SENSORS RESEARCH</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H45: AIR MOBILITY	2.328	2.445	2.515	-	2.515	2.552	2.588	2.625	2.671	Continuing	Continuing

**Note**

Not applicable for this item

**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 assess 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.

Work in this project complements and is fully coordinated with PE 62211 (Aviation Technologies).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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 Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Rotary Wing Aerodynamics	2.328	2.445	2.515
<b>Description:</b> Funding is provided for the following effort			
<b>FY 2011 Accomplishments:</b> Developed improved and validated hover performance methods, investigated the ability of pressure sensitive paint to acquire unsteady pressure measurements for both fuselage and rotor blades.			
<b>FY 2012 Plans:</b> Assess facility effects on existing highest-quality single-rotor hover data; investigate natural laminar flow wings for improved rotorcraft performance; and explore high performance computing methodology for difficult rotorcraft phenomenon.			
<b>FY 2013 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H45: <i>AIR MOBILITY</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Will experimentally investigate detailed helicopter wake structure for the existence of worm-like fluid phenomena seen in computational fluid dynamics (CFD) calculations; will analytically/numerically investigate the oscillation encountered in CFD prediction for hover performance; and will assess the importance of the fuselage impedance on rotor blade structural loads and helicopter vibration.			
<b>Accomplishments/Planned Programs Subtotals</b>		2.328	2.445
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> H47: <i>APPLIED PHYSICS RSCH</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H47: <i>APPLIED PHYSICS RSCH</i>	4.861	5.079	5.222	-	5.222	5.270	5.535	5.980	6.001	Continuing	Continuing

## Note

Not applicable for this item

## A. Mission Description and Budget Item Justification

This project performs basic research on electronic materials and structures as well as technologies in energy harvesting and energetic materials, 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 electrodes, and electronic materials; thin heterostructure systems where quantum confinement effects are important; advanced battery materials, thermoelectric devices, advanced photovoltaic and thermal photovoltaic devices as well as 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, nanomaterials for batteries and fuel cells, quantum dots for increased photovoltaic efficiency and advanced radar systems. Applications of cold atom chips include gyroscopes and accelerometers for inertial navigation units in global positioning system (GPS) denied environments, gravitational sensors for detecting underground facilities, very-low-phase noise precision oscillators for low-velocity Doppler radar, and atomic clocks for GPS denied environments as well as for future space-based timing applications. Technical barriers affecting performance, weight, cost, and power consumption will be addressed.

The work in this project complements and is fully coordinated with research at the Armaments Research, Development, and Engineering Center (RDEC) (ARDEC); the Communications-Electronics RDEC (CERDEC); and the Natick Soldier RDEC (NSRDEC).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Nanoelectronic Devices and Sensors	2.917	3.069	3.188
<b>Description:</b> 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; materials for advanced nano and micro devices; cold-atom chip devices for advanced sensors and ultra-stable atomic clocks; and integration of nanoenergetics and micro electro mechanical systems (MEMS) for fusing and microrobotic applications.			
<b>FY 2011 Accomplishments:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H47: <i>APPLIED PHYSICS RSCH</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Split a cold atom cloud in an atom chip waveguide. Integrated nanoporous energetic silicon with MEMS microthruster devices and developed nanoelectronic devices. Developed new battery electrode by bio-inspired processes from Institute for Collaborative Biotechnologies, PE 0601104A/project H05.  <b>FY 2012 Plans:</b> Study the coherence properties of a split cold atom cloud in an atom chip waveguide; investigate energetic energy conversion methods for on-chip pulsed power; examine existing models for graphene materials growth for potential use in nanoelectronic devices; investigate next generation wide band gap power device materials such as Aluminum Nitride (AlN) and diamond, conduct modeling of electron transport in alkaline membrane electrode assemblies, and model physical properties of Silicon (Si) anodes for Lithium ion batteries and the structure property relationships of Si anodes.  <b>FY 2013 Plans:</b> Will experimentally validate multiscale models for electrochemical transport and charge transfer in electrochemical devices to optimize performance. Investigate novel nanostructures for battery and fuel cell electrodes for increased efficiency. Will examine large area growth, material transfer, and substrate interactions of carbon based nanoelectronics for increased capabilities and reduced power consumption of battlefield electronics ; will investigate 3-dimensional growth and patterning of piezoelectric materials for low power large displacement MEMS actuators; will investigate methods and formulations for detonation using on-chip energetic materials; will investigate, emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, diamond) for energy storage electrodes, thin films, and energy conversion applications. Will characterize interference fringes using cold atoms on an atom chip; Will investigate GaN/AlGaIn and other wide-bandgap materials and device structure characteristics under high power conditions for improved electrical efficiency and associated thermal management .				
<b>Title:</b> Advanced Energy Science Research  <b>Description:</b> Conduct materials research and multi-scale modeling that will lead to advances in energy storage, harvesting, and conversion for a wide range of Army applications such as Soldiers, platforms, and microgrids.  <b>FY 2011 Accomplishments:</b> Conducted research to advance novel materials by design using modeling and theoretical computations to predict characteristics and performance a priori for energy storage and conversion materials; investigated multidisciplinary approaches for novel energy harvesting (light, heat, vibration, isotope, and biological energy sources); investigated emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, and diamond) for energy storage electrodes, thin films, and energy conversion applications.  <b>FY 2012 Plans:</b> Conduct research to design, fabricate and characterize materials properties in coordination with planned modeling and theoretical computations for energy storage and conversion materials; conduct research in developing computational tools in multi-scale modeling supporting electrochemical energy materials development; design and experiment with novel energy harvesting (light,		1.944	2.010	2.034

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> H47: <i>APPLIED PHYSICS RSCH</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
heat, vibration, isotope, biological energy, sources) methods; investigate, emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, and diamond) for energy storage electrodes, thin films, and energy conversion applications.				
<b>FY 2013 Plans:</b> Will conduct research on the design, fabrication and characterization of material properties in coordination with modeling and theoretical computations for energy storage and conversion materials; will investigate methods for developing multi scale computational and simulation tools supporting the development of materials for electrochemical energy conversion and generation; will design and experiment with novel energy harvesting (light, heat, vibration, isotope, biological energy, sources) methods; investigate emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, and diamond) for energy storage electrodes, and energy conversion applications. Will investigate advanced device architectures for thermoelectric and photovoltaic devices for increased energy conversion efficiency .				
<b>Accomplishments/Planned Programs Subtotals</b>		4.861	5.079	5.222
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H48: BATTLESPACE INFO & COMM RSC	13.309	15.701	21.519	-	21.519	22.557	23.177	23.446	23.752	Continuing	Continuing
Note Not applicable to this item											
A. Mission Description and Budget Item Justification <p>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 decreases 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 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.</p> <p>The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.</p> <p>Work in this project is performed by the Army Research Laboratory (ARL), Adelphi, MD.</p>											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: Communication for Tactical Networks								1.688	1.750	1.810	
Description: 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.											
FY 2011 Accomplishments:											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H48: <i>BATTLESPACE INFO &amp; COMM RSC</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Used network behavior models and scaling laws to develop cognitive networking protocols to enhance the performance of tactical mobile networks.  <b>FY 2012 Plans:</b> Develop techniques to characterize the quality of information and develop an understanding and potential metrics for impact on network behavior.  <b>FY 2013 Plans:</b> Will develop techniques to enhance overall operational capacity and military effectiveness of networks by adaptive management of quality of information and user trust in composite networks. The results will contribute to novel capabilities in tactical mobile communication networks that enhance effective communications of Warfighters in the networks by maximizing delivery of information of highest quality as well as managing trust in the information and the network.				
<b>Title:</b> Data to Knowledge to Support Decision Making  <b>Description:</b> 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.  <b>FY 2011 Accomplishments:</b> Conducted validations in a laboratory environment to assess the impact of scene recognition algorithms on Situation Understanding.  <b>FY 2012 Plans:</b> Extend scene recognition to scene understanding algorithms, assessing them and their associated machine learning approaches on collaborating mobile platforms.  <b>FY 2013 Plans:</b> Will investigate techniques for more closely coupling decision algorithms with image processing techniques to enhance and accelerate current data collection and information retrieval algorithms to improve exploitation of tactical intelligence.		1.485	1.513	2.632
<b>Title:</b> Information Protection for Mobile Ad-Hoc Networks (MANET)s  <b>Description:</b> 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.  <b>FY 2011 Accomplishments:</b>		1.704	1.767	4.953



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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Investigated techniques for incorporating security constraints in networking protocols. <b>FY 2012 Plans:</b> Investigate and develop techniques for securing information flows in mobile wireless tactical environments. <b>FY 2013 Plans:</b> Will develop new security protocols suitable for use in hybrid networks by leveraging and integrating techniques of both wireless and wired environments. The new protocols will contribute to novel capabilities that will enable the Warfighters to detect and defeat malicious activities of adversaries on tactical networks and hosts in MANETs, with a special focus in mobility effects.				
<b>Title:</b> Multi-Lingual Computing Research <b>Description:</b> Establishes formal methods for bridging language barriers in tactical environments, incorporating state of the art techniques in machine translation and natural language processing. <b>FY 2011 Accomplishments:</b> Conducted laboratory validations to assess multi-engine machine translation concepts, addressing scalability and robustness in noisy environments. <b>FY 2012 Plans:</b> Formalize techniques for adapting data flows to increase the effectiveness of multi-engine translation techniques; and develop methods to support decision making from machine translated segments. <b>FY 2013 Plans:</b> Will develop novel techniques for quantifying language similarity across military domains and assess the effectiveness of those techniques in extending existing translation engines to new military decision constraints in order to improve Soldier effectiveness in foreign-language tactical environments.		1.083	1.125	1.163
<b>Title:</b> Network Science for MANETs and Tactical Communications <b>Description:</b> 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. <b>FY 2011 Accomplishments:</b> Developed algorithms, techniques and metrics for robust local/global network optimization using cognitive and communication network metrics. <b>FY 2012 Plans:</b>		0.986	1.011	1.022

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Develop algorithms for the analysis of complicated large-scale network structures.  <b>FY 2013 Plans:</b> Will develop techniques and algorithms for assessing and optimizing the impact of social, cognitive and information structures on the behavior and performance of Army networks. The resulting techniques and algorithms will support future network technologies to enable Warfighters to anticipate and manage information, social and communication effects in network-enabled Mission Command.				
<b>Title:</b> Advanced Computing  <b>Description:</b> Investigate computing and networking architectures, algorithms, as well as visualization for advanced battle command applications of C4I system.  <b>FY 2011 Accomplishments:</b> Implemented large-scale battlefield network modeling; develop real-time algorithms to assist network emulations; developed models and analysis techniques; established information fusion of different data types for battle command applications that exploit emerging mobile hybrid computing architectures.  <b>FY 2012 Plans:</b> Validate battle command applications developed on mobile hybrid computing architectures, namely, large-scale network electromagnetic propagation; develop real time algorithms for network emulations, and network simulators; develop new methods for battle command information visualization; investigate scalable programming models and battle command applications for the next generation Intel high performance computing architectures, namely, cloud on a chip, and secure enclaves.  <b>FY 2013 Plans:</b> Will implement new scalable programming models for cloud-computing and will perform benchmarking for Mobile Network Modeling Institute battle scenario of C4ISR-on the move. The advanced computing approaches will assist in taking supercomputing as a deployable asset to the battlefield enhancing real-time Situational Awareness in tactical environments.		2.509	3.695	3.563
<b>Title:</b> Network Science Technology Experimental Center  <b>Description:</b> Supports in-house Network Science studies in conjunction with the Network Sciences CTA (0601104A/Project H50).  <b>FY 2011 Accomplishments:</b> Extended 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 are linked to field validations to extend the		3.854	4.840	6.376

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H48: <i>BATTLESPACE INFO &amp; COMM RSC</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
scale of the network evaluated. These efforts significantly improved the understanding of network behaviors under a full range of operational conditions, significantly improving the design of Network Centric Warfare NCW technologies.  <b>FY 2012 Plans:</b> Expand capabilities toward extensive integration of wireless communications emulation with academic and industrial experimental facilities developed under the Network Sciences CTA; instigate a comprehensive program of multi-disciplinary experiments with wireless emulation utilized as hardware in the loop; document experimental and theoretical results describing and predicting impact of mobility and adversarial attacks on the dynamics of information quality delivered through mobile communication networks to include observed phenomena of the characteristics of network reliability perceptions and trust on battle command decision making; research social network analysis metrics and techniques for integrating these with traditional communications and information network analysis methods.  <b>FY 2013 Plans:</b> Will develop and validate approaches and techniques to characterize, assess, model, and predict the performance of a notional composite network. will examine the interaction of social, informational and communication processes as they adapt to changes in mission, adversarial attacks and changes in tactics, and structure. The results will contribute to the development of tools to equip Warfighters with the capability to anticipate and manage the effects of information, social and communication dynamics on tactical networks for mission command.				
<b>Accomplishments/Planned Programs Subtotals</b>		13.309	15.701	21.519
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H52: EQUIP FOR THE SOLDIER	1.055	1.103	1.135	-	1.135	1.146	1.157	1.172	1.189	Continuing	Continuing

**Note**

Not applicable for this item

**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. The 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 Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work is performed and managed by the Natick Soldier Research, Development, and Engineering Center (NSRDEC), Natick, MA.

**B. Accomplishments/Planned Programs (\$ in Millions)**

<b>Title:</b> Equipment for the Soldier	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> 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.	1.055	1.103	1.135
<b>FY 2011 Accomplishments:</b> Continued fundamental work in supporting the goals of understanding cognition while performing multiple tasks; explored 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 conducted experiments to improve the understanding of the basic phenomena of the biomimetic approach to metal oxide formation for the production of novel multifunctional materials.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> H52: <i>EQUIP FOR THE SOLDIER</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Investigate the aerodynamics and structural behavior of permeable structures under dynamic loads; explore the cognitive behavior of non-spatial influences on navigation through complex environments; and perform fundamental biomechanical research on exoskeleton design and human sciences towards optimization of user performance.				
<b>FY 2013 Plans:</b> As a means to explore different methods to extract a concise feature vector to describe the shape of the human body: will implement computational algorithms to extract the shape- vectors of three-dimensional (3D) scans from the US Army and Marine Corps 3D scan database; will make modifications to available models to reflect the material dependencies on vapor concentration and solubility to understand experimental transport data for constituent membranes and laminates and linear permeation models.				
<b>Accomplishments/Planned Programs Subtotals</b>		1.055	1.103	1.135
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE				PROJECT			
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601102A: DEFENSE RESEARCH SCIENCES				H57: Single Investigator Basic Research			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H57: Single Investigator Basic Research	70.691	78.134	78.050	-	78.050	81.385	80.297	82.675	84.357	Continuing	Continuing

## Note

Not applicable

## A. Mission Description and Budget Item Justification

This project fosters extramural basic research to create and exploit new scientific discoveries and technology breakthroughs, primarily from universities, that will 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 life sciences), the engineering sciences (mechanical sciences, electronics, materials science and environmental science (atmospheric and terrestrial sciences)), and information sciences (mathematical sciences, computing sciences, and network sciences). Targeted research programs in nanotechnology, smart structures, multifunctional and micro-miniature sensors, intelligent systems, countermeasure, 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed extramurally by the Army Research Laboratory (ARL), Adelphi, MD.

## B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Basic Research in Life Sciences (formerly titled Basic research in molecular, physiological, and systems biology)	6.351	6.899	8.343
<b>Description:</b> Pursues fundamental discoveries in life sciences with the ultimate goal of facilitating the development of novel biomaterials to greatly enhance Soldier protection and performance. More specifically, i) molecular genetics research pursues fundamental studies in molecular and systems biology, and genetics, ii) neurosciences research investigates the physiology underlying perception, neuro-motor output, and potential methods of monitoring cognitive states during activity, iii) biochemistry research focuses on studies in structural and cell biology, metabolic processes, and biophysics; iv) research in microbiology pursues studies in microbial physiology, ecology, and evolution, and v) social science research aims to elucidate the social,			

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
cultural, and other influences to human actions. In FY13 this section includes some research activities and funding previously described under research in brain-electronic interfaces.			
<p><b>FY 2011 Accomplishments:</b> These research efforts continued to further advance their applicability and have ultimately enabled and facilitated development of new biotechnologies and bio-nano engineering applications for new Army capabilities and material. Research continued to compare the potential for various non-invasive methods to reproducibly interpret brain signals.</p> <p><b>FY 2012 Plans:</b> Efforts continue to improve Soldier protection; investigation of potential mechanisms to improve Soldier cognitive and physical performance is ongoing; and methods to harness biological mechanisms for energy and fuel production are being explored..</p> <p><b>FY 2013 Plans:</b> Efforts will study fundamental genetic and physiological properties that impact human cognitive and physical performance under normal and stressed conditions; explore mechanisms that control the nanoscale organization of biomolecules and novel approaches to support biological activity outside of the cellular environment; elucidate mechanisms of microbial adaptation and antimicrobial resistance; study the fundamental physiology underlying cognition and novel non-invasive methods to monitor cognitive processes; and explore the basic theoretical foundations of human behavior across various temporal and spatial scales</p>			
<p><b>Title:</b> Basic Research in Environmental Sciences</p> <p><b>Description:</b> Basic research in environmental science possesses three areas: atmospheric science research which enables the Army to use to operational advantage weather effects on combat operations, to include unmanned aerial vehicle employment, from the surface to the boundary layer (~14,000 feet) by possessing a fundamental understanding of the lower atmosphere; terrestrial science research to enable the Army to operate effectively in all military operating environments by understanding fundamental terrain and land-based phenomena; and military habitation science, basic research to allow military power projection that meets operational needs in a sustainable manner.</p> <p><b>FY 2011 Accomplishments:</b> Examined small-scale processes of the diurnal continental atmospheric boundary layer, investigated the overlapping topics of network science and geographic information science research as related to social networks, and improved operational sustainment through basic research in military habitation science.</p> <p><b>FY 2012 Plans:</b> Environmental sciences is addressing the knowledge and capability gap between current operational weather prediction models and local atmospheric conditions affecting soldiers and systems through basic research in atmospheric dynamics and observational capability; research is further examining the evolution of the nocturnal boundary layer structure using up to three</p>		2.474	3.679
			3.807

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<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H57: <i>Single Investigator Basic Research</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p>Tethered Lift Systems with multiple, redesigned, sensor packages trailing from each; the focus is on quantifying the turbulent processes as a function of separation scales; both experimental and modeling work continue to be performed that investigates the effects of both soil heterogeneity plus water and heat flux conditions at the soil surface on subsurface moisture distribution at different spatial scales in the unsaturated zone.</p> <p><b>FY 2013 Plans:</b> Environmental sciences will develop new approaches to improve the resolution and tradeoffs in high fidelity modeling of atmospheric and terrestrial physical processes; develop new approaches to spatially revise both theoretical and observational problems associated with the Monin-Obukhov theory such that scale-dependent intermittency statistics will be explicitly taken into account; optimize and enhance the performance of the sensor modalities used in UXO, landmine, and explosive device detection as well as develop constitutive models for near-surface processes.</p>			
<p><b>Title:</b> Basic Research in Chemical Sciences</p> <p><b>Description:</b> Focuses on the ultimate goals of achieving advanced energy control, improved threat detection, and novel responsive materials for Soldier protection. Research efforts in advanced energy control involve the study of electrochemistry and electrocatalysis, and physical and theoretical chemistry, which will lead to light-weight, reliable, compact power sources for the Soldier and more effective, lower vulnerability propellants and explosives for tailored precision strikes with minimum collateral damage. Research in protective materials involves discoveries in polymer, inorganic, and organic chemistry, which will provide new approaches for shielding the Soldier and Army platforms from ballistic, chemical, and biological threats, and reducing signatures for identification by the enemy. Threat detection research involves studies in the fields of physical, theoretical, and inorganic chemistry, which will lead to advances that provide advance warning of explosive, chemical, and biological weapons and dangerous industrial chemicals.</p> <p><b>FY 2011 Accomplishments:</b> Research efforts continued to functionalize morphology, novel reactive monomers, environmentally stable self-assembled materials, and reactions in extreme media; mechanophores (mechanically active molecules) were discovered and designed: never-before-created molecules that provide automatic conversions between mechanical, thermal and chemical energy, and synthesized and incorporated these compounds into polymers and polymeric materials.</p> <p><b>FY 2012 Plans:</b> Investigating how material and morphology can effect electron transfer and electrocatalysis; investigating novel approaches and designs for functionalized morphology, novel reactive monomers, and environmentally stable self-assembled materials; novel mechanophores previously integrated into composites are being evaluated for responses to mechanical damage; and initiating modeling and experimental studies to begin to uncover the physical properties that control chemical reactivity.</p> <p><b>FY 2013 Plans:</b></p>		8.373	9.970
			9.545



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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Will conduct research on ionic liquids in order to obtain an in-depth understanding of how their structure effects physical properties, such as transport, viscosity, and conductivity; will explore series of switchable catalysts that are capable of altering their activities in response to changes in their oxidation states in an effort to produce precisely controlled microstructures; will explore covalently immobilized peptides and proteins on non-biological surfaces to understand how the bio/abio interface can be manipulated to promote desired biological structure and function.			
<b>Title:</b> Basic Research in Physics		12.457	10.788
<p><b>Description:</b> Focuses on superior optics, signature management properties, ultra-sensitive sensors, precision guidance, quantum computing, and secure communications. Research efforts in superior optics, signature management properties, and ultra-sensitive sensors are made possible through discoveries in many subfields of physics, including optical physics and imaging science, and atomic and molecular physics. Research efforts in precision guidance involve the study of atomic and molecular physics, while the pursuit of the quantum computing and secure communications research topics is made possible from specific studies in the fields of quantum information sciences and condensed matter physics.</p> <p><b>FY 2011 Accomplishments:</b> Efforts continued on transformation optics for cloaking and omni-directional light collection; devised models and guided materials development for next generation electronics using optical lattices; engineered artificially layered oxides to enable disruptive electronic technology; studied quantum entanglement-enhanced metrology and stealth imaging; studied techniques to exploit quantum entanglement and controllable quantum physics effects for imaging; researched new spin-based electronics technology (spintronics) and 'cold atom' spintronics.</p> <p><b>FY 2012 Plans:</b> Research continues advancing transformation optics toward eventual uses in cloaking applications and omni-directional light collection; developing new ultra-cold chemistry concepts heralding novel chemical synthesis routes; exploring cross-platform qubit entanglement and evaluate potential applications in quantum entanglement-enhanced metrology and stealth imaging; assessing and improving theories to better understand and control defects in complex oxides, especially at interfaces.</p> <p><b>FY 2013 Plans:</b> Quantum optics of metamaterials will be the focus to include exploration of fundamentally new quantum effects including the photon spin and the interaction with negative index materials; will explore the control of light filaments and long distance propagation; will continue attempts to demonstrate a 25 atto-second laser pulse; will begin studies of high intensity laser light; will design and test alternative cooling techniques for use on molecules not amenable to traditional laser-cooling approaches; will investigate protected states of matter in condensed matter as well as atomic and molecular systems; will investigate non-equilibrium states in ultra-cold atomic optical lattices; will implement and characterize multi-qubit states. Will seek methodology for the rational design of novel quantum many-body states in complex oxide heterostructures; will identify the defect tolerance in</p>		12.290	

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
a series of complex oxides; will perform in-situ chemical analysis of complex oxides; will identify and characterize new candidate materials for topological insulators with strong electronic interactions.				
<b>Title:</b> Basic Research in Electronics and Photonics  <b>Description:</b> Focuses on electronic sensing, optoelectronics, solid state and high frequency science, electromagnetics, microwaves, and power electronics for situational awareness, communications, information processing, electro-magnetic warfare, and power efficiency.  <b>FY 2011 Accomplishments:</b> Demonstrated the first MOCVD grown superlattice infrared detector with interfacial layers. Performed epitaxial growth of Zinc Oxide on Zinc Oxide substrates for subsequent characterization and laser design. Developed tunable composition nano-wires that show optically pumped lasing across the visible spectrum in a small area. Determined the effects of polarization field upon ferromagnetic and optical properties of magnetically doped GaN. Developed near and far field RF-terahertz probes and antennas used for studies of biological cells and genetic based constructs.  <b>FY 2012 Plans:</b> Determining the effect of antidote lattices (a novel material structure) on the bandgap in graphene; Evaluating vertical lasing based on photonic crystal Fano resonances using nanomembrane broadband reflectors. Designing and fabricating photonic bandgap structures for use in multifunctional radio, radar, and sensor systems; Using novel probes to investigate biological cells and large scale nano-materials.  <b>FY 2013 Plans:</b> Will synthesize mercury cadmium selenide on gallium antimonide substrates and investigate its optical and structural characteristics for infrared detection. Will develop novel vertical cavity transistor lasers with high modulation rates. Will develop biologically-inspired RF direction finding antenna arrays and associated signal processing techniques based on the operation of the human auditory system. Will investigate nanoscale constructs within cells and engineered nano-structures.		14.474	11.554	11.218
<b>Title:</b> Basic Research in Materials Sciences (formerly titled Basic research in mechanical and material sciences)  <b>Description:</b> Focuses on providing innovations in materials design and processing to enable unprecedented materials through the elucidation of fundamental relationships linking composition, microstructure, defect structure, processing and properties of materials. Revolutionary materials provide support for the Army in firepower, mobility, communications, personnel protection, infrastructure and installations, and will directly affect virtually all mission areas. In FY13, the Mechanical Sciences research description and associated funding is moved to the Mechanical Sciences section within this Project.  <b>FY 2011 Accomplishments:</b>		11.324	14.131	7.097

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Devised 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. Investigated novel/emerging composite materials system that mimics biological adaptive and self-healing characteristics for novel structural materials. <b>FY 2012 Plans:</b> Developing an understanding at the microscopic level (single layer) for reaction processes and kinetics of reactive materials undergoing high speed impact; develop materials with stress-activated molecules that enhance macroscopic properties of interest when elastic force is applied; investigating a predictive theoretical framework to identify promising 2D free -standing crystalline oxides/ nitrides and nanocomposites; characterizing how the instantaneous 3-D structure of a turbulent boundary changes in the presence of an adverse pressure gradient for the understanding of dynamic stall processes. <b>FY 2013 Plans:</b> Will demonstrate novel materials with large electro-caloric effects for thermal management; will achieve rapid fabrication and densification of nanostructured materials with unique combinations of high-pressure and electrical field; will establish theory to guide the design and fabrication of multifunctional materials incorporating programmable responses and hierarchical constructs; will fabricate novel 3D topological insulators with unsurpassed bulk resistivity and surface electron mobility; will demonstrate the ability to translate biochemical activity onto inorganic surfaces. In FY13, the Mechanical Sciences research description and associated funding is moved to the Mechanical Sciences section within this Project.				
<b>Title:</b> Basic Research in Computing Sciences (formerly titled basic research in mathematical sciences and computing sciences) <b>Description:</b> Provides the backbone for performing complex, multi-system analysis, modeling and simulation for understanding information systems. Advancements in 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 FY13, the Mathematical Sciences research description and associated funding moves to the Mathematical Sciences section within this Project.  <b>FY 2011 Accomplishments:</b> Used the results of the evaluation and validation efforts from FY10 to refine and improve tools and an enhance theory. Improved tools and enhanced theory developed in FY10 on cyber situation awareness were investigated leveraging advances in cognitive science, adversarial reasoning, and decision sciences to establish new capabilities in effectively predicting, preventing, and detecting cyber intrusions, in sustaining mission critical functions and services, and in rapid recovering from damage. Studies created then assessed efficient (optimal and nearly optimal) change point detection procedures and spatiotemporal image processing techniques for clutter rejection, and nonlinear filtering methods for tracking dim targets in IR/video data.  <b>FY 2012 Plans:</b>		10.273	11.298	6.054

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Investigating trusted computing that is adaptive to both social and culture influences, and developing new capabilities for warfighters deployed in areas of different social and culture interactions; investigating adaptive change detection procedures for composite hypotheses in cyber security for comparison of several change point detection methods; developing computer network security and surveillance, clutter rejection and nonlinear filtering algorithms.					
<b>FY 2013 Plans:</b> Will continue to explore and investigate new effective computing architectures, computational methods and software tools, and to develop new methods for data sensing and fusion over large volumes of social data. Long term efforts in developing methods for the tomography of social networks, for predicting individual and collective human behaviors in the war against terrorism, and begin development of structural methods for automatic machine translation. In FY13, the Mathematical Sciences research description and associated funding moves to the Mathematical Sciences section within this Project.					
<b>Title:</b> Basic Research In Network Sciences			3.514	3.224	6.663
<b>Description:</b> Focuses on gaining 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, and more efficient logistics or communications support.					
<b>FY 2011 Accomplishments:</b> Developed the theory to understand the non-stationary, non-ergodic statistics of complex biological, social and cognitive networks observed in the experiments of FY10; understood the limitations of traditional statistical theory on which predictions have been historically based and how it impacts the capabilities of the net-centric force; specifically, the influence of intermittent uncertainty on situation awareness and decision-making in a networked environment was determined.					
<b>FY 2012 Plans:</b> Emphasis is on the understanding of human networks and, in particular, how information mathematically spreads through a network; the impact of the proposed work is providing a better understanding of how decisions are made in groups, and network effects of hard-line members of a group; commonalities between communication and human networks are being investigated, and how they can be analyzed in tandem.					
<b>FY 2013 Plans:</b> Experimental evaluation of mathematical models of how information spreads through groups/ networks is planned using Behavioral Game Theory framework; Mathematical model of decision making will be developed using neuroscience experiments, in collaboration with Life Sciences with attention being paid to errors in human judgment. Development of Game theory derived					

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
from observational data is also planned for FY13 to understand microbe adaptations and micro-scale locomotion and control for micro-bio-robots.			
<b>Title:</b> Basic Research in Bioforensics - in FY13 this effort moves to Life Sciences and Chemical Sciences  <b>Description:</b> Focuses on understanding how microbes adapt to complex and changing environments. The long term goal of this research is to discover and characterize the genetic, proteomic, and metabolic changes in response to a given environment, enabling the ability to determine where microbes originated, how closely related they are, and their recent growth environment. This research could ultimately reveal the identity and feasibility of bacterial signatures that could be used to trace the history of an organism to provide a means of tracking the cause, potential danger, and source of a biological event, whether naturally occurring or nefarious. In FY13 research activities and associated funding moves to Life Sciences and Chemical Sciences sections.  <b>FY 2011 Accomplishments:</b> Efforts identified the detection limits of bacterial poles (i.e., cell structures acting as 'age markers' within bacteria); compared sequences of virulence genes and fast-evolving microbial genes from temporally, spatially, and clinically diverse Salmonella isolates to determine whether this class of genes is useful for identifying subpopulations that associate with specific environmental niches and those that have increased capacity to cause human disease.  <b>FY 2012 Plans:</b> Efforts are determining the locations and compositions of palindromic repeats (i.e., structures acting as bacterial 'gene memory'); investigating methods to control of individual bacteria with external stimuli (chemical, optical or electrical) with appropriate spatial and temporal resolution; transferring bacteria from natural environments to the laboratory and identifying mutations that arise after transfer to laboratory culture environment; mapping gene expression patterns of bacterial outer membrane proteins in multiple combinations of environmental factors, including temperature, pH, and iron limitation.		1.451	1.997
<b>Title:</b> Basic Research in Oxide Electronics and Brain-electronic Interfaces - in FY13 this effort moves to Life Sciences  <b>Description:</b> Focuses on advancing the theory, materials growth, and characterization of artificially-layered complex oxides with the ultimate goal of discovering emergent phenomena in this material system that may ultimately provide far-reaching opportunities for new technological capabilities, and deciphering the coding of neural systems with the long-term goal of discovering and developing methods for the non-invasive decoding and modulation of neural systems, the sensing and decoding the complex brain signals responsible for specific muscle movements, and ultimately the bridging of the living/nonliving interface in peripheral nerves that may lead to future applications in silent communication and mental control of equipment such as the natural and full control of prosthetic limbs.  <b>FY 2012 Plans:</b>		-	1.997
			-

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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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Research is expanding predictive theories to accurately model materials and then verify accuracy; continuing to expand heteroepitaxial capabilities; exploring solutions to eliminate or mitigate dominant defects; pursuing luminescence diagnostic studies of material defects; developing and examining experimental methods for potential to 'decode' brain signals to determine how particular thoughts can be used as control inputs for engineered systems; and investigating potential methods for interfacing electronics with the brain.				
<b>Title:</b> Basic Research in Quantum Imaging and Defect State Enabled Spintronics - in FY13 this effort moves to Physics. <b>Description:</b> Focuses on advancing the theory, materials growth, and characterization of artificially designed and fabricated materials with the ultimate goal of discovering emergent phenomena that may ultimately provide far-reaching opportunities for new technological capabilities. Material systems of interest include for example, artificially structured complex oxides, topological insulators, nanoscale electronic systems that provide a fundamentally-new paradigm beyond semiconductor-based electronics because these systems have properties that depart from the characteristics of the building blocks. <b>FY 2012 Plans:</b> Research is expanding predictive theories to accurately model materials and then verify accuracy; continuing to expand heteroepitaxial capabilities with molecular beam epitaxy and pulsed laser deposition; exploring solutions to eliminating or mitigating dominant defects; pursuing luminescence diagnostic studies of material defects; exploring topological insulator material quality improvements to uncover unique physical phenomena; investigating the application of new optical spectroscopic techniques to topological insulators.		-	2.597	-
<b>Title:</b> Basic Research in Mechanical Sciences <b>Description:</b> Focuses on improved understanding of propulsion and combustion for improved efficiency and fuel flexibility, energetics initiation for insensitive munitions, fluid dynamics for rotorcraft, complex dynamic systems for novel sensors, energy generation and multi-dimensional systems, and solid mechanics especially at high strain rates in composite materials for novel armor and protection systems. In FY13, this section includes research plans in Mechanical Sciences moved from the Materials and Mechanics section. <b>FY 2013 Plans:</b> Will establish the differential geometry (geometric mechanics) of multi-body/granular media interactions; will develop understanding to enable JP-8 surrogate fuels for diesel engine cycle studies; will investigate novel nano-thermodynamic corrections for prediction of hot spots in energetic material; will investigate the flow mechanisms associated with transitory aerodynamic loading effected by flow control on the boundaries of stationary and moving platforms.		-	-	6.498
<b>Title:</b> Basic Research in Mathematical Sciences		-	-	6.535

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<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b>Description:</b> Pursue the creation of new mathematical tools, methods for performing complex, multi-system analysis and modeling to enhance soldier and overall weapon system performance. More specifically, the focus will be on creating mathematical principles and practical algorithms for modeling complex systems, analysis and control of biological systems, geometric analysis and topological modeling for complex systems, stochastic analysis and control, and numerical computation of infinite dimensional systems. Research in this section was previously described under Computational and Mathematical Sciences.</p> <p><b>FY 2013 Plans:</b>            New numerical methods and algorithms that facilitate improved aerodynamic performance of helicopters in adverse conditions as well as enabling optimal design of supersonic projectiles will be created. Efforts to develop a multivariate heavy-tail statistical theory and develop algorithms to improve modeling capability for complex systems will begin. New mathematical tools, computational algorithms, and capabilities that deepen understanding of protein-ligand docking will be created.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>		70.691	78.134
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H66: ADV STRUCTURES RSCH	1.851	1.939	1.999	-	1.999	2.018	2.046	2.069	2.022	Continuing	Continuing

**Note**

Not applicable for this item

**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 structural modeling 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. This is the only basic research project supporting investigations for rotorcraft and ground vehicle structures within the Department of Defense.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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 Programs (\$ in Millions)**

<b>Title:</b> Structural Analysis and Vibration Methods	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
	1.851	1.939	1.999



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H66: <i>ADV STRUCTURES RSCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b>Description:</b> This research explores new structural analyses and validation methods to achieve more accurate predictions of durability and damage tolerance in composite and metallic rotorcraft structures and evaluates structural dynamics modeling methods to address critical reliability issues in the rotating and fixed system components of future aircraft.</p> <p><b>FY 2011 Accomplishments:</b> Investigated predictive tools for residual strength after impact for thin-skin structural concepts; studied damage resistant and damage tolerant core and skin concepts; and validated residual strength prediction tools for stiffened skin components.</p> <p><b>FY 2012 Plans:</b> Use enhanced and selected Fatigue Crack Growth algorithms to validate damage tolerance (DT) methods through analytical redesign of a full-scaled rotorcraft component to meet DT requirements for Joint Future Theater Lift; investigate Prognostics &amp; Diagnostics (P&amp;D) frameworks for remaining useful life computations using flight evaluation data; validate emerging P&amp;D methods to establish probability of damage/ flaw detection, analyze usage credits, and establish fracture mechanics-based P&amp;D technology.</p> <p><b>FY 2013 Plans:</b> Will validate progressive failure analysis methods and fatigue damage model of composites under various loadings and composite configurations to address failures in Army vehicle composite structures. Will assess sensor technologies embedded in composite materials to enable multifunctional structures and to improve the capability to predict the remaining useful life of Army vehicle structures. Will investigate an advanced sensing method used for prognostics and diagnostics to reduce maintenance man-hours and to increase the availability of Army weapon systems.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>		1.851	1.939
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			
<b>E. Performance Metrics</b>			
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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> H67: <i>ENVIRONMENTAL RESEARCH</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H67: <i>ENVIRONMENTAL RESEARCH</i>	0.946	0.995	1.020	-	1.020	1.031	1.054	1.065	1.084	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project focuses basic research on innovative technologies for industrial pollution prevention (P2) that directly supports the Army production base and weapon systems and addresses non-stockpile chemical warfare (CW) site remediation. Work in pollution prevention 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, with the goal of reducing 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.

Work in this project complements and is fully coordinated with 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 the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army Armament, Research, Development and Engineering Center, Picatinny, NJ.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Industrial Pollution Prevention	0.946	0.995	1.020
<b>Description:</b> This effort conducts research on innovative environmentally- friendly technologies that support the warfighter (focusing on pollution prevention technologies).			
<b>FY 2011 Accomplishments:</b> Continued research efforts in FY10 that were reviewed by the Peer Panel during the Gate Reviews in September 2010..			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> H67: <i>ENVIRONMENTAL RESEARCH</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Begin a new three year cycle of projects with a full call for proposals sent to the RDECOM laboratories.  <b><i>FY 2013 Plans:</i></b> Will continue research efforts in FY12 that were reviewed by the Peer Panel during the Gate Reviews in September 2012; will conduct research on mechanics of antibiotic and disinfectant resistance from wastewater treatment and research into synthesis of biofuels.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		0.946	0.995	1.020
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A  <b>D. Acquisition Strategy</b> N/A  <b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
S13: SCI BS/MED RSH INF DIS	10.355	10.883	12.099	-	12.099	12.265	12.389	12.182	12.471	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project fosters basic research leading to medical countermeasures for naturally occurring diseases impacting military operations. Basic research for this project provides an understanding of the mechanisms that make organisms infectious, and mechanisms that render the human body response effective to prevent diseases caused by infectious agents. 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 transmission of such diseases. 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; (2) Bacterial Threats; (3) Viral Threats; and (4) Diagnostics and Disease Transmission Control. Work is managed by the U.S. Army Medical Research and Materiel Command (MRMC) 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.

Work in this project complements and is fully coordinated with PE 0602787A, project 870.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR) and Naval Medical Research Center (NMRC), Silver Spring, MD, and at their overseas laboratories.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Prevention/Treatment of Parasitic (symbiotic relationship between two organisms) Diseases	5.729	3.709	4.203
<b>Description:</b> This effort conducts basic research to better understand the biology of malaria and leishmaniasis (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 drugs and vaccines.			
<b>FY 2011 Accomplishments:</b>			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Continued iterative approaches for the discovery, design and synthesis of promising new antimalarial drug compounds and potential vaccine components.  <b>FY 2012 Plans:</b> Identify compounds to down-select for advance screening studies and evaluate their potential for future development as anti-parasitic drugs.  <b>FY 2013 Plans:</b> Will modify candidate compounds active against malaria and leishmania parasites to improve their anti-parasitic activity with a goal to transition these compounds to pre-clinical studies in an animal model.				
<b>Title:</b> Vaccines for Prevention of Malaria  <b>Description:</b> This effort conducts basic research to better understand and identify new proteins in the design of candidate vaccines for various types of malaria including the severe form of malaria (Plasmodium falciparum) and the less severe but relapsing form (Plasmodium vivax). A highly effective vaccine could reduce/eliminate the use of antimalarial drugs and also reduce the development of drug resistance to current/future drugs.  <b>FY 2012 Plans:</b> Identify new protein molecules as vaccine candidates against malaria to down-select for advance screening studies and evaluate their potential for future development; study the mechanism of developing antibodies against these new molecules in animal models; conduct research to develop methods of formulating new vaccine candidates for effective delivery inside the human body by using cutting-edge technologies.  <b>FY 2013 Plans:</b> Will formulate and evaluate newly identified vaccine candidates and assess mechanisms of protection in animal models. Will compare novel formulations of malaria vaccines for protective effectiveness in animal models.		-	2.227	2.440
<b>Title:</b> Bacterial Threats  <b>Description:</b> This effort conducts research to better understand the biology of bacterial organisms and their effects on humans, as well as how to prevent wound infections, diarrhea (a significant threat during initial deployments), and scrub typhus (a debilitating mite-borne disease that is developing resistance to currently available antibiotics).  <b>FY 2011 Accomplishments:</b> Developed further knowledge of the epidemiology (study of factors affecting the health and illness of populations) of diarrhea and wound infections in military personnel; assessed basic wound management measures (concentrated oxygen, nutritional		1.624	1.476	1.432

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> S13: <i>SCI BS/MED RSH INF DIS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
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 reduced antimicrobial resistance.			
<b>FY 2012 Plans:</b> Assess results of epidemiologic studies (studies of factors affecting the health and illness of populations) of bacterial diarrhea and wound infections to ensure formulation of the best vaccine candidates for diarrhea and the best prevention practices to mitigate wound infections; transition best basic wound management measures to preclinical (animal model) testing.			
<b>FY 2013 Plans:</b> Will undertake discovery of and evaluate new vaccine components needed for vaccine protection for severe bacterial diarrhea based on prior studies. Will evaluate different components from pathogens causing diarrhea for their ability to induce protection against these organisms. Will develop further knowledge of bacterial wound infection pathogens to develop effective treatments.			
<b>Title:</b> Viral Threats Research		1.667	1.736
<b>Description:</b> This effort conducts research to better understand Human Immunodeficiency Virus (HIV) and other highly lethal or incapacitating viruses, including those that cause hemorrhagic diseases (severe viral infection that causes internal bleeding), such as dengue hemorrhagic fever and hantaviruses (severe viral infection that causes internal bleeding and is contracted from close contact with rodents). 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 disease interaction with the human body.			2.109
<b>FY 2011 Accomplishments:</b> Continued to study and evaluated the basis of disease and how the immune system reacts to diseases of interest.			
<b>FY 2012 Plans:</b> Continue to study and evaluate the basis of the dengue disease and how the immune system reacts to it; conduct research on defining factors that contribute to causing dengue hemorrhagic fever that occurs in a subset of infected individuals only; also develop methods of distinguishing between protective and non-protective antibodies that will be used as surrogate markers of protection when evaluating vaccines against dengue infection.			
<b>FY 2013 Plans:</b> Will study and evaluate the basis of dengue disease and how the immune system reacts to it; will evaluate factors that contribute to causing dengue hemorrhagic fever that occurs in a subset of infected individuals only; will develop methods of distinguishing between protective and non-protective antibodies that will be used as surrogate markers of protection when evaluating vaccines against dengue infection; will determine the contribution of various cells present in human body to provide protection against dengue infection and/or dengue disease. Will study and evaluate pathogenesis of hemorrhagic fever caused by hantaviruses (a			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> S13: <i>SCI BS/MED RSH INF DIS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
family of deadly viruses transmitted by rodents). Will study the biology of HIV to understand the impact of human genes on HIV acquisition and progression to inform vaccine development.			
<b>Title:</b> Diagnostics and Disease Transmission Control		1.335	1.735
<b>Description:</b> This effort conducts research to investigate the biology of biting insects (including mosquitoes and leishmaniasis-infected sand flies) and other organisms that transmit disease (disease vectors) and their control. This effort also expands medical diagnostic and disease surveillance capabilities in the field. This research will help to direct new interventions into preventing disease transmission.			
<b>FY 2011 Accomplishments:</b> Conducted mosquito identification within U.S. Northern Command region using DNA markers to identify specimens. Conducted research leading to a new generation of detection assays for diagnosis of Rickettsial disease (carried by ticks, fleas, and lice) and lethal virus infectious agents within insect vectors (carriers of disease).			
<b>FY 2012 Plans:</b> Develop new trapping methods to improve sand fly surveillance; develop tools to identify mosquito species that transmit malaria parasites; develop a detection method for scrub typhus (a debilitating mite-borne disease that is developing resistance to currently available antibiotics) in the Pacific Commands area of operation.			
<b>FY 2013 Plans:</b> Will identify novel fast-acting, directly targeted, insecticides that rapidly degrade to harmless bi-products; will investigate next generation risk assessment tools for evaluating potential infectious disease transmission in insects (beyond modeling); will identify identification keys for medically important insect vectors.			
<b>Accomplishments/Planned Programs Subtotals</b>		10.355	10.883
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> S14: <i>SCI BS/CBT CAS CARE RS</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
S14: <i>SCI BS/CBT CAS CARE RS</i>	6.606	9.694	10.197	-	10.197	9.472	9.069	9.375	9.697	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project supports basic research to understand the fundamental mechanisms of severe trauma in order 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. This project 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.

Research conducted in this project focuses on the following five areas:

- (1) Damage Control Resuscitation
- (2) Combat Trauma Therapies
- (3) Combat Critical Care Engineering
- (4) Clinical and Rehabilitative Medicine
- (5) Traumatic Brain Injury (TBI)

Work in this project complements and is fully coordinated with PE 0602787A, Project 874.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the U.S. Army Dental Trauma Research Detachment; the U.S. 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 Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Damage Control Resuscitation	0.962	1.340	1.433
<b>Description:</b> This effort conducts studies of genetic pathways and metabolic mechanisms associated with blood clotting to understand the relationships between the human immune processes and bleeding in trauma.			
<b>FY 2011 Accomplishments:</b>			



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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Investigated genetic components of the response to hemorrhage (bleeding) in specific strains of rats.  <b>FY 2012 Plans:</b> Conduct studies of immune system interaction with the coagulation (blood clotting) system and the effect of trauma on fibrinogen (a blood clot component) formation.  <b>FY 2013 Plans:</b> Will conduct studies aimed at reducing effects on cells caused by hemorrhage (bleeding) in an animal model during resuscitation to determine the role of an enzyme in protecting cells.				
<b>Title:</b> Combat Trauma Therapies  <b>Description:</b> This effort conducts studies of trauma to tissues and organs, and ways to mitigate and/or repair this damage. Research addresses cellular repair/growth mechanisms to treat TBI, dental injuries, extremity wounds and fractures, and burns.  <b>FY 2011 Accomplishments:</b> Continued gene regulation and neuroprotection mechanism studies including studies to understand cellular mechanisms of cell death; characterization of a poly-trauma (multiple injuries) model; discovery of novel pharmaceuticals to mitigate TBI brain hypothermia (drop in temperature); investigated new therapies based upon dentally-derived stem cells for traumatic dental wound healing and repair; explored causes of low vision from head trauma.  <b>FY 2012 Plans:</b> Realign neuroprotection research to the TBI program area, and regenerative efforts in craniomaxillofacial trauma (soft tissue and skeletal injuries to the face, head and neck) to the Clinical and Rehabilitative Medicine Research Program; research potential bone defect models to find one that is clinically relevant to combat trauma.  <b>FY 2013 Plans:</b> Will continue to study the relevant model of bone defect to create a model for use in evaluating new therapies. Will identify factors capable of minimizing the development of chronic inflammation.		1.963	0.956	0.836
<b>Title:</b> Combat Critical Care Engineering  <b>Description:</b> This effort conducts 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 FY 2012.  <b>FY 2012 Plans:</b>		-	0.769	0.699

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> S14: <i>SCI BS/CBT CAS CARE RS</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Begin basic research studies to investigate differences in physiological responses between individuals with high- and low-tolerance to blood loss.  <b>FY 2013 Plans:</b> Will continue studies to investigate differences in physiological responses between individuals with high- and low-tolerance to blood loss as a path to tailoring resuscitation to individuals.			
<b>Title:</b> Traumatic Brain Injury  <b>Description:</b> This effort conducts basic research in poly-trauma (multiple injuries)/TBI model, cellular mechanisms of cell death, and the discovery of novel drugs to mitigate TBI.  <b>FY 2012 Plans:</b> Realign neuroprotection research from the Combat Trauma Therapies task area to the TBI task area; continue basic research in poly-trauma (multiple injuries)/TBI model, cellular mechanisms of cell death and discovery of novel drugs to mitigate TBI.  <b>FY 2013 Plans:</b> Will conduct research to further understand cell death and neuroprotection (protecting degeneration of the nervous system) mechanisms, and identify critical thresholds for secondary injury (i.e. polytrauma) complicating TBI.		-	0.986
<b>Title:</b> Clinical and Rehabilitative Medicine  <b>Description:</b> This effort conducts basic studies of mechanisms of tissue growth and traumatic injury to gain an understanding that will assist or facilitate the healing or transplantation process. The focus is placed on severe blast trauma to the limbs, head, and face (including eye), as well as burns.  <b>FY 2011 Accomplishments:</b> Continued the iterative process of exploring innovative regenerative tissue strategies and advancing promising approaches to the applied research phase.  <b>FY 2012 Plans:</b> Continue research in eye trauma to understand the cellular and neuronal mechanisms of eye injury; continue the process of exploring innovative regenerative tissue strategies and advancing promising approaches to the applied research phase.  <b>FY 2013 Plans:</b>		3.681	5.643
			0.660
			6.569

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> S14: <i>SCI BS/CBT CAS CARE RS</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Will continue to explore the mechanisms of eye trauma injury and the epidemiology (studying incidence or prevalence of injury) of eye trauma wounds. Will continue exploring innovative strategies to regenerate tissues and advance promising approaches to the applied research phase.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		6.606	9.694	10.197
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
S15: SCI BS/ARMY OP MED RSH	8.602	6.310	5.683	-	5.683	6.692	6.666	6.522	6.590	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project fosters 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, as well as 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
- (2) Physiological Health
- (3) Environmental Health and Protection
- (4) Computational Biology
- (5) Psychological Health and Resilience

Work in this project complements and is fully coordinated with PE 0602787A, project 869.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Walter Reed Army Institute of Research (WRAIR), Silver Spring, MD; the U.S. Army Institute of Surgical Research (USAISR), San Antonio TX; and the U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Injury Prevention and Reduction	1.396	1.094	0.970
<b>Description:</b> This effort conducts research on the body's effects from non-ionizing radiation and directed energy (laser), as well as the physiological mechanisms of musculoskeletal injury.			
<b>FY 2011 Accomplishments:</b>			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Identified specificity of hormonal fatigue markers in Soldiers during states of physical exertion and energy status; investigated responses to physical fatigue to prevent musculoskeletal injury; examined dose-response relationships to blood and tissue changes, and modeled results for visible and infrared wavelengths as a risk assessment tool for laser eye injury. <b>FY 2012 Plans:</b> Examine effectiveness of topical applications of drugs to prevent further nerve degeneration from eye trauma and high-risk military environmental exposures. For example, an intervention could be applied through an eye dropper as a treatment against laser eye injury. <b>FY 2013 Plans:</b> Will identify indicators of cellular responses to determine efficacy of intervention strategies related to injury susceptibility in the skeletal muscle; will diagnose and characterize repeated and long duration exposure from military lasers. Will characterize ocular injury as a function of shock wave (IED) impulse in a large-eye animal model to establish advanced triage, treatment, and prevention methodologies. This data will lead to our understanding of multiple ocular injuries from a single blast or laser exposure; this data will also anchor predictive biophysical models to prevent or mitigate Soldier eye injury from blast.				
<b>Title:</b> Physiological Health <b>Description:</b> This effort conducts research on the physiological mechanisms of sleep, fatigue, and nutrition on Soldier performance and well-being. <b>FY 2011 Accomplishments:</b> Investigated the extent to which the recuperative value of recovery sleep and the rate of recuperation can be enhanced through use of medication; identified the nutritional strategies required to sustain health in the modern training environment; explored the impact of micronutrient (nutrients essential in small quantities to orchestrate a whole range of physiological functions) status on performance and immune function during military training. <b>FY 2012 Plans:</b> Identify menus, food service practices, labeling and educational materials to promote healthy eating behavior in military dining facilities; identify the hormonal and metabolic responses of human fat tissue during periods of underfeeding, followed by overfeeding. <b>FY 2013 Plans:</b> Will determine muscle metabolic responses to nutritional deficit; will identify the relationship between micronutrient and bone adaptation during military training; will identify the effects of energy deficits on human brain function and cognitive performance. These results will lead to an increased understanding of the benefits of adequate nutrition for the Warfighter.		2.065	2.776	3.068
<b>Title:</b> Environmental Health and Protection		1.227	1.199	0.245

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army			<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>		<b>PROJECT</b> S15: <i>SCI BS/ARMY OP MED RSH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>			<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> This effort conducts research on the physiological mechanisms of exposure to extreme heat, cold, altitude, and other environmental stressors.  <b>FY 2011 Accomplishments:</b> Explored molecular mediators of tissue, organ and skeletal muscle injury associated with exertional heat injury and/or heat stroke in the rodent model; expanded the investigation of dose-response of medication countermeasures for the effectiveness of preventing altitude illness at moderate altitude (3,000 meters).  <b>FY 2012 Plans:</b> Identify clinical measures (blood and molecular changes within tissue) of heat stroke.  <b>FY 2013 Plans:</b> Will identify how clinical pathways alter progression and extent of organ damage following heat injury/ stroke. These studies will determine the role of inflammation in multi-organ failure. These results will be used to develop protective treatments against damage to internal organs resulting from heat exposure.					
<b>Title:</b> Computational Biology  <b>Description:</b> This effort conducts 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 began in FY 2011 and transfers to PE 61102, Project T64 in FY 2012.  <b>FY 2011 Accomplishments:</b> Conducted computational biology modeling to advance the development of protein-protein interaction models for the prediction of host-pathogen interaction networks.			0.893	-	-
<b>Title:</b> Psychological Health and Resilience  <b>Description:</b> This effort conducts 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 understanding underlying mechanisms driving suicide behavior, as well as underlying neurobiological mechanisms related to post-traumatic stress disorder (PTSD) and depression.  <b>FY 2011 Accomplishments:</b> Induced and evaluated PTSD-like symptoms in rodents for potential drug and behavioral intervention to treat combat-related PTSD; further explored associations of completed and attempted suicides with the use of anti-depression medication; investigated			3.021	1.241	1.400

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> S15: <i>SCI BS/ARMY OP MED RSH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
the predictive value of neuropsychological and neurological measures for prediction of likelihood and/or severity of subsequent post-concussion symptoms.			
<b>FY 2012 Plans:</b> Identify deployment-related measures to assess intervention effectiveness (e.g., mitigating functional impairment, transition, risky behaviors) for the treatment of PTSD. Examine and validate underlying psychosocial and biological theories of suicidal behavior. Examine underlying neural systems? response to depression treatment.			
<b>FY 2013 Plans:</b> Will identify markers to indicate the effectiveness of candidate medications for post-traumatic stress disorder (PTSD) treatments. Through exploration with an animal model, existing candidate compounds will be evaluated for efficacy in the treatment of PTSD. Neural systems response to depression treatment will be used to inform development of optimized treatment regimen for depression.			
<b>Accomplishments/Planned Programs Subtotals</b>		8.602	6.310
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
T22: SOIL & ROCK MECH	4.243	4.918	4.034	-	4.034	4.579	4.780	4.978	5.056	Continuing	Continuing

## A. Mission Description and Budget Item Justification

This project fosters basic research to correlate 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 of 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.

Work in this project provides the basis for applied research in PE 0602784A (Military Engineering Technology), Project T40 (Mobility/Weapons Effects Technology). The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Military Engineering Basic Research	2.307	2.434	2.209
<b>Description:</b> Funding is provided for this activity			
<b>FY 2011 Accomplishments:</b> Developed a mathematical technique to create continuum models for engineering-level analysis at coarser scales using discrete variables from nanoscale models.			
<b>FY 2012 Plans:</b> Complete a particle scale model to study the effects of two naturally occurring bonding agents on the suspension of particulates from naturally occurring soils.			
<b>FY 2013 Plans:</b> Will develop basic wave propagation/sensor interaction knowledge, modifications to current and future data analysis, processing, and classification algorithms to account for use of conduit, and produce a modeling framework for future variable manipulation.			
<b>Title:</b> Materials Modeling for Force Protection	1.936	2.484	1.825
<b>Description:</b> This effort moved from PE 0601102 Project T23 in FY 11 to this Project T22 in FY 12. The long-term goal of this task is to develop a structural ceramic composite that could replace steel and aluminum for most applications at one third the			



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T22: <i>SOIL &amp; ROCK MECH</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> weight. To accomplish this goal, a technical ceramic such as silicon carbide will have to be improved five-fold in tensile strength and fracture toughness.  <b>FY 2011 Accomplishments:</b> Conducted 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.  <b>FY 2012 Plans:</b> Perform fundamental 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 through engineered material models. This work moves from PE0601102A-T23 Facilities Research in FY12.  <b>FY 2013 Plans:</b> Will create experimental techniques that provide measurements at the nano- to micro-scale to allow for validation and verification of simulations of material. These techniques will allow for better understanding of how bio-lamina are created and how or if those processes can be exploited for synthesis and self-healing.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		4.243	4.918	4.034
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> T23: <i>BASIC RES MIL CONST</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
T23: <i>BASIC RES MIL CONST</i>	1.779	1.898	1.659	-	1.659	1.773	1.715	1.732	1.964	Continuing	Continuing

**Note**

Not applicable for this item

**A. Mission Description and Budget Item Justification**

Work in the project fosters basic research and supports facilities research initiatives. The research 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.

Work in this project provides the basic research basis for applied research in PE 0602784A (Military Engineering Technology), Projects T41 (Military Facilities Engineering Technology) and T45 (Energy Technology Applied to Military Facilities).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Facilities Research	1.779	1.898	1.659
<b>Description:</b> Funding is provided for the following effort.			
<b>FY 2011 Accomplishments:</b> Continued to establish a basic understanding of physical, chemical, and biological phenomena specific to the next generation nanotechnology research initiatives of military interest. Also, completed investigation of electric field effects on chemical reactions in confined nanoporous geometries.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T23: <i>BASIC RES MIL CONST</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Explore the controlled dissociation of either methane or ammonia in order to produce pure hydrogen gas; determine the effects of temperature on the quantum dot output spectrum in order to increase understanding for improved sensor development.			
<b>FY 2013 Plans:</b> Will complete investigations of enhanced heat transfer of hybrid surfaces and switching mechanisms in bioinspired polymers.			
<b>Accomplishments/Planned Programs Subtotals</b>		1.779	1.898
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE				PROJECT			
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601102A: DEFENSE RESEARCH SCIENCES				T24: Signature Physics and Terrain State Basic Research			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
T24: Signature Physics and Terrain State Basic Research	1.543	1.613	1.495	-	1.495	1.601	1.539	1.547	1.656	Continuing	Continuing

## Note

Not applicable for this item

## A. Mission Description and Budget Item Justification

This project supports basic research to increase knowledge in the areas of terrain state and signature physics. It investigates 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/infering 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.

Work in this project provides a foundation for applied research in PE 0602784A (Military Engineering Technology), Project 855 (Topographical, Image Intel and Space) and T42 (Terrestrial Science Applied Research).

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.

## B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Terrain State and Signature Physics	1.543	1.613	1.495
<b>Description:</b> Funding is provided for the following effort.			
<b>FY 2011 Accomplishments:</b> Investigated the topography and morphology of a high relief mountain basin as a major factor driving the spatial distribution of snow melt onset as measured by passive microwave sensors. Devised 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 identified the characteristics and significance of random terrain effects on wave scattering.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T24: <i>Signature Physics and Terrain State Basic Research</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p>Determine if radars can better detect subsurface disturbances through improved coherent waveform detection, and understanding of volume scatter loss rates; formulate methods for near real-time calculation of sound fields in complex environments; construct a 3D numerical model of gas transport in soil that incorporates convection and diffusion and will determine the role of soil microstructure in gas movement through porous media in the near-surface ground, which will support emerging methods of subsurface target detection; investigate a novel approach to represent terrain state spatial and temporal patterns and relationships to significantly reduce computational complexity and intensity required to model soil moisture and surface temperature.</p> <p><b><i>FY 2013 Plans:</i></b> Will formulate new statistical approaches for improved sensing and communication systems operating in complex terrestrial environments with new quantitative measures for heterogeneity and intermittency of random terrestrial media; will formulate a methodology for assessing motivational intensities (cognitive-based processes) contributing to movement patterns in constrained landscapes.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>		1.543	1.613
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			
<b>E. Performance Metrics</b>			
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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
T25: Environmental Science Basic Research	7.851	8.221	6.888	-	6.888	7.175	7.170	7.293	8.254	Continuing	Continuing
Note Not applicable for this item											
A. Mission Description and Budget Item Justification This project supports basic research to investigate 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.  Work in this project provides a fundamental basis for applied research in 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the US Army Engineer Research and Development Center (ERDC), Vicksburg, MS.											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants								3.292	3.979	3.272	
Description: Funding is provided for the following effort.											
FY 2011 Accomplishments: Established a basic understanding of physical, chemical, and biological phenomena specific to the environmental and ecological fate of contaminants of military interest. Continued investigations of degradation and transformation mechanisms of insensitive munitions and emerging contaminants.											
FY 2012 Plans:											

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Investigate bioassay response to climate and contaminant stress on a standard laboratory organism (Daphnia) to elucidate impacts on other species of concern to Military installations; characterize metals-rich granules (MRG) produced by lead (Pb) exposed soil invertebrates to determine bioavailability and potential for bacteria to release the Pb back into the environment in a biologically available form; construct a neuro-endocrine feedback mechanism ex vivo to replicate the neuroendocrine system in environmental monitoring species (fish) for advancement of high throughput screening and analyses, and computation modeling of contaminants; also, investigate the linkage of oxidative stress to behavior and animal survival impacts using real time-time imaging of gene expression and behavioral tracking.  <b>FY 2013 Plans:</b> Will initiate research on amphibian response to various militarily relevant chemicals and materials to develop an understanding of if and how these unique organisms are impacted. Will develop an understanding of transport of compounds through cellular channels that will allow information for more sensitive nano-sensors. Will investigate the new insensitive munitions behavior and persistence in environmental condition and media.				
<b>Title:</b> Remediation of Explosives, Energetics, and UXO  <b>Description:</b> Funding is provided for the following effort.  <b>FY 2011 Accomplishments:</b> Continued to establish a base of understanding of the physical, chemical, and biological phenomena specific to the remediation of explosives and energetics on training ranges.  <b>FY 2012 Plans:</b> Determine the potential for abiotic and biotic degradation of insensitive explosives, NTO and FOX-7, potential insensitive replacements for RDX; investigate non-traditional concentration response relationships for prediction of environmental risks supporting development of novel energetics.  <b>FY 2013 Plans:</b> Will investigate the mineralization of depleted uranium munitions and effects on solubility, sorption, and mobility; will explore novel microbial systems for degrading energetic compounds; and will study the bioavailability implications of interactions between munitions constituents and performance enhancing nano-material in mixtures.		2.229	2.391	1.967
<b>Title:</b> Training Land Natural Resources  <b>Description:</b> Funding is provided for the following effort.  <b>FY 2011 Accomplishments:</b>		0.862	0.749	0.616

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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>B. Accomplishments/Planned Programs (\$ in Millions)</b>				
Continued to establish a basic understanding of physical, chemical, and biological phenomena specific to ecosystem maintenance, mitigations, and rehabilitation. Investigated 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.  <b>FY 2012 Plans:</b> Define multiple-stressor assessment techniques to identify and evaluate the relative contribution of interacting stressors that impact military lands and critical natural resources; investigate how geographical fragmentation affects the pollination dynamics and gene flow within species populations to advance the fundamental knowledge for management of rare and endemic plant and pollinator species on Army ranges; also, through dermal and dietary exposure in plant and animal tissue determine the magnitude of tungsten bioavailability impacting firing range sustainability as well as to advance ecological assessment capabilities.  <b>FY 2013 Plans:</b> Will investigate how climate induced change affects the adsorption and biotransformation characteristics of northern peat-land ecosystems; will conduct mechanistic investigations of Lead (Pb) chemical separation by plant exudates to advance understanding on the potential for plant exudates to mobilize Pb in the presence of environmentally relevant completing interactions; will analyze pollination networks and nectar-dwelling yeast communities and discern shared dynamics and structural interactions between two systems to continue to advance the fundamental knowledge for management of rare and endemic plant and pollinator species on Army ranges.				
<b>Title:</b> Network Science  <b>Description:</b> Funding is provided for the following effort.  <b>FY 2011 Accomplishments:</b> Established a basic understanding of physical, chemical, and biological phenomena specific to network science applications. Evaluated alternative compositions of heterogeneity in population vigilance affording resilient/adaptive behavior at reduced cost. Developed cognitive elements to dynamically elicit the emergence of desired composition in heterogeneity. Defined the network structure involving steroidogenesis genes using time series analysis. Developed approaches using genetic tools to perturb network dynamics by gene silencing or over-expression.  <b>FY 2012 Plans:</b> Investigate first principle phenomenology describing spontaneous formation of highly regular biological networks by bacteria to determine spatial pattern relationships in bacteria colonies; determine cognitive elements associated with attention and memory		1.468	1.102	1.033



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T25: <i>Environmental Science Basic Research</i>	

  

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>  allowing heterogeneity in vigilance across a population to emerge naturally in a form conducive to social network resilience and adaptive behavior under predatory threat.  <b><i>FY 2013 Plans:</i></b> Will investigate the molecular architecture that dictates the highly specific ligand preference of insect pheromone receptors based on amino acid networks for intelligent receptor design; will investigate genetic and genomic basis of intra-species variance in sensitivity to munitions and reduced uncertainty in risk/toxicity assessment of military sites; will explore the trade-offs between adaptability and susceptibility within self-organizing biological networks.	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>	7.851	8.221	6.888

  

**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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army								DATE: February 2012			
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
T63: ROBOTICS AUTONOMY, MANIPULATION, & PORTABILITY RSH	1.411	1.854	1.956	-	1.956	1.991	2.025	2.059	2.094	Continuing	Continuing
Note Not applicable for this item.											
A. Mission Description and Budget Item Justification This project supports basic research in 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Army Research Laboratory (ARL) at the Aberdeen Proving Ground, MD.											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: Robotics autonomy and human robotic interface research								1.411	1.854	1.956	

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T63: <i>ROBOTICS AUTONOMY, MANIPULATION, &amp; PORTABILITY RSH</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Description:</b> 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. These efforts will include research activities in micromechanics conducted in association with the Micro Autonomous Systems and Technology Collaborative Technology Alliance.  <b>FY 2011 Accomplishments:</b> New combinations of advanced sensor data were fused in real time to provide enhanced dynamic situation awareness for small robotic systems, increasing the speed and agility of operation.  <b>FY 2012 Plans:</b> Evaluate novel modes of air and ground mobility for micro-mechanical systems.  <b>FY 2013 Plans:</b> Will conduct experimental studies to create a fundamental model of flapping wing locomotion to enable future micro-scale unmanned aerial vehicle systems. Will examine basic concepts and underpinning mechanics of grasping and manipulating unknown and arbitrarily shaped objects.				
<b>Accomplishments/Planned Programs Subtotals</b>		1.411	1.854	1.956
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>				<b>PROJECT</b> T64: <i>SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
T64: <i>SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE</i>	1.233	2.195	2.824	-	2.824	2.959	2.930	2.972	3.022	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project fosters research investigations 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 from these studies provides a better understanding of the overall biological system and its molecular network of interactions, which leads to improved early strategic decision-making in the 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.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the U.S. Army Medical Research and Material Command (USAMRMC), Fort Detrick, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Network Sciences Initiative	1.233	2.195	2.824
<b>Description:</b> This effort supports 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.			
<b>FY 2011 Accomplishments:</b> Validated these mathematical models developed in FY 2010 that predict host/pathogen networks			
<b>FY 2012 Plans:</b> Validate the accuracy of the models and apply the models to identify markers for traumatic brain injury.			
<b>FY 2013 Plans:</b> Will expand the identification of traumatic brain injury biomarkers to include key biological pathways. This will lead to the development of diagnostic assays and identification of potential drug targets.			
<b>Accomplishments/Planned Programs Subtotals</b>	1.233	2.195	2.824

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> T64: <i>SCI BS/SYSTEM BIOLOGY AND NETWORK SCIENCE</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
APPROPRIATION/BUDGET ACTIVITY 2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				R-1 ITEM NOMENCLATURE PE 0601102A: DEFENSE RESEARCH SCIENCES				PROJECT VR9: SURFACE SCIENCE RESEARCH			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
VR9: SURFACE SCIENCE RESEARCH	-	2.246	1.936	-	1.936	2.010	2.328	2.631	2.675	Continuing	Continuing
Note Not applicable for this item.											
A. Mission Description and Budget Item Justification This project fosters basic research to establish and maintain a core capability to enable a molecular level understanding of properties and behaviors of materials relevant to the Army; by developing understanding and ability to manipulate nanostructured materials as a means to tune properties which meet desired performance requirements; by advancing the scientific understanding of surface properties and interfacial dynamics of complex materials; and by providing scalable processes grounded in a molecular understanding of materials. This project funds basic research in the characterization of chemical and biochemical phenomena occurring at or near solid surfaces and interfaces; the interactions between chemical reactions and transport processes on surfaces; theory and modeling of processes at complex surfaces; and the synthesis and characterization of catalysts that function at the nanoscale. Investment in basic research centered on the surface science disciplines will enable growth of a knowledge base that will result in improved understanding of the interactions of complex materials in real world environments.  The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Edgewood Chemical and Biological Center (ECBC), Research, Development and Engineering Command, in Aberdeen, Maryland.											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: Surface Science Research								-	2.246	1.936	
Description: The activities in this program are related to performing basic and early applied research in chemistry, biology and physics on fundamental problems related to surfaces, interfacial dynamics, thin film materials, chemical-biological catalysis and opto-electronic/sensory technologies.											
FY 2012 Plans: Investigate the complex behavior of mass transport in microporous systems; will design rational molecular and nano-system functional abiotic structures; will conduct fundamental studies and modeling of the interfacial phenomena of particulate matter											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601102A: <i>DEFENSE RESEARCH SCIENCES</i>	<b>PROJECT</b> VR9: <i>SURFACE SCIENCE RESEARCH</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
(solid/liquid) with surfaces and the interaction of matter and mechanisms of transfer of energy at the nanoscale and at biological interfaces.  <b>FY 2013 Plans:</b> Will develop a robust set of surface science tools, both experimentally and theoretically, that can be used to further our understanding of surface properties and interfacial dynamics of complex materials; investigate rational design approaches to metal-metal oxide nano-architectures; systematically model engineered functional systems; investigate the mechanisms governing specific binding or adherence of biological molecules to abiotic surfaces; and perform structural determination and in silico modeling of trans-membrane proteins from human induced pluripotent cells.			
<b>Accomplishments/Planned Programs Subtotals</b>		-	2.246
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2013 Army	<b>DATE:</b> February 2012
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APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				PE 0601103A: <i>University Research Initiatives</i>							
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	84.445	80.850	80.986	-	80.986	82.953	83.246	83.727	84.095	Continuing	Continuing
D55: <i>University Research Initiative</i>	76.393	77.517	77.650	-	77.650	79.615	79.906	80.387	80.698	Continuing	Continuing
V72: <i>MINERVA</i>	8.052	3.333	3.336	-	3.336	3.338	3.340	3.340	3.397	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This program element (PE) supports Army basic research 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.

Work in the PE provides a foundation for applied research initiatives at the Army laboratories and research, development and engineering centers.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work on this project is performed by the Army Research Laboratory (ARL), Research Triangle Park, NC.



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<b>Exhibit R-2, RDT&amp;E Budget Item Justification: PB 2013 Army</b>	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103A: <i>University Research Initiatives</i>
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<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	91.161	80.977	82.107	-	82.107
Current President's Budget	84.445	80.850	80.986	-	80.986
Total Adjustments	-6.716	-0.127	-1.121	-	-1.121
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.606	-			
• Adjustments to Budget Years	-	-	-1.121	-	-1.121
• Other Adjustments 1	-4.110	-0.127	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
D55: University Research Initiative	76.393	77.517	77.650	-	77.650	79.615	79.906	80.387	80.698	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This project supports 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 based 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.

Work in this project provides a foundation for applied research initiatives at the Army laboratories and research, development and engineering centers.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work on this project is performed by the Army Research Laboratory (ARL) located in Research Triangle Park, NC.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Multidisciplinary University Research Initiative (MURI)	58.766	59.661	59.410
<b>Description:</b> MURI programs are typically 5 years in length at a cost of \$1.25M/yr.			
<b>FY 2011 Accomplishments:</b> The program supported MURI, with 8 new awards that are critical to the Army's future operating capabilities. MURI topics were Understanding the Interaction of Peptides and Proteins with Abiotic Surfaces: Towards Water-Free Biologics; Control of Quantum Open Systems: Theory and Experiments; Multi-Qubit Enhanced Sensing and Metrology; Stress-Controlled Catalysis via Engineering Nanostructures; Scalable, Stochastic and Spatiotemporal Game Theory for Real-World Human Adversarial Behavior; Studies of the Delayed Nonlinear Index and Two-Beam Coupling for the Propagation and Control of Filaments; Atomic Layers of			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103A: <i>University Research Initiatives</i>	<b>PROJECT</b> D55: <i>University Research Initiative</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Nitrides, Oxides, and Sulfides (ALNOS); and Value-centered Information Theory for Adaptive Learning, Inference, Tracking, and Exploitation.  <b>FY 2012 Plans:</b> Support MURI awards made in prior years and initiated 8 FY12 start MURI awards critical to future operating capabilities. 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 including Engineer Research and Development Center, U.S. Army Medical Research and Materiel Command, U.S. Army Research Institute, and industry.  <b>FY 2013 Plans:</b> Will provide support for MURI awards made in prior years will continue and will start 8 new FY13 MURI awards critical to future operating capabilities. 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 including Engineer Research and Development Center, U.S. Army Medical Research and Materiel Command, U.S. Army Research Institute, and industry.				
<b>Title:</b> Presidential Early Career Awards for Scientists and Engineers (PECASE) <b>Description:</b> Supports PECASE investigators started in prior years.  <b>FY 2011 Accomplishments:</b> Continued support for prior year awardees and selected five new awards.  <b>FY 2012 Plans:</b> Selected five new awardees and supported prior year's awardees.  <b>FY 2013 Plans:</b> Will continue support for prior year PECASE awards and select new FY13 PECASE awardees.		4.340	4.389	4.559
<b>Title:</b> Defense University Research Instrumentation Program (DURIP) <b>Description:</b> Supports basic research through competitive grants for research instrumentation.  <b>FY 2011 Accomplishments:</b> Awarded competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation.  <b>FY 2012 Plans:</b>		13.287	13.467	13.681

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103A: <i>University Research Initiatives</i>	<b>PROJECT</b> D55: <i>University Research Initiative</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Award competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation.  <b>FY 2013 Plans:</b> Will award competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		76.393	77.517	77.650
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A  <b>D. Acquisition Strategy</b> N/A  <b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
V72: MINERVA	8.052	3.333	3.336	-	3.336	3.338	3.340	3.340	3.397	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This project is supports the Minerva Research Initiative (MRI), a university-based social science research program initiated by the Secretary of Defense in FY09. It focuses on areas in the social sciences that are of strategic importance to U.S. national security policy which have not been substantially pursued in the past. The Minerva research effort will be performed to understand the internal military-political dynamics of repressive regimes, the vulnerabilities of regimes and institutions to various kinds of influence and instability, the nature of crowd dynamics, the potential to influence public opinions and attitudes in diverse cultures, cultural effects on network security and military operations, the influence of technology on military capabilities of potential adversaries and allies, and other intersections of social-cultural issues with military activities. Predictive models and other analysis tools will be developed. Leveraging the expertise in the social sciences within the academic community is needed to provide understanding of the roots of terrorist organizations and the challenges and opportunities for military operations in a culturally diverse environment. Better understanding at a fundamental level and new computational tools will provide a beneficial impact on war fighting capabilities at the national policy, military strategy, operational, and tactical levels, and will enhance the capabilities of intelligence activities at all levels. All research results will be open source.

In FY11, this project consolidated efforts that were initiated under PE 0601103A, Project D55. Existing grants on the studies of the strategic impact of religious and cultural change in the Muslim world; Iraqi perspectives; and 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 FY12.

Beginning in FY12, new research activities related to Minerva Outreach and In-House capability are funded though the Office of the Secretary of Defense.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project will is performed by the Army Research Office.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Minerva Outreach and In-house Capability	4.802	0.033	-
<b>Description:</b> Supports Minerva basic research projects and establishment of a Chairs program at principally military educational institutions.			
<b>FY 2011 Accomplishments:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103A: <i>University Research Initiatives</i>	<b>PROJECT</b> V72: <i>MINERVA</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Extended research areas to new topics, such as new theories of deterrence and the national security implications of energy and climate change. Developed 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.			
<b>FY 2012 Plans:</b> This effort was transferred to the Office of the Secretary of Defense (OSD) in FY2012 and will be executed by OSD in FY2013			
<b>Title:</b> The Minerva Research Initiative (MRI)		3.250	3.300
<b>Description:</b> The 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: Chinese Military and Technology Research and Archive Programs; Studies of the Strategic Impact of Religious and Cultural Changes within the Islamic World; Iraqi Perspectives Project; Studies of Terrorist Organization and Ideologies; New Approaches to Understanding Dimensions of National Security, Conflict, and Cooperation.			3.336
<b>FY 2011 Accomplishments:</b> Continued research was initiated in PE 0601103, Project D55 to conduct studies of the relationship of technology and national security in China, the stability vulnerabilities of African states and institutions to environmental stress, and the internal dynamics of the Baathist regime from the Iraqi perspective.			
<b>FY 2012 Plans:</b> Continue efforts on three (3) existing projects focused 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; as well as other issues related to the national security implications of conflict and cooperation.			
<b>FY 2013 Plans:</b> Research will continue into the relationship of technology and national security in China, the vulnerabilities of stability in African regimes and institutions to environmental stress, and the internal political and military dynamics in authoritarian Middle-Eastern regimes. Predictive models developed previously will be validated by extensive field research and extended by new theoretical			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601103A: <i>University Research Initiatives</i>	<b>PROJECT</b> V72: <i>MINERVA</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
development. Collaborations with combatant commands, DoD policy staff, and governmental activities will be extended and strengthened. Workshops and training courses for high level policy staff will be increased.			
<b>Accomplishments/Planned Programs Subtotals</b>		8.052	3.333
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army									DATE: February 2012		
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601104A: University and Industry Research Centers							
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
Total Program Element	93.101	140.715	123.045	-	123.045	128.947	136.085	141.558	146.194	Continuing	Continuing
F17: NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE	4.852	5.153	5.251	-	5.251	5.381	5.462	5.659	5.595	Continuing	Continuing
H04: HBCU/MI PROGRAMS	2.678	18.043	18.507	-	18.507	18.855	19.209	19.711	20.044	Continuing	Continuing
H05: INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	9.327	12.195	12.326	-	12.326	12.958	13.377	13.801	14.034	Continuing	Continuing
H09: ROBOTICS CTA	4.897	5.276	5.550	-	5.550	5.649	5.695	5.842	5.940	Continuing	Continuing
H50: Network Sciences CTA	3.172	12.888	12.968	-	12.968	14.951	15.729	16.020	16.044	Continuing	Continuing
H53: Army High Performance Computing Research Center	3.574	4.348	4.516	-	4.516	4.902	6.193	6.991	7.109	Continuing	Continuing
H54: Micro-Autonomous Systems Technology (MAST) CTA	7.763	7.932	8.127	-	8.127	8.296	8.648	9.081	8.969	Continuing	Continuing
H59: International Tech Centers	5.396	6.346	7.503	-	7.503	7.609	7.708	7.832	7.964	Continuing	Continuing
H62: Institute for Advanced Technology (IAT)	5.310	1.421	-	-	-	-	-	-	-	Continuing	Continuing
H64: MATERIALS CENTER	2.766	2.915	0.758	-	0.758	-	-	-	-	Continuing	Continuing
H73: Automotive Research Center (ARC)	2.845	3.988	4.092	-	4.092	4.195	4.197	4.251	4.321	Continuing	Continuing
J08: INSTITUTE FOR CREATIVE TECHNOLOGIES (ICT)	7.598	8.009	8.003	-	8.003	8.404	9.051	9.955	10.123	Continuing	Continuing
J12: Institute for Soldier Nanotechnology (ISN)	10.113	10.770	10.706	-	10.706	11.308	11.396	11.589	11.784	Continuing	Continuing
J13: UNIVERSITY AND INDUSTRY INITIATIVES (CA)	-	19.968	-	-	-	-	-	-	-	Continuing	Continuing
J14: Army Educational Outreach Program	3.628	5.417	9.593	-	9.593	9.738	9.864	9.935	10.038	Continuing	Continuing



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Exhibit R-2, RDT&E Budget Item Justification: PB 2013 Army									DATE: February 2012		
APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE							
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601104A: University and Industry Research Centers							
J15: NETWORK SCIENCES ITA	7.786	8.204	4.048	-	4.048	4.125	4.242	4.321	4.601	Continuing	Continuing
J17: VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE	1.992	2.650	2.771	-	2.771	3.062	3.026	3.189	3.243	Continuing	Continuing
J22: NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER	9.404	-	-	-	-	-	-	-	-	Continuing	Continuing
VS1: CENTER FOR FLEXIBLE ELECTRONICS	-	-	-	-	-	-	-	-	2.058	Continuing	Continuing
VS2: Multi-scale Materials Modeling Centers	-	5.192	8.326	-	8.326	9.514	10.163	10.851	11.240	Continuing	Continuing
VS3: CENTER FOR QUANTUM SCIENCE RESEARCH	-	-	-	-	-	-	2.125	2.530	3.087	Continuing	Continuing

**Note**

FY12 increase is a congressional add.

**A. Mission Description and Budget Item Justification**

This program element (PE) fosters university and industry based research to provide a scientific foundation for 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 University Affiliated Research Centers (UARC). 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 are industry-led 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 scientists to shape, mature, and transition technology relevant to the Army mission. CTAs have been competitively established in the areas of Micro Autonomous Systems Technology (MAST), Network Sciences, Robotics and Cognition and Neuroergonomics. COEs 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 are Army Educational Outreach Program (AEOP) and activities to stimulate interest in science, math, and technology among middle and high school students. This PE includes support for basic research at four Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. The Institute of Advanced Technology (IAT) funds basic research in electromagnetic and hypervelocity physics. In January 2012 the UARC contract with IAT will end with remaining funds moved to project VS2. These funds will be used to competitively establish a new external center to address the extreme challenges associated with understanding and modeling materials subject to high impact rates. 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 focuses on enabling network centric-technologies, and broadening 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

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**Exhibit R-2, RDT&E Budget Item Justification:** PB 2013 Army **DATE:** February 2012

## APPROPRIATION/BUDGET ACTIVITY

2040: *Research, Development, Test & Evaluation, Army*

BA 1: *Basic Research*

## R-1 ITEM NOMENCLATURE

PE 0601104A: *University and Industry Research Centers*

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. This PE also includes the Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence that address critical research areas for Army Transformation.

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this PE is performed 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>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>
Previous President's Budget	98.087	120.937	118.577	-	118.577
Current President's Budget	93.101	140.715	123.045	-	123.045
Total Adjustments	-4.986	19.778	4.468	-	4.468
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	20.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.889	-			
• Adjustments to Budget Years	-	-	4.468	-	4.468
• Other Adjustments 1	-2.097	-0.222	-	-	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army	<b>DATE:</b> February 2012
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APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE				PROJECT			
2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				PE 0601104A: <i>University and Industry Research Centers</i>				F17: <i>NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE</i>			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
F17: <i>NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE</i>	4.852	5.153	5.251	-	5.251	5.381	5.462	5.659	5.595	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This project fosters research through 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 focused in three areas: understanding fundamental principles underlying Soldier neurocognitive performance in operational environments, advancing computational approaches for the analysis and interpretation of neural functioning, fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Neurocognitive performance in operational environments	1.700	1.915	1.965

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
<p><b>Description:</b> This effort is intended to understand fundamental principles underlying Soldier neurocognitive performance in operational environments.</p> <p><b>FY 2011 Accomplishments:</b> Explored formal models of information presentation, including multi-modal and adaptive displays as well as multisensory attentional cueing; examined interactions between information systems and physical-cognitive performance.</p> <p><b>FY 2012 Plans:</b> Transition lessons learned to the design and creation of simulation experiments to capture neurocognitive performance while embedded in military-relevant operational contexts; will utilize simulation environments to evaluate predictions made from formal models; will elaborate and refine models of neurocognitive function developed based on results generated during simulation experiments.</p> <p><b>FY 2013 Plans:</b> Will complete execution of large scale simulation evaluations to generate data for addressing issues of individual differences in neurocognitive performance; will transition lessons learned from evaluation of formal models in simulation assessments to inform the development of a second phase of evaluation with increased military relevance/realism.</p>				
<p><b>Title:</b> Computational neural analysis</p> <p><b>Description:</b> This effort advances computational approaches for the analysis and interpretation of neural functioning.</p> <p><b>FY 2011 Accomplishments:</b> Examined how the nervous system filters large-scale, multi-dimensional data sets for decision making; identified individual differences in neural processing underlying successful and unsuccessful decision making.</p> <p><b>FY 2012 Plans:</b> Analyze data sets generated during large-scale simulation experiments; used simulation data sets for further expansion and elaboration of models and methods for assessing predictive features involving inter- and intra-subject variability; and refined models according to assessments of the adequacy of overlap and agreement between data and observations.</p> <p><b>FY 2013 Plans:</b> Will complete the analysis of large-scale simulations including further elaboration of models and computational methods for assessing neurocognitive performance and identifying predictive features of inter- and intra-subject variability; will design extensions of databases to enable further analysis and modeling of individual differences in neurocognitive function.</p>		1.550	1.563	1.586
<p><b>Title:</b> Neurotechnologies</p>		1.602	1.675	1.700

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> F17: <i>NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p><b>Description:</b> This effort provides a fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance.</p> <p><b>FY 2011 Accomplishments:</b> Explored methods for state detection and signal processing techniques for signal integration; developed static algorithms that account for the variability in individual differences and/or environmental stressors on performance. Implemented modeling of human visual attention for insertion into computer vision algorithm for automated scene processing and alerting of events of interest in the visual field.</p> <p><b>FY 2012 Plans:</b> Refined online signal processing methods as well as expand methods for analysis of electroencephalogram (EEG) data; identified key biomechanical measures based on the inertial fatigue-monitoring sensors and investigate remote monitoring of Soldier fatigue; designed algorithms for a neuro-computer vision system for automated environmental appraisal; and developed methods for integration of user feedback into a system for alerting the Soldier to important environmental events involving saliency and attention modeling, object detection, object tracking and crowd modeling.</p> <p><b>FY 2013 Plans:</b> Will further mature and assess online signal processing methods for analysis of EEG data; will validate methods and sensor performance for remote monitoring of Soldier fatigue; will implement and evaluate algorithms for a neuro-computer vision system for automated environmental appraisal; will implement and assess user feedback / alerting system relating to saliency and attention modeling, object detection, object tracking for automation and Soldier training technology design.</p>			
<b>Accomplishments/Planned Programs Subtotals</b>		4.852	5.153
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 PROGRAMS			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H04: HBCU/MI PROGRAMS	2.678	18.043	18.507	-	18.507	18.855	19.209	19.711	20.044	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project supports basic research through the Partnership in Research Transition (PIRT) program, the Army's research initiative focused on partnerships with Historically Black Colleges and Universities and Minority Institutions (HBCU/MI), and provides support Department of Defense Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) program providing support for research and collaboration with DoD facilities and personnel for research and collaboration with DoD facilities and personnel. The focus of this effort is to enhance programs and capabilities of a select number of high-interest scientific and engineering disciplines through innovative research at Centers of Excellence established at Historically Black Colleges and Universities. These COEs work with Army, industrial, and other academic partners to accelerate the transition from the research phase to technology demonstration. In addition, these Centers of Excellence recruit, educate, and train outstanding students and post-doctoral researchers in science and technology areas relevant to the Army.

Work in this project is fully coordinated with the Office of Secretary of Defense program manager for HBCU/MI programs.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work on this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Centers of Excellence for Battlefield Capability Enhancements (BCE)	2.678	2.826	2.908
<b>Description:</b> In FY11, five new PIRT Centers of Excellence were established at: Hampton Univ. (Lower Atmospheric Research Using Lidar Remote Sensing); NCA&T State Univ. (Nano to Continuum Multi-Scale Modeling Techniques and Analysis for Cementitious Materials Under Dynamic Loading); Delaware State Univ. (Center for Advanced Algorithms); Howard Univ (2) Bayesian Imaging and Advanced Signal Processing for Landmine and IED Detection Using GPR and Extracting Social Meaning From Linguistic Structures in African Languages). These Centers were selected to: enhance programs and capabilities through Army-relevant, topic-focused, near-transition-ready innovative research; strengthen the capacity of the HBCUs to provide excellence in education; and to conduct research critical to the national security functions of the DoD.			
<b>FY 2011 Accomplishments:</b> Completed awards for five centers.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H04: <i>HBCU/MI PROGRAMS</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Continuing the FY11 research efforts based upon the new Centers. <b>FY 2013 Plans:</b> Will continue research efforts at PIRT Centers of Excellence began in FY12.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) <b>Description:</b> The Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) program provides support for research and collaboration with DoD facilities and personnel; the research grants further knowledge in the basic physical scientific and engineering disciplines through theoretical and empirical activities; collaborative research allows university professors to work directly with military laboratories or other universities. <b>FY 2012 Plans:</b> This effort is devolved from the Office of the Secretary of Defense, PE 0602228D8Z; as executive agent, the Army is conducting a Broad Agency Announcement and solicitations and is executing funding for grants and awards following legislative and executive policy and guidance when Congress directs. <b>FY 2013 Plans:</b> The Army will conduct Broad Agency Announcement and solicitations to execute funding for grants and awards following legislative and executive policy and guidance when Congress directs.		-	15.217	15.599
<b>Accomplishments/Planned Programs Subtotals</b>		2.678	18.043	18.507
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>				<b>PROJECT</b> H05: <i>INSTITUTE FOR COLLABORATIVE</i> <i>BIOTECHNOLOGIES</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H05: <i>INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES</i>	9.327	12.195	12.326	-	12.326	12.958	13.377	13.801	14.034	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project supports research at the Army's Institute for Collaborative Biotechnologies (ICB), 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 was established as a University Affiliated Research Center (UARC) to support leveraging biotechnology for: advanced sensors; new electronic, magnetic, and optical materials; and 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Institute for Collaborative Biotechnologies	8.151	10.981	10.908
<b>Description:</b> Perform sustained multidisciplinary basic research supporting technology to provide the Army with bio-inspired materials and biomolecular sensor platforms.			
<b>FY 2011 Accomplishments:</b> Began development and analysis of a platform that integrates surface enhanced Raman spectroscopy technologies into free surface fluidic explosives detection system with an open surface microchannel system featuring controlled flow velocities; began development of optimized materials as implantable, biodegradable tissue scaffolds for eventual application to battlefield trauma; and conducted force measurements to verify a gecko-inspired reversible adhesive system.			
<b>FY 2012 Plans:</b>			



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H05: <i>INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
<p>Research efforts pursue development of mass-based assays for detecting molecular, viral and cell-based pathogens relevant to the Army; developing shell and bone-inspired passive actuators aimed toward dissipating energy targeted against buildings, barracks and bunkers; expanding use of synthetic biology for engineering novel materials and fuels; and develop first-principles molecular design rules to create honeycomb micro-trusses for fabrication into composite blast-resistant materials.</p> <p><b>FY 2013 Plans:</b> Will investigate engineering glucosidases (enzyme class responsible for catalyzing breakdown of plant and other biomaterials into nutrients) and will assess bio- mixtures with thermally-stable cellulases for potential future applications in biofuel production; will research concepts and designs for bio-inspired energy-dispersive composites.</p>			
<p><b>Title:</b> Neuroscience</p> <p><b>Description:</b> Perform multidisciplinary basic research in the area of neuroscience.</p> <p><b>FY 2011 Accomplishments:</b> Researched electroencephalogram (EEG) and functional magnetic resonance imaging (fMRI) methods to understand the neural underpinnings leading to successful perceptual discrimination; improved the characterization of neural data previously obtained from this research effort using methodologies in network dynamics, optimal control and complex systems.</p> <p><b>FY 2012 Plans:</b> Continue the study of spatial and temporal dynamics of brain function via simultaneous fMRI-EEG neuroimaging and integrating cognitive theory and biologically constrained computational models with multimodal imaging to further develop enabling technologies that support improved methods for Soldier training; continue investigations of genetic markers that can be linked to abilities in classification learning; investigate the shared neural substrates for action simulation and intention understanding.</p> <p><b>FY 2013 Plans:</b> Will continue studies of genetic, anatomic, and strategic differences of cognitive performance using EEG and fMRI methods to characterize individual differences of brain activity; will begin design and validation of new methods to characterize brain anatomic networks and dynamical patterns relevant to neuroimaging studies.</p>		1.176	1.214
<b>Accomplishments/Planned Programs Subtotals</b>		9.327	12.195
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H05: <i>INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES</i>

### 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 CTA			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H09: ROBOTICS CTA	4.897	5.276	5.550	-	5.550	5.649	5.695	5.842	5.940	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; understanding the interaction of humans with machines focusing upon intuitive control by Soldiers to minimize cognitive burden; dexterous manipulation of the environment by unmanned systems; and unique modes of mobility to enable unmanned systems to seamlessly navigate complex or highly constrained three dimensional environments. The program will conduct both analytic and validation studies.

Work in this projects builds fundamental knowledge for and complements the companion applied technology program, PE 0602120A, project TS2 (Robotics).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) at the Aberdeen Proving Ground, MD.

## B. Accomplishments/Planned Programs (\$ in Millions)

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Autonomous systems	4.897	5.276	5.550
<b>Description:</b> 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.			
<b>FY 2011 Accomplishments:</b> Researched expanded abilities to perceive and understand activities, consistent with complex urban environments and investigated concepts underlying the planning and coordinated response by multiple heterogeneous robots.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>		<b>PROJECT</b> H09: <i>ROBOTICS CTA</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Explore principles for constructing and managing a hierarchical world model combining cognitive higher level representations with lower level planning to enable formation of effective human robot teams; evaluate the learned recognition of terrain and objects with placement into context; assess situational awareness within human-robot teams; and explore methodologies for coordinated manipulation.				
<b>FY 2013 Plans:</b> Will investigate incorporation of learning into recognition of relationships between both static and dynamic elements of the environment; will explore mechanisms for common understanding between humans and machines to enable effective teaming; will examine fundamental principles and mechanics of grasping, manipulation, and ambulation.				
<b>Accomplishments/Planned Programs Subtotals</b>		4.897	5.276	5.550
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H50: Network Sciences CTA	3.172	12.888	12.968	-	12.968	14.951	15.729	16.020	16.044	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project supports a competitively selected university and industry consortium, the Network Sciences Collaborative Technology Alliance (NS 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, meeting the Army's needs for a state-of-the-art wireless mobile communications networks for command-on-the-move. The NS CTA performs foundational, cross-cutting research on network science leading to: a fundamental understanding of the interplay and common underlying science among social/cognitive, information, and communications networks; determination of how processes and parameters in one network affect and are affected by those in other networks; and prediction and control of the individual and composite behavior of these complex interacting networks. This research will lead to optimized human performance in network-enabled warfare and greatly enhanced speed and precision for complex military operations. 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.

Beginning in FY12, all funds from PE 61104/project J22 were realigned to this project.

Work in this project builds fundamental knowledge for and accelerates the transition of communications and networks technology to PE 0602783A (Computer and Software Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Network Sciences Collaborative Technology Alliance (NS CTA)	3.172	12.888	12.968
<b>Description:</b> The Network Sciences CTA focuses on four major research areas: Information Networks, Communication Networks, Social/Cognitive Networks, and Interdisciplinary Research 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 and human domains as related to human decision making within the networked command and control (C2) structure. Social/Cognitive Networks research is developing the fundamental understanding of the interplay of the various aspects of the social and cognitive networks with information and communications. Communications Networks research is developing the foundational techniques to			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>		<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>		<b>PROJECT</b> H50: <i>Network Sciences CTA</i>
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<p>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.</p> <p><b>FY 2011 Accomplishments:</b> Designed an evaluation scheme for the verification and validation of models of trust in network supported decision making.</p> <p><b>FY 2012 Plans:</b> Develop models of network performance that capture the complex interactions between social, cognitive, information and communication networks; Extend the initial trust model that will improve network fidelity and reliability in the tactical mobile ad hoc network (MANET) environment; develop theoretically grounded empirical models of emergence and propagation of trust and beliefs in insurgent-civilian populations and in battle command decision-making; produce experimentally-confirmed results in dynamics and stability of large-scale, dynamic, distributed, human-centric networks of information; and investigate the impacts of mobility and adversarial attacks on the dynamics of information quality delivered through mobile communication networks.</p> <p><b>FY 2013 Plans:</b> Using human-in-the-loop and simulation-emulation experiments, along with collections of empirical data, will extend, calibrate and validate theories and models of complex interactions between social, cognitive, information and communication networks, particularly in the evolution and propagation of information, trust and beliefs in insurgent-civilian populations, as well as in battle command decision-making under the conditions of dynamics and adversarial attacks.</p>				
<b>Accomplishments/Planned Programs Subtotals</b>		3.172	12.888	12.968
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>D. Acquisition Strategy</b>				
N/A				
<b>E. Performance Metrics</b>				
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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H53: Army High Performance Computing Research Center	3.574	4.348	4.516	-	4.516	4.902	6.193	6.991	7.109	Continuing	Continuing
Note Not applicable for this item.											
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 Robotics Technology (PE 0602618A, project H03). 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: AHPCRC								3.574	4.348	4.516	
Description: The AHPCRC research mission is to advance computational science and its application to critical Army technologies through an Army-university-industry collaborative research program in such areas as combat systems survivability, and chemical and biological defense.											
FY 2011 Accomplishments: Validated lightweight fabric structure systems; implemented and evaluated new and novel programming models on heterogeneous systems; implemented computational approaches to analyze very large-scale mobile network simulation applications; implemented new multi-scale computational approaches for micro-systems design; advanced scalable algorithms for material											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H53: <i>Army High Performance Computing Research Center</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> sciences, computational bio- and nano-sciences; and stimulated innovations in algorithms for new multi-core hybrid computing architectures.  <b>FY 2012 Plans:</b> Developing computational approaches for coupling light weight fabric structural mechanics with computational electromagnetics to study contact mechanics between electromagnetically charged fabrics and structures; scalable approaches for nano-fluidics for Army medical applications; quantum level approaches for an all electron battery; and programming models for emerging hybrid computing architectures for Army applications. Investigated scalable algorithms for large-scale social networks and validate multi-scale computational approach for micro-systems design.  <b>FY 2013 Plans:</b> Will develop reduced order modeling (ROM) concepts for underbody blast problems by developing and solving high-fidelity fully-coupled blast-structure interaction application and then developing appropriate complex mathematical formulations for accurate reduced models; will develop scalable approaches for drug delivery through non-fluidic methods for Army medical applications; validated preliminary simulations for all electron battery; will perform validation of back projection applications for battle command applications on new hybrid computing architecture; and will investigate scalable algorithms for large-scale graphene modeling software and associated validation approaches with ARL experiments.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		3.574	4.348	4.516
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H54: Micro-Autonomous Systems Technology (MAST) CTA	7.763	7.932	8.127	-	8.127	8.296	8.648	9.081	8.969	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project fosters basic research through 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.

Work in this project complements and is fully coordinated with the Tank and Automotive Research and Development Center (RDEC) (TARDEC); the Natick Soldier RDEC (NSRDEC); and the Special Operations Command (SOCOM).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2011	FY 2012	FY 2013
Title: Micro Autonomous Systems Technology CTA	7.763	7.932	8.127
Description: Enhance tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional mobile Microsystems.			
FY 2011 Accomplishments: Extramural partners modeled multiple robotic platform architectures; explored autonomous tactical behaviors in realistic 3-D environments, designed holistic sensing, processing, actuation architectures; and transitioned processing algorithms to the Army robotics community. Investigated contractor developed models and technologies for future implementation. Investigated methods			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>	<b>PROJECT</b> H54: <i>Micro-Autonomous Systems Technology</i> (MAST) CTA	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
to optimize and implement microelectronics technology for navigation, communication, information processing, and sensing for micro-autonomous systems.			
<b>FY 2012 Plans:</b> Experimentally validating the ability of small air and ground platforms to identify points of ingress into a structure and to navigate through them in a robust, stable manner and conduct experiments on the ability of small air and ground platforms to navigate to a waypoint based on sensor input.			
<b>FY 2013 Plans:</b> Will experimentally validate the ability of small air platforms to navigate autonomously in disturbed air and develop technology to allow micro ground platforms to move over rough terrain. Will conduct experiments on the ability of small air and ground platforms to work collaboratively to enter and explore an urban structure.			
<b>Accomplishments/Planned Programs Subtotals</b>		7.763	7.932
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> H59: <i>International Tech Centers</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H59: <i>International Tech Centers</i>	5.396	6.346	7.503	-	7.503	7.609	7.708	7.832	7.964	Continuing	Continuing

**Note**

Not applicable for this item.

**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 the 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 organizations 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 early assessments of the technology's potential contributions to the Army's S&T strategy.

Work in this project related to the USMA Basic Research Center for Network Science is fully coordinated with and complementary to PE 0601104/Project H50 (Network Science CTA).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by Headquarters, Army Research, Development and Engineering Command (RDECOM), the Army Research Laboratory (ARL) in Adelphi, MD, and the United States Military Academy, NY.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> International Technology Centers (ITC)	4.440	5.359	6.514
<b>Description:</b> Funding is provided for the following effort.			
<b>FY 2011 Accomplishments:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>	<b>PROJECT</b> H59: <i>International Tech Centers</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Continued to solicit projects and build on the success of the FTAS Program. Continued efforts to explore ITCs technology based on critical Army requirements. Eleven additional projects with technology originating from eight different countries were worked on in FY11. These projects were initiated from TIPs received and submitted by AMRDEC, ARDEC, ARL, CERDEC and TARDEC.  <b>FY 2012 Plans:</b> Continue to solicit projects and build on the success of the FTAS Program; continue to enhance and refine technology search capabilities using feedback from customers (RDECs, PMs and labs) to focus on near and long term capabilities.  <b>FY 2013 Plans:</b> Will continue to solicit projects and build on the success of the FTAS Program; will continue to enhance and refine technology search capabilities using feedback from customers (RDECs, PMs and labs) to focus on near and long term capabilities.			
<b>Title:</b> Basic Research Center in Network Science at the United States Military Academy (USMA)  <b>Description:</b> Network science research at USMA in coordination with the NS CTA.  <b>FY 2011 Accomplishments:</b> The Center abstracted common concepts across fields, performed evaluations and measurements of network structure, to allow enhancement of the robustness and security of networks; advanced scientific and technological knowledge needed to support NCO and contributed to the tactics, techniques and procedures using the existing USMA knowledge of current and emerging Army doctrine, world geo-political circumstances, and the Army as an organization.  <b>FY 2012 Plans:</b> Greater emphasis is given on studying emerging markets and the role they play in the economic development of a country; research biological networks to understand the impact of environmental contaminants on genetic and metabolomic circuits in the human body.  <b>FY 2013 Plans:</b> Will investigate cooperation networks and how these theoretical frameworks can improve systems and organizations; will continue to research biological networks and implement these insights towards improvement in communication and organizational networks; will study economic cascading events in order to better understand obstacles to the economic development of a country.		0.956	0.987
<b>Accomplishments/Planned Programs Subtotals</b>		5.396	6.346
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H59: <i>International Tech Centers</i>
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

<b>APPROPRIATION/BUDGET ACTIVITY</b>				<b>R-1 ITEM NOMENCLATURE</b>				<b>PROJECT</b>			
2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				PE 0601104A: <i>University and Industry Research Centers</i>				H62: <i>Institute for Advanced Technology (IAT)</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
H62: <i>Institute for Advanced Technology (IAT)</i>	5.310	1.421	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project funds a University Affiliated Research Center (UARC), 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.

In January 2012, the UARC contract with IAT is scheduled to end. New efforts beginning in FY12 will be conducted via competitive solicitation and performed under PE 0601104/Project VS2, Center for Advanced Research.

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 Aberdeen Proving Ground, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Pulsed Power	2.566	-	-
<b>Description:</b> This effort investigates advanced pulsed power concepts.			
<b>FY 2011 Accomplishments:</b> Analyzed advanced pulsed power concepts that are reduced in size and weight and identify gaps in understanding of pulsed power research.			
<b>Title:</b> Launch	1.330	-	-
<b>Description:</b> This effort investigates rail and armature design.			
<b>FY 2011 Accomplishments:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H62: <i>Institute for Advanced Technology (IAT)</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
Incorporated FY10 investigation results into advanced rail and armature design.			
<b>Title:</b> Electromagnetic Lethality		1.414	1.421
<b>Description:</b> Funding is provided for the following effort.			-
<b>FY 2011 Accomplishments:</b> Conducted theory critical evaluations that determine the lethality potential of novel concepts.			
<b>FY 2012 Plans:</b> Complete theoretical investigations of novel lethal concepts and document findings; and will finalize contract obligations.			
<b>Accomplishments/Planned Programs Subtotals</b>		5.310	1.421
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H64: MATERIALS CENTER	2.766	2.915	0.758	-	0.758	-	-	-	-	Continuing	Continuing

**Note**

Not applicable for this item.

**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): Composite Materials Research; Advanced Metals and Ceramics Research; and 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.

Work in this project builds fundamental knowledge supporting ARL in-house materials research projects (PE 0601102A, project H42) and accelerates the transition of technology to PE 0602105A (Materials Technology). In FY13, the efforts of the Materials Center scale back and the advanced materials emphasis for the Army will focus on multi-disciplinary, multi-scale materials behavior in extreme environments conducted in PE 0601104A Project VS2 titled Center for Advanced Research.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) in Aberdeen Proving Ground, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Materials Research for vehicle protection	2.766	2.915	0.758
<b>Description:</b> Materials Research for vehicle protection Performs research and exploits promising breakthroughs in multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymers, and hybrid systems to enable revolutionary vehicle protection.			
<b>FY 2011 Accomplishments:</b>			



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H64: <i>MATERIALS CENTER</i>	

  

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
Researched the relationship between microstructures of nanoscale composites and observations of high rate deformation; and examined the dynamic response of multifunctional materials systems.  <b><i>FY 2012 Plans:</i></b> Investigating the role of non-traditional deformation mechanisms in the failure and flow of potential armor materials; and modeled the twinning (local intermediate plastically) behavior of non-cubic metals and ceramic materials.  <b><i>FY 2013 Plans:</i></b> Will finalize mechanism-based multi-scale approach to microstructure design for dynamic applications; and will develop understanding of size effects in magnesium vis-à-vis etching and orientation for quantifying demonstrated enhanced mechanical properties.			
<b>Accomplishments/Planned Programs Subtotals</b>	2.766	2.915	0.758

  

**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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**Exhibit R-2A, RDT&E Project Justification:** PB 2013 Army **DATE:** February 2012

APPROPRIATION/BUDGET ACTIVITY				R-1 ITEM NOMENCLATURE				PROJECT			
2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research				PE 0601104A: University and Industry Research Centers				H73: Automotive Research Center (ARC)			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
H73: Automotive Research Center (ARC)	2.845	3.988	4.092	-	4.092	4.195	4.197	4.251	4.321	Continuing	Continuing

## Note

Not applicable for this item.

## A. Mission Description and Budget Item Justification

This project fosters basic research in 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.

Work in this project complements and is fully coordinated with work under PE 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, Virginia Tech, Wayne State University, University of Alaska, Oakland University, 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by TARDEC, Warren, MI.

## B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2011	FY 2012	FY 2013
<b>Title:</b> Automotive Research Center (ARC)	2.845	3.988	4.092
<b>Description:</b> Funding is provided for the following effort.			
<b>FY 2011 Accomplishments:</b> Explored advanced automotive propulsion concepts that will potentially improve the fuel economy and mobility of military ground vehicles including novel hybrid electric architectures; investigate the feasibility of advanced materials for reducing Army ground			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> H73: <i>Automotive Research Center (ARC)</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
vehicle weight while meeting survivability needs; and assessed the impact of alternative diesel and jet fuels on advanced automotive and heavy-duty diesel engines combustion characteristics.  <b>FY 2012 Plans:</b> Researching fundamental challenges synthesizing and advancing ground vehicle technologies as well as power systems to improve mobility and reliability; addressing novel electronic architectures, alternative fuels and advanced materials for weight reduction.  <b>FY 2013 Plans:</b> Will conduct research in areas that include: non-traditional off-road vehicle dynamics and controls, soldier/vehicle interaction modeling, high-performance/lightweight structures and materials, advanced alternative propulsion systems including hybrids, strategic and innovative thermal management schemes, and vehicle system optimization and design for reliability with robustness. Research will target key areas such as fuel economy, safety, system compactness, soldier/vehicle performance, cost savings, vehicle control (including autonomous vehicles), and system optimality/reliability.			
<b>Accomplishments/Planned Programs Subtotals</b>		2.845	3.988
<b>C. Other Program Funding Summary (\$ in Millions)</b>			
N/A			
<b>D. Acquisition Strategy</b>			
N/A			
<b>E. Performance Metrics</b>			
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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> J08: <i>INSTITUTE FOR CREATIVE TECHNOLOGIES (ICT)</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J08: <i>INSTITUTE FOR CREATIVE TECHNOLOGIES (ICT)</i>	7.598	8.009	8.003	-	8.003	8.404	9.051	9.955	10.123	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project supports simulation and training technology research at the Army's Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established as a University Affiliated Research Center (UARC) 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.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Immersive Environments	2.930	3.098	3.063
<b>Description:</b> 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.			
<b>FY 2011 Accomplishments:</b> Investigated methods of interaction between multiple real and virtual humans in virtual immersive environments.			
<b>FY 2012 Plans:</b> The use of large scale 3D displays for immersive simulation and learning environments is being investigated; and social perception as well as reactivity studies to improve virtual human responsiveness and rapport is being completed.			
<b>FY 2013 Plans:</b>			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 TECHNOLOGIES (ICT)		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
Will implement psychophysiology to improve the simulation fidelity of virtual immersive environments. Will continue evaluation of techniques and methods to address the rapid development of synthetic environments.				
<b>Title:</b> Graphics and Animations  <b>Description:</b> 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 provides the sound stimulus for increasing the realism for military training and simulation devices.  <b>FY 2011 Accomplishments:</b> Developed tools for rapidly creating virtual characters that can be animated based on real people.  <b>FY 2012 Plans:</b> Researching novel approaches for using specialized light sources to facilitate 3D modeling; develop algorithms that provide real-time reconstruction of geometric shapes using a single photographic view of an object.  <b>FY 2013 Plans:</b> Will further research the creation of photo-real characters and environments and demonstrate these capabilities. Will develop comprehensive facial performance capture techniques, develop software for rendering multiple faces and will complete the research investigation of high-fidelity eye models for virtual characters.		1.732	1.780	1.788
<b>Title:</b> Techniques and Human-virtual Human Interaction  <b>Description:</b> Conduct basic research to investigate methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans.  <b>FY 2011 Accomplishments:</b> Investigated techniques that allow multiple real people to interact with multiple virtual humans.  <b>FY 2012 Plans:</b> Toolkits for virtual humans to accelerate the development of virtual humans via collaborations with external organizations are being enhanced; and statistical models of culture-specific behaviors for conversations are being developed.  <b>FY 2013 Plans:</b> Will integrate virtual human system with life-like graphics, facial and body animations and develop multiple forms of learning algorithms as a part of Virtual Humans. Group behavior prediction models and algorithms will be developed to include social cognition, social perception and social reactivity models and algorithms for Virtual Humans.		2.936	3.131	3.152
Accomplishments/Planned Programs Subtotals		7.598	8.009	8.003

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> J08: <i>INSTITUTE FOR CREATIVE TECHNOLOGIES (ICT)</i>
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A		
<b>D. Acquisition Strategy</b> N/A		
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> J12: <i>Institute for Soldier Nanotechnology (ISN)</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J12: <i>Institute for Soldier Nanotechnology (ISN)</i>	10.113	10.770	10.706	-	10.706	11.308	11.396	11.589	11.784	Continuing	Continuing
<b>Note</b> Not applicable for this item.											
<b>A. Mission Description and Budget Item Justification</b> This project supports sustained multidisciplinary research at the Army's Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN was established as a University Affiliated Research Center (UARC) to support research to devise nanotechnology-based solutions for the Soldier. 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 Research, Development and Engineering Center (NSRDEC), and other Army Research Development and Engineering Command (RDECOM) elements, as well as several major industrial partners, including Raytheon and DuPont, in pursuit of its goals. This project 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Army Research Lab (ARL) in Adelphi, MD.											
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>								<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	
<b>Title:</b> Nanomaterials								2.551	2.748	2.705	
<b>Description:</b> Nanomaterials research efforts focus on light-weight, multifunctional nanostructured fibers and materials.											
<b>FY 2011 Accomplishments:</b> Characterized the absorption and emission properties of nanoparticles using models and experimental tests; toward the development of photodetector arrays, designed rules for optimized incorporation of quantum dots into organic and inorganic thin film structures are being developed; began development of technology for the controlled assembly of large-scale ordered carbon nano-tube (CNT) arrays and develop library of new responsive thermoplastic elastomers containing attached field responsive											

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012		
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 J12: Institute for Soldier Nanotechnology (ISN)
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2011	FY 2012	FY 2013
groups for the generation of electro-actuating, chemically responsive or temperature/light responsive contractile fibers or porous fabrics. <b>FY 2012 Plans:</b> Design and fabricate photoconducting and photodiode fibers with bandwidth and noise equivalent power commensurate with communication system specifications; investigate the electrical tunability of conductive electrospun fibers establishing a clear processing-structure-property relationship for these fibers; examining properties of nanoparticle-containing layer-by-layer films, including films designed to be self-cleaning and with decontamination properties. <b>FY 2013 Plans:</b> Will examine carbon nanotube/conducting polymer composite films assembled onto electrospun nanofibers to determine sensing properties; will study properties conferred by various functional group additions/modifications to polymers for potential sensing applications; will investigate the range of electrical robustness of conductive electrospun fibers for future signal communications; will investigate mechanical properties of electrospun materials.				
<b>Title:</b> Blast Effects on Soldier <b>Description:</b> Blast Effects on Soldier research involves the areas of Battle Suit Medicine and Blast and Ballistic Protection. <b>FY 2011 Accomplishments:</b> Synthesized controlled release films using layer-by-layer technique; used transfer printing of graphene-carbon nanotube multilayers to build stacked, alternate laminates of graphene chainmail structures; evaluated mechanical properties of superelastic alloys as a function of their nano-scale dimensions and at blast application rates; conducted novel nanomechanical impact loading experiments to map hydrated-tissue mechanical properties and impact penetration resistance in the absence and presence of protective materials. <b>FY 2012 Plans:</b> Model shock propagation in new polymeric materials; examine the underlying biomechanical motion mechanisms of the P. senegalus (dinosaur eel) exoskeleton as well as the effect of curvature on the exoskeleton mechanics of this fish; examine properties of new aluminum nanoscale crystalline alloys and develop underpinning theory for stabilizing these alloys; continuing development of nanostructured contractile polymers to serve as new actuator material technologies. <b>FY 2013 Plans:</b> Will investigate natural armor systems to determine related mechanical behavior and penetration resistance; will explore how new biological-design concepts can be scaled to resist forces proportional to blast or ballistic impact; will assess new membranes for		5.010	5.275	5.295



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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>	<b>PROJECT</b> J12: <i>Institute for Soldier Nanotechnology (ISN)</i>	
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>
peptide immobilization and potential as a high-throughput assay of peptide activity; will synthesize and characterize continuous shape memory alloy fibers.			
<b>Title:</b> Soldier Protection		2.552	2.747
<b>Description:</b> Soldier Protection research efforts focus on Soldier Survivability and Protection and Nanosystems Integration.			
<b>FY 2011 Accomplishments:</b> Prepared 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; initiated chemical vapor deposition (iCVD) films containing sensing functionalized groups; fabricate into various geometries and optimize for sensing sensitivities; investigated new approaches to enable 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.			
<b>FY 2012 Plans:</b> Optimize quantum dot synthesis in pursuit of new schemes and collaborations with Army partners to improve the performance of quantum detector (QD) sensors in detecting biological warfare agents; evaluated hemorrhagic shock device and continue to develop rapid reconstitution prototype to be integrated in a spring-loaded syringe; and characterizing novel nanoscale virucidal and bactericidal coatings for equipment surface protection.			
<b>FY 2013 Plans:</b> Will investigate nanotube-based assemblies for detection of DNA and determine whether structures can be adapted to detect other chemicals and biological warfare agents; will synthesize and characterize high-quality nanoscale virucidal and bactericidal coatings of sensory polymers using photochemical grafting and other fabrication methods; will develop and characterize new fiber designs to determine structures that improve fiber sensing functionality; will functionalize surface of graphene sensing devices to confer different electrochemistries and determine changes in selectivity.			
<b>Accomplishments/Planned Programs Subtotals</b>		10.113	10.770
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A			
<b>D. Acquisition Strategy</b> N/A			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army		DATE: February 2012
APPROPRIATION/BUDGET ACTIVITY 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	R-1 ITEM NOMENCLATURE PE 0601104A: <i>University and Industry Research Centers</i>	PROJECT J12: <i>Institute for Soldier Nanotechnology (ISN)</i>

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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army									<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>	-	19.968	-	-	-	-	-	-	-	Continuing	Continuing
<b>Note</b> Not applicable for this item.											
<b>A. Mission Description and Budget Item Justification</b> Congressional Interest Item funding provided for University and Industry Initiatives.											
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>									<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Historically Black Colleges and Universities (HBCU)									-	19.968	-
<b>Description:</b> This is a Congressional Interest Item.											
<b>FY 2012 Plans:</b> Congressional increase for HBCU											
<b>Accomplishments/Planned Programs Subtotals</b>									-	19.968	-
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A											
<b>D. Acquisition Strategy</b> N/A											
<b>E. Performance Metrics</b> 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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: Army Educational Outreach Program			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
J14: Army Educational Outreach Program	3.628	5.417	9.593	-	9.593	9.738	9.864	9.935	10.038	Continuing	Continuing

Note

Consolidated funds from 0605803 729 and 06061104 J14 to align educational outreach program elements into a central funding line of accounting.

A. Mission Description and Budget Item Justification

This project supports science activities that encourage elementary/middle/high school and college youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering (STEM) fields. These activities are consolidated within the Army Educational Outreach Program (AEOP) that links and networks appropriate components to derive the best synergies to present the Army to a larger pool of technical talent and to provide students with Army-unique practical experiences at Army laboratories, centers, and institutes to fill future Army Science and Technology workforce needs. AEOP increases interest and involvement of students and teachers across the nation in science, mathematics, and engineering at all proficiency levels and backgrounds to include under-represented and economically disadvantaged groups through exposure to Army sponsored research, education, competitions, internships, and practical experiences. This project enhances the national pool of science and engineering personnel that in turn supports defense industry and Army laboratory and research, development, and engineering center needs.

In FY13, activities and funds for educational outreach are consolidated here from PE 61104/J14 (eCybermission) and PE65803/729 (Youth Science Activities)

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus area, the Army Modernization Strategy, the Department of Defense STEM Educational Outreach Strategic Plan and the President's "Educate to Innovate" campaign for STEM education.

Work in this project is performed by the Research, Development, and Engineering Command (RDECOM), the Army Research Institute (ARI) for the Behavioral and Social Sciences, the Army Corps of Engineers' Engineer Research and Development Center (ERDC), Medical Research and Materiel Command (MRMC), and Space and Missile Defense Command (SMDC).

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2011	FY 2012	FY 2013
Title: eCYBERMISSION	3.628	3.628	3.628
Description: This program supports a nation-wide, web-based, science, technology, engineering and mathematics (STEM) competition for students grades 6 through 9, designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide.			
FY 2011 Accomplishments:			

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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army			DATE: February 2012		
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: Army Educational Outreach Program		
B. Accomplishments/Planned Programs (\$ in Millions)			FY 2011	FY 2012	FY 2013
Continued to seek increased participation from existing levels and increased geographic diversity; sustained eCYBERMISSION and implemented enhancements based on lessons learned from previous years. <b>FY 2012 Plans:</b> Work to increase participation from existing levels and to increase geographic diversity; Sustain CYBERMISSION and implemented enhancements based on lessons learned from previous years. <b>FY 2013 Plans:</b> Will work to increase participation from existing levels with a concentrated effort in underserved populations, and to increase geographic diversity; will sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years.					
<b>Title:</b> Educational Outreach and Workforce Development <b>Description:</b> Beginning in FY13, funds for this effort are transferred fromPE 0605803 Project 729 to align educational outreach program elements within a single Project. <b>FY 2013 Plans:</b> Will continue AEOP support to reach under-represented and economically disadvantaged areas to enhance STEM education through student experiences in Army labs and academic partner institutions. Will provide direct mentorship to students to broaden their interest in and their development of STEM education			-	-	2.416
<b>Title:</b> Army Educational Outreach Program Cooperative Agreement <b>Description:</b> Youth Science Cooperative Outreach Agreement (COA) encompasses a variety of outreach activities that are part of the AEOP. This activity supports a strong partnership with government, academia and industry to address the shortfall of clearable STEM skilled talent preparing for the workforce. These activities include Army-sponsored research, education, competitions, internships and practical experiences designed to engage and guide students and teachers in Army sponsored STEM programs. The funding for this line item was consolidated from PE 0605803 Project 729. <b>FY 2012 Plans:</b> This funding was executed for the Army Educational Outreach program support. Effort for this will be fully rolled into 0601104 J14 from 0605803 729 in 2013. <b>FY 2013 Plans:</b> Will continue to increase Army lab and research center sponsorship of students and STEM education opportunities. Will provide competition incentives in STEM competitions that include scholarships, experiences and mentorships as well as expose students to DoD career opportunities. Will streamline processes, leverage funding and build educational partnerships.			-	1.789	3.211
<b>Title:</b> West Point Cadet Research			-	-	0.338

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> J14: <i>Army Educational Outreach Program</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>  <b>Description:</b> Beginning in FY13, funds for this effort are transferred from PE 0605803 Project 729 to align educational outreach program elements within a single Project.  <b>FY 2013 Plans:</b> Will conduct West Point cadet research internship program to enhance cadet training through field experience within Army research labs and centers.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		3.628	5.417	9.593
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>				<b>PROJECT</b> J15: <i>NETWORK SCIENCES ITA</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J15: <i>NETWORK SCIENCES ITA</i>	7.786	8.204	4.048	-	4.048	4.125	4.242	4.321	4.601	Continuing	Continuing

**Note**

Not applicable for this item.

**A. Mission Description and Budget Item Justification**

This project supports research at a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science investigations 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 with the emphasis on integration of multiple technical disciplines in an international arena. 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 cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) at Adelphi, MD.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Title:</b> Network and information science basic research for US/UK coalition operations information.	7.786	8.204	4.048
<b>Description:</b> This research will address the fundamental science underpinning the complex information network issues that are vital to future US/UK coalition military operations and to fully exploit the joint development of emerging technologies necessary to enable coalition operations.			
<b>FY 2011 Accomplishments:</b> Established theoretical foundations for policy specification with formal representations at various levels of abstraction. Devised mathematical models to represent mappings between events, sensor monitored information, and end-uses; optimized compression of information flows based on human cognition metrics. Designed reasoning algorithms to enable the creation of agents that promote trust among teammates and manage differing levels of trust.			
<b>FY 2012 Plans:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012	
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> J15: <i>NETWORK SCIENCES ITA</i>	

  

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>  Devise mathematical models to reason about network behaviors and composite security metrics to improve the security of heterogeneous coalition networks; investigate efficient and effective distributed federated database techniques to fuse and aggregate data from heterogeneous networks in support of dynamic coalition operations.  <b><i>FY 2013 Plans:</i></b> Will develop scaling laws for hybrid networks with less restrictive assumptions regarding network homogeneity (relax the assumptions to account for variable bandwidth, network management information, etc.). Will develop techniques for the management and control of hybrid coalition networks and techniques for the security of distributed services. These efforts will contribute to the creation of novel capabilities to assist coalition Warfighters' capability to manage secure distribution of information in coalition networks, with efficiency and agility.	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>	7.786	8.204	4.048

  

**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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> J17: <i>VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J17: <i>VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE</i>	1.992	2.650	2.771	-	2.771	3.062	3.026	3.189	3.243	Continuing	Continuing
<b>Note</b> Not applicable for this item.											
<b>A. Mission Description and Budget Item Justification</b> This project fosters research to provide vertical lift capability and engineering expertise for the Army. The focus of the 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) (Aeroflightdynamics Directorate located at the NASA Ames Research Center, Moffett Field, CA). 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>B. Accomplishments/Planned Programs (\$ in Millions)</b>								<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>	
<b>Title:</b> Vertical Lift Research Center of Excellence								1.992	2.650	2.771	
<b>Description:</b> Funding is provided for the following effort											
<b>FY 2011 Accomplishments:</b> Developed a method to describe nonlinear propagation path of rotor noise, developed a methodology for airfoil design that accounts for unsteady aerodynamics, used validated 3-D model to explore helical gear vibration, and compute induced power for typical rotor configurations and compared with measured data. The Vertical Lift Research Center of Excellence (VLRCE) program was re-competed in FY2011 and new agreements initiated in 4th quarter FY2011.											
<b>FY 2012 Plans:</b>											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> J17: <i>VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b> Fully implement multiple new VLRCOE agreements, with substantial participation by Navy and NASA that includes experimental and analytic work toward basic research applicable to future DoD rotorcraft fleet requirements.  <b><i>FY 2013 Plans:</i></b> Will implement year two of new VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology; will secure Navy and NASA funding to supplement a robust experimental and analytic basic research program in rotorcraft technologies including: Aeromechanics, Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations.		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b>Accomplishments/Planned Programs Subtotals</b>		1.992	2.650	2.771
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A  <b>D. Acquisition Strategy</b> N/A  <b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army								<b>DATE:</b> February 2012			
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>				<b>PROJECT</b> J22: <i>NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
J22: <i>NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER</i>	9.404	-	-	-	-	-	-	-	-	Continuing	Continuing

**A. Mission Description and Budget Item Justification**

This project fosters basic research in Network Science. Beginning in FY12 all funds in this project were realigned to PE 61104/Project H50.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is extramurally performed by the Army Research Laboratory (ARL) in Adelphi, MD.

<b><u>B. Accomplishments/Planned Programs (\$ in Millions)</u></b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
<b><i>Title:</i></b> Network Science and Technology Research Center (NSTRC)	9.404	-	-
<b><i>Description:</i></b> 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.			
<b><i>FY 2011 Accomplishments:</i></b> Studied relevant cross-domain issues and developed trust models that support networks of humans connected through wireless mobile ad hoc networks. Studied mathematical models and human/metric-driven mobility modeling to develop a better understanding of the dynamic behaviors of composite networks; investigated the ability of network science to assess, understand, analyze, measure and predict the performance of combined social, cognitive, information and communication networks.			
<b>Accomplishments/Planned Programs Subtotals</b>	9.404	-	-

**C. Other Program Funding Summary (\$ in Millions)**  
N/A

**D. Acquisition Strategy**  
N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> J22: <i>NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER</i>

### 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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 VS1: CENTER FOR FLEXIBLE ELECTRONICS			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
VS1: CENTER FOR FLEXIBLE ELECTRONICS	-	-	-	-	-	-	-	-	2.058	Continuing	Continuing

**Note**

No funding for this program in FY13

**A. Mission Description and Budget Item Justification**

No Funding for this program in FY13

**B. Accomplishments/Planned Programs (\$ in Millions)**

N/A

**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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Exhibit R-2A, RDT&E Project Justification: PB 2013 Army									DATE: February 2012		
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 VS2: Multi-scale Materials Modeling Centers			
COST (\$ in Millions)	FY 2011	FY 2012	FY 2013 Base	FY 2013 OCO	FY 2013 Total	FY 2014	FY 2015	FY 2016	FY 2017	Cost To Complete	Total Cost
VS2: Multi-scale Materials Modeling Centers	-	5.192	8.326	-	8.326	9.514	10.163	10.851	11.240	Continuing	Continuing
Note Not applicable for this item.											
A. Mission Description and Budget Item Justification This project supports a competitively awarded external center to provide the Army with next generation multi-functional materials for ballistic and electronic applications and to address the extreme challenges associated with understanding and modeling materials subject to Army operational environments. Research will address the modeling and experimental challenges associated with developing multidisciplinary physics simulations across multiple length scales for materials to include: a limited ability to relate materials chemistry, structure, and defects to materials response and failure under extreme conditions; an inadequate ability to predict the roles of materials structure, processing, and properties on performance in relevant extreme environments and designs; and the lack of experimental capabilities to quantify multiscale response and failure of materials under extreme conditions.  The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.  Work in this project is performed by the Army Research Laboratory (ARL) in Aberdeen Proving Ground, MD.											
B. Accomplishments/Planned Programs (\$ in Millions)								FY 2011	FY 2012	FY 2013	
Title: Multi-Disciplinary, Multi-Scale Materials Behavior in Extreme Environments.								-	5.192	8.326	
Description: Research will focus on the following areas: two-way multiscale modeling for predicting performance and designing materials, investigating analytical and theoretical analyses to effectively define the interface physics across length scales; advancing experimental capabilities for verification and validation of multiscale physics; and modeling and strategies for the synthesis of high loading rate tolerant materials so that all of the latter lead to the development of a comprehensive set of metrics that define high loading rate tolerant material systems. The multi-scale modeling capability will be applied across multiple disciplines to facilitate revolutionary advances in materials for coupled environments (electromagnetic, high rate, high pressure and other extreme environments).											
FY 2012 Plans:											

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army		<b>DATE:</b> February 2012		
<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>	<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry Research Centers</i>	<b>PROJECT</b> VS2: <i>Multi-scale Materials Modeling Centers</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013</b>
An external center was competitively awarded to establish first- generation modeling and experimental techniques for multi-scale materials modeling.  <b>FY 2013 Plans:</b> Will demonstrate real-time microstructural interrogation of materials during high-rate experiments; will identify key microstructural phenomena related to high-rate deformation, fracture, and failure at critical length and time scales; and accurately predict one or more bulk dynamic properties based upon models built up from smaller size scales in each of the four selected material systems (metallic, polymeric, ceramic, and composite).				
<b>Accomplishments/Planned Programs Subtotals</b>		-	5.192	8.326
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>D. Acquisition Strategy</b> N/A				
<b>E. Performance Metrics</b> 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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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2013 Army	<b>DATE:</b> February 2012
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<b>APPROPRIATION/BUDGET ACTIVITY</b> 2040: <i>Research, Development, Test &amp; Evaluation, Army</i> BA 1: <i>Basic Research</i>				<b>R-1 ITEM NOMENCLATURE</b> PE 0601104A: <i>University and Industry</i> <i>Research Centers</i>				<b>PROJECT</b> VS3: <i>CENTER FOR QUANTUM SCIENCE</i> <i>RESEARCH</i>			
<b>COST (\$ in Millions)</b>	<b>FY 2011</b>	<b>FY 2012</b>	<b>FY 2013 Base</b>	<b>FY 2013 OCO</b>	<b>FY 2013 Total</b>	<b>FY 2014</b>	<b>FY 2015</b>	<b>FY 2016</b>	<b>FY 2017</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
VS3: <i>CENTER FOR QUANTUM SCIENCE RESEARCH</i>	-	-	-	-	-	-	2.125	2.530	3.087	Continuing	Continuing

**Note**

no funding for this program in FY13

**A. Mission Description and Budget Item Justification**

No funding for this program in FY13

**B. Accomplishments/Planned Programs (\$ in Millions)**

N/A

**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.