Department of Defense
Fiscal Year (FY) 2014 President's Budget Submission

April 2013

Army

Justification Book

Research, Development, Test & Evaluation, Army

RDT&E - Volume I, Budget Activity 1

Department of the Army

FY 2014 RDT&E Program

President's Budget 2014

Summary

20-Feb-2013

Summary Recap of Budget Activities	Thousands of Dollars				
	FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
Basic research	408,842	444,071	436,725	0	436,725
Applied Research	929,984	874,730	885,924	0	885,924
Advanced technology development	1,067,459	890,722	882,106	0	882,106
Advanced Component Development and Prototypes	513,368	629,981	636,392	26,625	663,017
System Development and Demonstration	3,135,367	3,286,629	2,857,026	0	2,857,026
Management support	1,341,545	1,153,980	1,159,610	0	1,159,610
Operational system development	1,303,974	1,664,534	1,126,602	0	1,126,602
Total RDT&E, Army	8,700,539	8,944,647	7,984,385	26,625	8,011,010

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Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
			Basic research					
1	0601101A	01	IN-HOUSE LABORATORY INDEPENDENT RESEARCH	20,395	20,860	21,803		21,803
2	0601102A	01	DEFENSE RESEARCH SCIENCES	207,983	219,180	221,901		221,901
3	0601103A	01	UNIVERSITY RESEARCH INITIATIVES	78,380	80,986	79,359		79,359
4	0601104A	01	UNIVERSITY AND INDUSTRY RESEARCH CENTERS	102,084	123,045	113,662		113,662
		Total:	Basic research	408,842	444,071	436,725	0	436,725
			Applied Research					
5	0602105A	02	MATERIALS TECHNOLOGY	37,707	29,041	26,585		26,585
6	0602120A	02	SENSORS AND ELECTRONIC SURVIVABILITY	42,189	45,260	43,170		43,170
7	0602122A	02	TRACTOR HIP	14,207	22,439	36,293		36,293
8	0602211A	02	AVIATION TECHNOLOGY	43,430	51,607	55,615		55,615
9	0602270A	02	ELECTRONIC WARFARE TECHNOLOGY	15,667	15,068	17,585		17,585
10	0602303A	02	MISSILE TECHNOLOGY	65,591	49,383	51,528		51,528
11	0602307A	02	ADVANCED WEAPONS TECHNOLOGY	19,392	25,999	26,162		26,162
12	0602308A	02	ADVANCED CONCEPTS AND SIMULATION	20,356	23,507	24,063		24,063
13	0602601A	02	COMBAT VEHICLE AND AUTOMOTIVE TECHNOLOGY	62,339	69,062	64,589		64,589
14	0602618A	02	BALLISTICS TECHNOLOGY	60,507	60,823	68,300		68,300
15	0602622A	02	CHEMICAL, SMOKE AND EQUIPMENT DEFEATING TECHNOLOGY	4,753	4,465	4,490		4,490
16	0602623A	02	JOINT SERVICE SMALL ARMS PROGRAM	8,010	7,169	7,818		7,818
17	0602624A	02	WEAPONS AND MUNITIONS TECHNOLOGY	53,883	35,218	37,798		37,798
18	0602705A	02	ELECTRONICS AND ELECTRONIC DEVICES	74,518	60,300	59,021		59,021
19	0602709A	02	NIGHT VISION TECHNOLOGY	54,002	53,244	43,426		43,426
20	0602712A	02	COUNTERMINE SYSTEMS	32,226	18,850	20,574		20,574
21	0602716A	02	HUMAN FACTORS ENGINEERING TECHNOLOGY	21,540	19,872	21,339		21,339
22	0602720A	02	ENVIRONMENTAL QUALITY TECHNOLOGY	20,389	20,095	20,316		20,316
23	0602782A	02	COMMAND, CONTROL, COMMUNICATIONS TECHNOLOGY	25,703	28,852	34,209		34,209
24	0602783A	02	COMPUTER AND SOFTWARE TECHNOLOGY	8,433	9,830	10,439		10,439
25	0602784A	02	MILITARY ENGINEERING TECHNOLOGY	75,465	70,693	70,064		70,064

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Exhibit R-1

FY 2014 RDT&E Program

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Line No	Program Element Number	Act	Item	Thousands of Dollars				
				FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
26	0602785A	02	MANPOWER/PERSONNEL/TRAINING TECHNOLOGY	18,623	17,781	17,654		17,654
27	0602786A	02	WARFIGHTER TECHNOLOGY	46,864	28,281	31,546		31,546
28	0602787A	02	MEDICAL TECHNOLOGY	104,190	107,891	93,340		93,340
		Total:	Applied Research	929,984	874,730	885,924	0	885,924
			Advanced technology development					
29	0603001A	03	WARFIGHTER ADVANCED TECHNOLOGY	55,679	39,359	56,056		56,056
30	0603002A	03	MEDICAL ADVANCED TECHNOLOGY	101,655	69,580	62,032		62,032
31	0603003A	03	AVIATION ADVANCED TECHNOLOGY	60,333	64,215	81,080		81,080
32	0603004A	03	WEAPONS AND MUNITIONS ADVANCED TECHNOLOGY	75,607	67,613	63,919		63,919
33	0603005A	03	COMBAT VEHICLE AND AUTOMOTIVE ADVANCED TECHNOLOGY	142,833	104,359	97,043		97,043
34	0603006A	03	SPACE APPLICATION ADVANCED TECHNOLOGY	4,158	4,157	5,866		5,866
35	0603007A	03	MANPOWER, PERSONNEL AND TRAINING ADVANCED TECHNOLOGY	10,063	9,856	7,800		7,800
36	0603008A	03	ELECTRONIC WARFARE ADVANCED TECHNOLOGY	67,673	50,661	40,416		40,416
37	0603009A	03	TRACTOR HIKE	8,142	9,126	9,166		9,166
38	0603015A	03	NEXT GENERATION TRAINING & SIMULATION SYSTEMS	14,970	17,257	13,627		13,627
39	0603020A	03	TRACTOR ROSE	12,577	9,925	10,667		10,667
40	0603105A	03	MILITARY HIV RESEARCH	22,552	6,984			
41	0603125A	03	COMBATING TERRORISM - TECHNOLOGY DEVELOPMENT	21,939	9,716	15,054		15,054
42	0603130A	03	TRACTOR NAIL	4,271	3,487	3,194		3,194
43	0603131A	03	TRACTOR EGGS	2,257	2,323	2,367		2,367
44	0603270A	03	ELECTRONIC WARFARE TECHNOLOGY	23,046	21,683	25,348		25,348
45	0603313A	03	MISSILE AND ROCKET ADVANCED TECHNOLOGY	87,749	71,111	64,009		64,009
46	0603322A	03	TRACTOR CAGE	10,299	10,902	11,083		11,083
47	0603461A	03	HIGH PERFORMANCE COMPUTING MODERNIZATION PROGRAM	176,533	180,582	180,662		180,662
48	0603606A	03	LANDMINE WARFARE AND BARRIER ADVANCED TECHNOLOGY	30,687	27,204	22,806		22,806
49	0603607A	03	JOINT SERVICE SMALL ARMS PROGRAM	7,473	6,095	5,030		5,030
50	0603710A	03	NIGHT VISION ADVANCED TECHNOLOGY	41,283	37,217	36,407		36,407
51	0603728A	03	ENVIRONMENTAL QUALITY TECHNOLOGY DEMONSTRATIONS	15,247	13,626	11,745		11,745
52	0603734A	03	MILITARY ENGINEERING ADVANCED TECHNOLOGY	40,496	28,458	23,717		23,717

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				Thousands of Dollars				
53	0603772A	03	ADVANCED TACTICAL COMPUTER SCIENCE AND SENSOR TECHNOLOGY	29,937	25,226	33,012		33,012
		Total:	Advanced technology development	1,067,459	890,722	882,106	0	882,106
			Advanced Component Development and Prototypes					
54	0603305A	04	ARMY MISSLE DEFENSE SYSTEMS INTEGRATION	23,463	14,505	15,301		15,301
55	0603308A	04	ARMY SPACE SYSTEMS INTEGRATION	9,557	9,876	13,592		13,592
56	0603619A	04	LANDMINE WARFARE AND BARRIER - ADV DEV	16,399	5,054	10,625		10,625
57	0603627A	04	SMOKE, OBSCURANT AND TARGET DEFEATING SYS-ADV DEV	4,357	2,725			
58	0603639A	04	TANK AND MEDIUM CALIBER AMMUNITION	40,201	30,560	30,612		30,612
59	0603653A	04	ADVANCED TANK ARMAMENT SYSTEM (ATAS)	62,343	14,347	49,989		49,989
60	0603747A	04	SOLDIER SUPPORT AND SURVIVABILITY	13,720	29,933	6,703	26,625	33,328
61	0603766A	04	TACTICAL ELECTRONIC SURVEILLANCE SYSTEM - ADV DEV	5,757	8,660	6,894		6,894
62	0603774A	04	NIGHT VISION SYSTEMS ADVANCED DEVELOPMENT		10,715	9,066		9,066
63	0603779A	04	ENVIRONMENTAL QUALITY TECHNOLOGY - DEM/VAL	4,788	4,631	2,633		2,633
64	0603782A	04	WARFIGHTER INFORMATION NETWORK-TACTICAL - DEM/VAL	177,122	278,018	272,384		272,384
65	0603790A	04	NATO RESEARCH AND DEVELOPMENT	4,612	4,961	3,874		3,874
66	0603801A	04	AVIATION - ADV DEV	6,879	8,602	5,018		5,018
67	0603804A	04	LOGISTICS AND ENGINEER EQUIPMENT - ADV DEV	12,107	14,605	11,556		11,556
68	0603805A	04	COMBAT SERVICE SUPPORT CONTROL SYSTEM EVALUATION AND ANALYSIS	5,090	5,054			
69	0603807A	04	MEDICAL SYSTEMS - ADV DEV	34,809	24,384	15,603		15,603
70	0603827A	04	SOLDIER SYSTEMS - ADVANCED DEVELOPMENT	23,516	32,050	14,159		14,159
71	0603850A	04	INTEGRATED BROADCAST SERVICE	1,494	96	79		79
72	0604115A	04	TECHNOLOGY MATURATION INITIATIVES	11,839	24,868	55,605		55,605
73	0604131A	04	TRACTOR JUTE		59			
74	0604319A	04	INDIRECT FIRE PROTECTION CAPABILITY INCREMENT 2-INTERCEPT (IFPC2)		76,039	79,232		79,232
75	0604785A	04	INTEGRATED BASE DEFENSE (BUDGET ACTIVITY 4)	3,926	4,043	4,476		4,476
76	0305205A	04	ENDURANCE UAVS	51,389	26,196	28,991		28,991
		Total:	Advanced Component Development and Prototypes	513,368	629,981	636,392	26,625	663,017

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				FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
			System Development and Demonstration					
77	0604201A	05	AIRCRAFT AVIONICS	115,890	78,538	76,588		76,588
78	0604220A	05	ARMED, DEPLOYABLE HELOS	80,323	90,494	73,309		73,309
79	0604270A	05	ELECTRONIC WARFARE DEVELOPMENT	33,164	181,347	154,621		154,621
80	0604280A	05	JOINT TACTICAL RADIO			31,826		31,826
81	0604290A	05	MID-TIER NETWORKING VEHICULAR RADION (MNVR)	47,000	12,636	23,341		23,341
82	0604321A	05	ALL SOURCE ANALYSIS SYSTEM	7,400	5,694	4,839		4,839
83	0604328A	05	TRACTOR CAGE	23,535	32,095	23,841		23,841
84	0604601A	05	INFANTRY SUPPORT WEAPONS	81,081	96,478	79,855		79,855
85	0604604A	05	MEDIUM TACTICAL VEHICLES	3,835	3,006	2,140		2,140
86	0604611A	05	JAVELIN	9,655	5,040	5,002		5,002
87	0604622A	05	FAMILY OF HEAVY TACTICAL VEHICLES	5,239	3,077	21,321		21,321
88	0604633A	05	AIR TRAFFIC CONTROL	22,218	9,769	514		514
89	0604641A	05	TACTICAL UNMANNED GROUND VEHICLE (TUGV)		13,141			
90	0604642A	05	LIGHT TACTICAL WHEELED VEHICLES	68,442				
91	0604661A	05	FCS SYSTEMS OF SYSTEMS ENGR & PROGRAM MGMT	257,513				
92	0604663A	05	FCS UNMANNED GROUND VEHICLES	34,845				
93	0604710A	05	NIGHT VISION SYSTEMS - ENG DEV	55,412	32,621	43,405		43,405
94	0604713A	05	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	2,008	2,132	1,939		1,939
95	0604715A	05	NON-SYSTEM TRAINING DEVICES - ENG DEV	29,206	44,787	18,980		18,980
96	0604716A	05	TERRAIN INFORMATION - ENG DEV	1,593	1,008			
97	0604741A	05	AIR DEFENSE COMMAND, CONTROL AND INTELLIGENCE - ENG DEV	57,050	73,333	18,294		18,294
98	0604742A	05	CONSTRUCTIVE SIMULATION SYSTEMS DEVELOPMENT	27,530	28,937	17,013		17,013
99	0604746A	05	AUTOMATIC TEST EQUIPMENT DEVELOPMENT	13,932	10,815	6,701		6,701
100	0604760A	05	DISTRIBUTIVE INTERACTIVE SIMULATIONS (DIS) - ENG DEV	15,357	13,926	14,575		14,575
101	0604780A	05	COMBINED ARMS TACTICAL TRAINER (CATT) CORE	21,541	17,797	27,634		27,634
102	0604798A	05	BRIGADE ANALYSIS, INTEGRATION AND EVALUATION		214,270	193,748		193,748
103	0604802A	05	WEAPONS AND MUNITIONS - ENG DEV	13,384	14,581	15,721		15,721
104	0604804A	05	LOGISTICS AND ENGINEER EQUIPMENT - ENG DEV	173,902	43,706	41,703		41,703
105	0604805A	05	COMMAND, CONTROL, COMMUNICATIONS SYSTEMS - ENG DEV	79,188	20,776	7,379		7,379

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				FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
106	0604807A	05	MEDICAL MATERIEL/MEDICAL BIOLOGICAL DEFENSE EQUIPMENT - ENG DEV	26,316	43,395	39,468		39,468
107	0604808A	05	LANDMINE WARFARE/BARRIER - ENG DEV	73,955	104,983	92,285		92,285
108	0604814A	05	ARTILLERY MUNITIONS - EMD	45,821	4,346	8,209		8,209
109	2604818A	05	ARMY TACTICAL COMMAND & CONTROL HARDWARE & SOFTWARE	91,490	77,223	22,958		22,958
110	0604820A	05	RADAR DEVELOPMENT	3,093	3,486	1,549		1,549
111	0604822A	05	GENERAL FUND ENTERPRISE BUSINESS SYSTEM (GFEBS)	787	9,963	17,342		17,342
112	0604823A	05	FIREFINDER	12,032	20,517	47,221		47,221
113	0604827A	05	SOLDIER SYSTEMS - WARRIOR DEM/VAL	41,680	51,851	48,477		48,477
114	0604854A	05	ARTILLERY SYSTEMS - EMD	116,293	167,797	80,613		80,613
115	0604869A	05	PATRIOT/MEADS COMBINED AGGREGATE PROGRAM (CAP)	377,610	400,861			
116	0604870A	05	NUCLEAR ARMS CONTROL MONITORING SENSOR NETWORK	7,160	7,922			
117	0605013A	05	INFORMATION TECHNOLOGY DEVELOPMENT	35,714	51,463	68,814		68,814
118	0605018A	05	INTEGRATED PERSONNEL AND PAY SYSTEM-ARMY (IPPS-A)	66,612	158,646	137,290		137,290
119	0605028A	05	ARMORED MULTI-PURPOSE VEHICLE (AMPV)			116,298		116,298
120	0605030A	05	JOINT TACTICAL NETWORK CENTER (JTNC)			68,148		68,148
121	0605380A	05	AMF JOINT TACTICAL RADIO SYSTEM (JTRS)			33,219		33,219
122	0605450A	05	JOINT AIR-TO-GROUND MISSILE (JAGM)	123,100	10,000	15,127		15,127
123	0605455A	05	SLAMRAAM	1,186				
124	0605456A	05	PAC-3/MSE MISSILE	86,139	69,029	68,843		68,843
125	0605457A	05	ARMY INTEGRATED AIR AND MISSILE DEFENSE (AIAMD)	262,032	277,374	364,649		364,649
126	0605625A	05	MANNED GROUND VEHICLE	434,977	639,874	592,201		592,201
127	0605626A	05	AERIAL COMMON SENSOR	31,415	47,426	10,382		10,382
128	0605766A	05	NATIONAL CAPABILITIES INTEGRATION (MIP)			21,143		21,143
129	0605812A	05	JOINT LIGHT TACTICAL VEHICLE (JLTV) ENGINEERING AND MANUFACTURING D		72,295	84,230		84,230
130	0303032A	05	TROJAN - RH12	3,914	4,232	3,465		3,465
131	0304270A	05	ELECTRONIC WARFARE DEVELOPMENT	13,798	13,942	10,806		10,806
	Total:		System Development and Demonstration	3,135,367	3,286,629	2,857,026	0	2,857,026
			Management support					
132	0604256A	06	THREAT SIMULATOR DEVELOPMENT	25,838	18,090	16,934		16,934

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				FY2012	FY2013	FY2014	FY2014 OCO	FY2014 Total
133	0604258A	06	TARGET SYSTEMS DEVELOPMENT	10,973	14,034	13,488		13,488
134	0604759A	06	MAJOR T&E INVESTMENT	47,972	37,394	46,672		46,672
135	0605103A	06	RAND ARROYO CENTER	19,730	21,026	11,919		11,919
136	0605301A	06	ARMY KWAJALEIN ATOLL	141,365	176,816	193,658		193,658
137	0605326A	06	CONCEPTS EXPERIMENTATION PROGRAM	27,923	27,902	37,158		37,158
138	0605502A	06	SMALL BUSINESS INNOVATIVE RESEARCH	208,324				
139	0605601A	06	ARMY TEST RANGES AND FACILITIES	366,327	369,900	340,659		340,659
140	0605602A	06	ARMY TECHNICAL TEST INSTRUMENTATION AND TARGETS	68,968	69,183	66,061		66,061
141	0605604A	06	SURVIVABILITY/LETHALITY ANALYSIS	42,088	44,753	43,280		43,280
142	0605605A	06	DOD HIGH ENERGY LASER TEST FACILITY	18				
143	0605606A	06	AIRCRAFT CERTIFICATION	5,555	5,762	6,025		6,025
144	0605702A	06	METEOROLOGICAL SUPPORT TO RDT&E ACTIVITIES	7,062	7,402	7,349		7,349
145	0605706A	06	MATERIEL SYSTEMS ANALYSIS	19,498	19,954	19,809		19,809
146	0605709A	06	EXPLOITATION OF FOREIGN ITEMS	5,435	5,535	5,941		5,941
147	0605712A	06	SUPPORT OF OPERATIONAL TESTING	68,311	67,789	55,504		55,504
148	0605716A	06	ARMY EVALUATION CENTER	62,845	62,765	65,274		65,274
149	0605718A	06	ARMY MODELING & SIM X-CMD COLLABORATION & INTEG	3,312	1,545	1,283		1,283
150	0605801A	06	PROGRAMWIDE ACTIVITIES	82,015	83,422	82,035		82,035
151	0605803A	06	TECHNICAL INFORMATION ACTIVITIES	52,085	50,820	33,853		33,853
152	0605805A	06	MUNITIONS STANDARDIZATION, EFFECTIVENESS AND SAFETY	53,530	46,763	53,340		53,340
153	0605857A	06	ENVIRONMENTAL QUALITY TECHNOLOGY MGMT SUPPORT	4,801	4,601	5,193		5,193
154	0605898A	06	MANAGEMENT HQ - R&D	17,480	18,524	54,175		54,175
155	0909999A	06	FINANCING FOR CANCELLED ACCOUNT ADJUSTMENTS	90				
	Total:		Management support	1,341,545	1,153,980	1,159,610	0	1,159,610
			Operational system development					
156	0603778A	07	MLRS PRODUCT IMPROVEMENT PROGRAM	64,609	143,005	110,576		110,576
157	0607141A	07	LOGISTICS AUTOMATION			3,717		3,717
158	0607665A	07	BIOMETRICS ENTERPRISE	44,155				
159	0607865A	07	PATRIOT PRODUCT IMPROVEMENT		109,978	70,053		70,053

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160	0102419A	07	AEROSTAT JOINT PROJECT OFFICE	317,382	190,422	98,450		98,450
161	0203726A	07	ADV FIELD ARTILLERY TACTICAL DATA SYSTEM	28,649	32,556	30,940		30,940
162	0203735A	07	COMBAT VEHICLE IMPROVEMENT PROGRAMS	35,046	253,959	177,532		177,532
163	0203740A	07	MANEUVER CONTROL SYSTEM	39,282	68,325	36,495		36,495
164	0203744A	07	AIRCRAFT MODIFICATIONS/PRODUCT IMPROVEMENT PROGRAMS	144,904	280,247	257,187		257,187
165	0203752A	07	AIRCRAFT ENGINE COMPONENT IMPROVEMENT PROGRAM	800	898	315		315
166	0203758A	07	DIGITIZATION	7,771	35,180	6,186		6,186
167	0203801A	07	MISSILE/AIR DEFENSE PRODUCT IMPROVEMENT PROGRAM	52,811	20,733	1,578		1,578
168	0203802A	07	OTHER MISSILE PRODUCT IMPROVEMENT PROGRAMS			62,100		62,100
169	0203808A	07	TRACTOR CARD	42,487	63,243	18,778		18,778
170	0208053A	07	JOINT TACTICAL GROUND SYSTEM	27,586	31,738	7,108		7,108
171	0208058A	07	JOINT HIGH SPEED VESSEL (JHSV)		35			
172	0301359A	07	SPECIAL ARMY PROGRAM					
173	0303028A	07	SECURITY AND INTELLIGENCE ACTIVITIES	2,763	7,591	7,600		7,600
174	0303140A	07	INFORMATION SYSTEMS SECURITY PROGRAM	15,282	15,961	9,357		9,357
175	0303141A	07	GLOBAL COMBAT SUPPORT SYSTEM	155,813	120,927	41,225		41,225
176	0303142A	07	SATCOM GROUND ENVIRONMENT (SPACE)	11,765	15,756	18,197		18,197
177	0303150A	07	WWMCCS/GLOBAL COMMAND AND CONTROL SYSTEM	22,658	14,443	14,215		14,215
178	0305204A	07	TACTICAL UNMANNED AERIAL VEHICLES	26,508	31,303	33,533		33,533
179	0305208A	07	DISTRIBUTED COMMON GROUND/SURFACE SYSTEMS	31,401	40,876	27,622		27,622
180	0305219A	07	MQ-1 SKY WARRIOR A UAV	121,846	74,618	10,901		10,901
181	0305232A	07	RQ-11 UAV	1,935	4,039	2,321		2,321
182	0305233A	07	RQ-7 UAV	31,896	31,158	12,031		12,031
183	0305235A	07	MQ-18 UAV	4,000	2,387			
184	0307665A	07	BIOMETRICS ENABLED INTELLIGENCE	15,018	15,248	12,449		12,449
185	0708045A	07	END ITEM INDUSTRIAL PREPAREDNESS ACTIVITIES	57,607	59,908	56,136		56,136
		Total:	Operational system development	1,303,974	1,664,534	1,126,602	0	1,126,602
Total:	RDT&E, Army			8,700,539	8,944,647	7,984,385	26,625	8,011,010

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

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

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Program Element Table of Contents (Alphabetically by Program Element Title)

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army										DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601101A: *In-House Laboratory Independent Research*						
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	20.395	20.860	21.803	-	21.803	21.202	21.549	21.834	22.236	Continuing	Continuing
91A: *ILIR-AMC*	-	14.620	16.062	17.504	-	17.504	16.847	17.118	17.320	17.632	Continuing	Continuing
91C: *ILIR-Med R&D Cmd*	-	3.575	2.839	2.886	-	2.886	2.935	2.984	3.032	3.087	Continuing	Continuing
91D: *ILIR-Corps Of Engr*	-	1.495	1.073	0.587	-	0.587	0.597	0.608	0.626	0.646	Continuing	Continuing
91E: *ILIR-ARI*	-	0.000	0.153	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
F16: *ILIR-SMDC*	-	0.705	0.733	0.826	-	0.826	0.823	0.839	0.856	0.871	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army				**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*		**R-1 ITEM NOMENCLATURE** PE 0601101A: *In-House Laboratory Independent Research*		

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.

B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	21.031	20.860	21.609	-	21.609
Current President's Budget	20.395	20.860	21.803	-	21.803
Total Adjustments	-0.636	0.000	0.194	-	0.194
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.146	-			
• SBIR/STTR Transfer	-0.490	-			
• Adjustments to Budget Years	-	-	0.194	-	0.194

| Exhibit R-2A, RDT&E Project Justification: PB 2014 Army | | | | | | | | | | DATE: April 2013 | |

| 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)	All Prior Years	FY 2012	FY 2013[#]	FY 2014 Base	FY 2014 OCO ^{##}	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
91A: *ILIR-AMC*	-	14.620	16.062	17.504	-	17.504	16.847	17.118	17.320	17.632	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

^{##} The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Edgewood Chemical Biological Center	0.833	0.956	0.968
Description: Funds basic research in chemistry, biology, biotechnology, and aerosol for counter improvised explosive devices (IEDs), obscurants, and/or target defeat. **FY 2012 Accomplishments:** Continued 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; Continued investigations in synthetic biology using new molecular programming techniques for creating biofuels and materials; continued fundamental research in surface science in PE 0601102A, Project VR9, Surface Science Research. **FY 2013 Plans:**			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
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 insensitive munitions (IM) properties, counter terrorism technologies, power and energy systems, smaller more lethal warheads and composite materials. *FY 2014 Plans:* Will conduct fundamental research to develop an understanding of rational molecular and nano-system design, synthetic biology, nano-scale chemical and biological sensing and signaling, molecular toxicology, interfacial phenomena of particulate matter (solid/liquid) with chemical surfaces, and synthesis of new materials for protection, decontamination, and detection, as well as research the mathematics involved in data processing and interpretation.			
Title: Armaments Research, Development and Engineering Center *Description:* Funds basic research in weapons component development, explosives synthesis/detection and area denial. *FY 2012 Accomplishments:* Solicitied 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. *FY 2013 Plans:* 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. *FY 2014 Plans:* 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 insensitive munition (IM) properties, counter terrorism technologies, power and energy systems, smaller more lethal warheads and composite materials.	1.673	1.682	1.707
Title: Tank-Automotive Research, Development and Engineering Center *Description:* Funds basic research in ground vehicle technologies to include power, mobility, and unmanned systems. *FY 2012 Accomplishments:* Developed and investigated models for nanofluid coolants and lubricants; developed and investigate durability and blast models for composite materials, including carbon nanotube reinforced composite; and developed algorithms for bio-inspired object recognition for unmanned systems. *FY 2013 Plans:*	1.202	1.199	1.220

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Continue to research models for nanofluid coolants and lubricants. Rresearch functionally graded structures exposed to shock, will investigate statistical theories and algorithms for reliability based design optimization. Rresearch the combustion properties of JP-8, diesel and other fuels. *FY 2014 Plans:* Will research novel nanofluid coolants and lubricants; investigate statistical theories and algorithms for multi-disciplinary design optimization; research the combustion properties of new fuels; explore novel on-chip microwave nonreciprocal devices; research manned/unmanned teaming and cooperative mobility behaviors; and study electromagnetic wave reflection from nano-structured non-reciprocal metamaterials for non-reflective, cloak-type coatings.			
Title: Natick Soldier Research, Development and Engineering Center *Description:* Funds basic research in food sciences, textiles, and lightweight materials with potential for individual protection. *FY 2012 Accomplishments:* Created zwitterionic 3-dimensional nanofibrous architectures for antifouling and food pathogen sensing; conducted fundamental studies on novel metal oxides for tuned optical response; and explored understanding of the lysis mechanisms of peptides for antimicrobial protection. *FY 2013 Plans:* Develop novel biochemical functionalization strategies to tether bio-recognition elements and antibodies onto graphene; 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; validate experimental paradigms; conduct experiments to refine the use of immersive virtual reality technologies for use with Soldier-volunteers. *FY 2014 Plans:* Will explore the unique physics of photonic nanomaterials for revolutionizing the performance and size of systems such as IR detectors, power generation and remote imaging; continue to explore the relationship between peptide structure on tailored structures for controlling and optimizing the destructive efficacy of antimicrobial peptides for multiple applications.	1.358	1.321	1.341
Title: Aviation and Missile Research, Development and Engineering Center: Missile Efforts *Description:* Funds basic research in guided missile and rocket systems, directed energy weapons, unmanned vehicles, and related components. *FY 2012 Accomplishments:*	2.237	2.241	2.273

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Solicited new concepts for basic research efforts with broad applicability to science and technology that support exploratory and advanced development for guided missile and rocket systems, directed energy weapons, unmanned vehicles, and related components. *FY 2013 Plans:* Experimentally explore infrared emissivity / absorptivity enhancement of polar materials by surface phonon coupling; analyze nonlinear effects in nanostructure devices; experimentally investigate excitation. *FY 2014 Plans:* Will investigate paucity of attractors phenomenon in dynamical systems; develop theory of harmonic generation and Raman scattering from surfaces in nano-cavity environments; study optical propagation phenomena in the plasmonic regime in semiconductor and metal-based nanostructures and metamaterials; explore remote sensing of trace gases in the atmosphere using infrared/terahertz double resonance active interrogation; assess enhancement of infrared emissivity/absorptivity of polar materials near optical phonon resonances by surface phonon coupling and metamaterial effects.			
Title: Aviation and Missile Research, Development and Engineering Center: Aviation Efforts *Description:* Funds basic research for aviation enabling technologies in the areas of aerodynamics, structural dynamics, and material science. *FY 2012 Accomplishments:* Investigated inflow dynamics and wake physics at high advance ratios and investigated dielectric barrier discharge plasma devices for reduced bluff body drag. *FY 2013 Plans:* Complete initial testing on trailed wake vorticity and spanwise loading; complete Particle Image Velocimetry (PIV) data analysis for dynamic stall test case; and complete project on high advance ratio theory including all reporting. *FY 2014 Plans:* Will continue basic aerodynamic science research in the areas of vorticity dynamics, compressible dynamic stall, bluff body flow separation and flow physics; and will investigate advanced boundary layer flow control phenomenon including fluidic oscillators and plasma devices.	1.621	1.623	1.647
Title: Communications-Electronics Research, Development, and Engineering Center *Description:* Funds basic research for communication and network enabling technologies in the areas of antenna design, network management, power generation and storage, and also sensors. *FY 2012 Accomplishments:*	1.475	1.485	2.509

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Performed research for developing cognitive algorithm and intelligent cognitive network with optimized managed resources, and flexible and reconfigurable radio frequency (RF) technologies; explored RF interaction of nano-tubes and metamaterial for wideband signal amplification and also electromagnetic radiation; explored control theory in addressing the uncertainty and latency in the cognitive ad-hoc network; performed research on sensor network scenarios that can perform blind signal sensing and classification of weak signals; investigated alternative separator and electrolytes for high energy/power electrochemical couples; concentrated on reducing the parasitic (non-electrochemical) reactions between synthesized separator and electrolyte and high energy electrode components; and investigated new metallic polymers for next generation infrared sensors. *FY 2013 Plans:* 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; investigate novel electromagnetic polymer nanocomposites to gain a fundamental understanding of the underlying physics for potential antenna applications; 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 initiate research into halogenated mixed metal oxides cathode material for advanced lithium electrochemical systems. *FY 2014 Plans:* Will conduct research into signals exploitation techniques by investigating algorithms for intelligently and rapidly searching wide bands of RF spectrum for short duration signals by mathematically representing the shape of a specific RF signals; Will research new algorithms based on mathematical models and new routing schemes for scalable and secure mobile ad hoc network (MANET)-based Real-Time Peer-to-Peer (P2P) Voice-over-IP (VoIP)/Multimedia Network; Will synthesize and evaluate high energy cathode materials for application to electrochemical capacitors for increased energy density and longer cycle life; Will investigate the feasibility of real-time, in-vacuo band edge thermometry for heteroepitaxy of II-VI thin films on semiconductor substrates for advanced IR detectors. Will research the synthesis of dense Bismuth Selenide thin films, maximizing the material properties of conduction on the surface and insulating properties in the bulk, for use in RF front end electronics. Initiate research in Cyber Protection and Attack.			
Title: Peer Reviewed Proposal Efforts *Description:* 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. *FY 2012 Accomplishments:*	4.221	5.555	5.839

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Conducted 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.			
FY 2013 Plans: 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.			
FY 2014 Plans: Will solicit new basic research proposals 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.			
Accomplishments/Planned Programs Subtotals	14.620	16.062	17.504

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
91C: ILIR-Med R&D Cmd	-	3.575	2.839	2.886	-	2.886	2.935	2.984	3.032	3.087	Continuing	Continuing

\# FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

\#\# The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Independent Research Efforts Description: Funds basic research in medical and force health protection. FY 2012 Accomplishments: Investigated an in vitro (outside of animal/in test tube) and in vivo (in animal) model systems to examine nutritional countermeasures for enhanced neuroprotection and stress resilience; Studied the evolution of RNA genome viruses under immune system selective pressure to improve vaccine design: Theory, modeling, and validation; Investigated the use of recombinant reovirus particles as environmentally stable oral vaccine vectors against bioweapon threat agents; Enhanced understanding the role of the Sap proteins (particular type of proteinase protein) in disease causing capability of microorganisms (pathogenesis); Investigated genetic determinants which contribute to the intracellular survival and replication of Burkholderia pseudomallei (a gram negative bacterium often associated with infections); Evaluated 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; 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)	3.575	2.839	2.886

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601101A: *In-House Laboratory Independent Research*	**PROJECT** 91C: *ILIR-Med R&D Cmd*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
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. *FY 2013 Plans:* The program funds innovative in-house basic research proposals that focus on research to explore treatments and countermeasures against militarily relevant infectious diseases; defense against environmental extremes and operational hazards to health; mechanisms of combat trauma and innovative treatment and surgical procedures; and medical chemical/biological warfare threats. Examples of research efforts are as follows: Host and Wound Adaptations in Acinetobacter baumannii (a highly infectious bacteria) - this research enables novel methods to detect pathogens (germs) in the operating environment and predict their capacity to colonize or contaminate wounds in Soldiers and contaminate equipment to reduce infection with aggressive and drug resistant pathogens; explore the psychology of fear conditioning and learning to combat stimuli, to better understand psychopathology (causes of abnormal psychology) associated with combat experience; develop rodent models to study stress effects on brain cells, and use those models to identify nutritional measures conferring neuroprotection (brain protection) and resilience. *FY 2014 Plans:* 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.			
Accomplishments/Planned Programs Subtotals	3.575	2.839	2.886

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

D. Acquisition Strategy
   N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army										DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
91D: *ILIR-Corps Of Engr*	-	1.495	1.073	0.587	-	0.587	0.597	0.608	0.626	0.646	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Geospatial Research and Engineering/Military Engineering/Environmental Quality and Installations *Description:* Funds basic research in the areas of geospatial research and military engineering as well as environmental quality and installations. *FY 2012 Accomplishments:* Completed basic research efforts for ultra-compact soils for soil mechanics systems; investigated vegetation photopigment decay for remote sensing of hazardous materials; and investigated DNA pattern formation upon non-directed assembly at a functionalized surface for Army relevant compounds. *FY 2013 Plans:* Create a numerical physics-based model of dynamic geologic-material contact behavior with buried sensors; create a methodology to rapidly characterize the near-ground atmospheric and instantaneous sound field between sensor nodes for a large region; 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. *FY 2014 Plans:*	1.495	1.073	0.587

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Will quantify the fundamental coupling effects and transfer functions of fiber optic cable sensors inside of protective conduit within realistic and variable geologic media; determine parameters and build physics-based seismic propagation models for fiber, conduit, and geomaterial interaction.			
Accomplishments/Planned Programs Subtotals	1.495	1.073	0.587

C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army										**DATE:** April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013**#	**FY 2014 Base**	**FY 2014 OCO** ##	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
91E: *ILIR-ARI*	-	0.000	0.153	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	**FY 2012**	**FY 2013**	**FY 2014**
Title: Army Research Institute	0.000	0.153	0.000
Description: 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.			
FY 2013 Plans: Research focused 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.			
Accomplishments/Planned Programs Subtotals	0.000	0.153	0.000

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

D. Acquisition Strategy
  N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

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 2014 Army		DATE: April 2013

APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601101A: *In-House Laboratory Independent Research*	PROJECT F16: *ILIR-SMDC*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
F16: *ILIR-SMDC*	-	0.705	0.733	0.826	-	0.826	0.823	0.839	0.856	0.871	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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/ARSTRAT, Huntsville, AL.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: SMDC In-house Laboratory Independent Research (ILIR)	0.705	0.733	0.826

Description: Funds basic research to investigate laser propagation phenomenology for application in modeling and simulation and future directed energy weapons design.

FY 2012 Accomplishments:
Conducted modeling and simulation studies and experiments for new laser technology and beam propagation concepts to enable understanding of next generation high energy laser systems.

FY 2013 Plans:
Continue to conduct laser beam propagation experiments and spectroscopic research to improve modeling and simulation capabilities and improve high energy laser systems design.

FY 2014 Plans:
Will complete laser beam propagation experiments and provide data for model anchoring. Will continue spectroscopic research and improve modeling and simulation capabilities and begin design for flowing rare earth laser.

	FY 2012	FY 2013	FY 2014
Accomplishments/Planned Programs Subtotals	0.705	0.733	0.826

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601101A: *In-House Laboratory Independent Research*	**PROJECT** F16: *ILIR-SMDC*

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2, **RDT&E Budget Item Justification:** PB 2014 Army												**DATE:** April 2013	

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
Total Program Element	-	207.983	219.180	221.901	-	221.901	224.167	229.009	234.391	238.657	Continuing	Continuing
305: *ATR Research*	-	2.385	2.204	2.281	-	2.281	2.386	2.397	2.621	2.668	Continuing	Continuing
31B: *Infrared Optics Rsch*	-	2.763	2.836	2.861	-	2.861	2.893	2.926	2.895	2.947	Continuing	Continuing
52C: *Mapping & Remote Sens*	-	2.878	2.233	2.259	-	2.259	2.288	2.312	2.344	2.386	Continuing	Continuing
53A: *Battlefield Env & Sig*	-	3.412	3.534	3.572	-	3.572	3.621	3.583	3.642	3.708	Continuing	Continuing
74A: *Human Engineering*	-	7.886	8.265	8.413	-	8.413	8.642	8.816	8.880	9.040	Continuing	Continuing
74F: *Pers Perf & Training*	-	5.560	7.094	5.719	-	5.719	5.838	5.958	6.083	6.219	Continuing	Continuing
F20: *Adv Propulsion Rsch*	-	3.940	4.211	4.256	-	4.256	4.307	4.283	4.357	4.435	Continuing	Continuing
F22: *Rsch In Veh Mobility*	-	0.577	0.606	0.612	-	0.612	0.621	0.630	0.642	0.654	Continuing	Continuing
H42: *Materials & Mechanics*	-	8.262	8.644	8.907	-	8.907	8.998	9.053	9.208	9.374	Continuing	Continuing
H43: *Research In Ballistics*	-	8.867	9.103	9.383	-	9.383	9.546	9.607	9.769	9.945	Continuing	Continuing
H44: *Adv Sensors Research*	-	9.778	10.219	10.347	-	10.347	10.658	10.943	11.127	11.327	Continuing	Continuing
H45: *Air Mobility*	-	2.393	2.515	2.552	-	2.552	2.588	2.625	2.671	2.719	Continuing	Continuing
H47: *Applied Physics Rsch*	-	4.977	5.222	5.270	-	5.270	5.535	5.980	6.001	6.109	Continuing	Continuing
H48: *Battlespace Info & Comm Rsc*	-	15.399	21.519	21.557	-	21.557	22.177	22.446	22.752	23.180	Continuing	Continuing
H52: *Equip For The Soldier*	-	1.096	1.135	1.146	-	1.146	1.157	1.172	1.189	1.210	Continuing	Continuing
H57: *Single Investigator Basic Research*	-	76.109	78.050	80.385	-	80.385	80.047	82.675	84.357	85.875	Continuing	Continuing
H66: *Adv Structures Rsch*	-	1.929	1.999	2.018	-	2.018	2.046	2.069	2.022	2.058	Continuing	Continuing
H67: *Environmental Research*	-	0.987	1.020	1.031	-	1.031	1.054	1.065	1.084	1.104	Continuing	Continuing
S13: *Sci BS/Med Rsh Inf Dis*	-	10.693	12.099	10.702	-	10.702	10.656	11.119	11.249	11.657	Continuing	Continuing
S14: *Sci BS/Cbt Cas Care Rs*	-	9.424	10.197	9.172	-	9.172	9.302	9.161	9.721	9.607	Continuing	Continuing
S15: *Sci BS/Army Op Med Rsh*	-	6.246	5.683	7.370	-	7.370	7.320	6.977	7.056	7.307	Continuing	Continuing
T22: *Soil & Rock Mech*	-	4.824	4.034	4.579	-	4.579	4.780	4.978	5.056	5.147	Continuing	Continuing
T23: *Basic Res Mil Const*	-	1.863	1.659	1.773	-	1.773	1.715	1.732	1.964	1.999	Continuing	Continuing

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*							
T24: *Signature Physics And Terrain State Basic Research*	-	1.605	1.495	1.601	-	1.601	1.539	1.547	1.656	1.686	Continuing	Continuing
T25: *Environmental Science Basic Research*	-	8.027	6.888	7.175	-	7.175	7.170	7.293	8.254	8.403	Continuing	Continuing
T63: *Robotics Autonomy, Manipulation, & Portability Rsh*	-	1.797	1.956	1.991	-	1.991	2.025	2.059	2.094	2.132	Continuing	Continuing
T64: *Sci BS/System Biology And Network Science*	-	2.128	2.824	2.959	-	2.959	2.930	2.972	3.022	3.038	Continuing	Continuing
VR9: *Surface Science Research*	-	2.178	1.936	2.010	-	2.010	2.328	2.631	2.675	2.723	Continuing	Continuing

\# FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

\#\# The FY 2014 OCO Request will be submitted at a later date

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.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army				DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*			R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	213.604	219.180	226.586	-	226.586
Current President's Budget	207.983	219.180	221.901	-	221.901
Total Adjustments	-5.621	0.000	-4.685	-	-4.685
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.000	-			
• SBIR/STTR Transfer	-4.621	-			
• Adjustments to Budget Years	-	-	-4.685	-	-4.685

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*					**PROJECT** 305: *ATR Research*		

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
305: *ATR Research*	-	2.385	2.204	2.281	-	2.281	2.386	2.397	2.621	2.668	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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. Critical technology issues include low depression angle, relatively short range, and highly competing background clutter. The resulting research will provide a 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 (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 for 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)	FY 2012	FY 2013	FY 2014
Title: ATR Algorithms	1.391	1.300	1.339
Description: Investigate new algorithms to improve aided/unaided target detection and identification. *FY 2012 Accomplishments:* Researched automatic machine perception algorithms that provide enhanced situational awareness; investigated fast algorithms for feature extraction and scene understanding from hyperspectral and multimodal data. *FY 2013 Plans:*			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** 305: *ATR Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Investigate methods for object and event detection and classification using multimodal and hyperspectral imaging sensors to support Data-to-Decision capabilities. Conduct research for optimal sensor fusion and novel feature selection techniques to enhance Automatic Target Recognition (ATR) and biometric capabilities. *FY 2014 Plans:* Will investigate methods for human detection, cross-modality face recognition, and robust spectral signature analysis to enhance Data-to-Decision capabilities. Will develop ATR algorithms insensitive to signature variations and environmental changes.			
Title: Tagging, Tracking and Locating (TTL) *Description:* 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. *FY 2012 Accomplishments:* Researched efforts in the areas of imaging and tagging for TTL enhancements and applications. Specific research included novel concepts of e-field detection, ultraviolet taggant detection, and lensless imaging. *FY 2013 Plans:* Investigate and design advanced algorithms, components, sensors, and techniques applicable to TTL. Assess the use of inherent target signatures including hyperspectral signatures to provide enhanced TTL standoff capabilities. Further investigate the application of nanotechnology and microelectromechanical systems(MEMS) to TTL technologies. Examine the development of advanced taggant technologies across the electromagnetic spectrum including ultraviolet, infrared, and radio frequency for enhanced range performance and covertness. Advance flexible electronics and non-cooperative biometric identification for TTL applications. *FY 2014 Plans:* Will develop multimodal methods to monitor, extract and disseminate information related to target's changing characteristics and the means to influence target behavior to create measurable signatures of interest. Will develop (from the hyperspectral data assessment made in FY13) more effective methods for autonomous, non-motion based, motor-vehicle tracking by fusing proven detection/classification techniques for different applications (e.g. hyperspectral target detection, speech recognition) to provide enhanced TTL standoff capabilities.	0.994	0.904	0.942
Accomplishments/Planned Programs Subtotals	2.385	2.204	2.281

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** 305: *ATR Research*

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

Remarks

D. Acquisition Strategy
   N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
31B: Infrared Optics Rsch	-	2.763	2.836	2.861	-	2.861	2.893	2.926	2.895	2.947	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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. Its 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 for 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)	FY 2012	FY 2013	FY 2014
Title: IR Focal Plane Arrays, RF Photonics, and Infrared Countermeasures	2.763	2.836	2.861

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT 31B: *Infrared Optics Rsch*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: 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. *FY 2012 Accomplishments:* Conducted laser research for IR countermeasures including detailed studies on the thermal characteristics of Midwave Infrared (MWIR) lasers for IRCM; investigated environmental effects of RF-photonic devices and reduced their vibration and temperature sensitivity for improved reliability; continue the development of nano-fabrication techniques to achieve chip-scale RF photonic devices; and investigated methodologies for quantum well infrared detector arrays to be fabricated up to 2K x 2K focal plane arrays. *FY 2013 Plans:* Advance investigations of environmental effects on RF photonic devices and reduce their vibration and temperature sensitivity for improved reliability; Experimentally validate the RF-Photonic time domain signal auto-correlation processor for signals intelligence applications; develop nano-photonic devices and nano-fabrication techniques for chip-scale opto-electronic integrated circuit devices with reduced size, weight and power, Investigate plasmonic materials, metamaterials, photonic crystals and resonating materials on the quantum efficiency of Quantum Well Infrared Photodetectors (QWIPS); extend the operating wavelength of III-V semiconductor devices, 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. Investigate possible methods of improving power output of quantum cascade lasers with potential transition to infrared countermeasures applications. *FY 2014 Plans:* Will research advanced Radio Frequency (RF)-Photonic/optical techniques to study noise generation and mitigation in RF-over fiber links to achieve ultra high resolution, wideband signal transmission. Will investigate long-wave infrared (LWIR) two-color IR detectors using combinations of bulk materials and artificially layered structures, taking advantage of low cost materials and novel insights in materials properties. Will establish a 3-dimensional, finite element electromagnetic model to calculate Quantum Efficiency (QE) for any infrared detector structures. Will design novel semiconductor metastructure photonic devices to provide the basic building blocks for future chip scale processing. Will investigate frontier optical effects to design high QE detectors. Will improve power output of quantum cascade lasers.			
Accomplishments/Planned Programs Subtotals	2.763	2.836	2.861

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
52C: *Mapping & Remote Sens*	-	2.878	2.233	2.259	-	2.259	2.288	2.312	2.344	2.386	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Sensor Phenomenology and Spatial-Temporal Pattern Discovery	2.878	2.233	2.259
Description: Funding provided for the following research.			
FY 2012 Accomplishments: Investigated the effects of underground anomalies on the spectral properties of surface vegetation; created a specific mathematical boundary for determining if a trajectory is an outlier.			
FY 2013 Plans:			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** 52C: *Mapping & Remote Sens*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Investigate a multi-parameter soil metabolic index to understand environmental impacts on emerging biological sensing; construct primitives to aid in efficiently solving concurrent complex queries in hierarchically represented spatial-temporal data; validate new infrasound signal propagation models against collected data applicable to remote assessment of hostile activity. ***FY 2014 Plans:*** Will investigate and define the concepts of neighborhood and scale for human terrain parameters, and examine clustering and topology in human terrain neighborhoods to understand how human terrain events propagate through Euclidean and social network space; investigate methodologies for transforming multi-dimensional spatial-temporal trajectory data into linear representation for discovering patterns and hierarchical structure; investigate approaches to estimating terrain physical properties from proprioceptive sensor data.			
Accomplishments/Planned Programs Subtotals	2.878	2.233	2.259

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

D. Acquisition Strategy
   N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army								DATE: April 2013			

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
53A: *Battlefield Env & Sig*	-	3.412	3.534	3.572	-	3.572	3.621	3.583	3.642	3.708	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 understand, characterize, and depict 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 ability to provide predictable, actionable, accurate and timely tactical environmental intelligence to battlefield commanders and small Soldier units. 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 and the interaction between aerosols and meteorological processes for Soldier health initiatives ,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-magnetic spectrum, and formulation of objective analysis tools that can assimilate on-scene all-source weather observations, atmospheric composition, and fuse this information with forecasts to provide immediate Nowcast products and actionable information. 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)	FY 2012	FY 2013	FY 2014
Title: Research in optical and acoustical propagation in the atmosphere	2.023	2.090	2.113
Description: 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.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Characterized atmospheric propagation effects on emerging technologies including Terahertz spectroscopy and imaging systems; Performed investigations and analyses of environmental impacts on thermal and infrared polarimetric images; Investigated the use of high resolution, multi-spectra, Light Detection And Ranging techniques for the detection of atmospheric aerosols and trace gases; Investigated the effects of ozone and other atmospheric constituents on the fluorescence spectra and other properties of bioaerosols; Measured fluorescence and absorption cross sections of aerosolized bio-warfare simulants/agents using laser-induced fluorescence and photoacoustic spectroscopy; Investigated the use of active wind screens for infrasound sensors to reduce sensor footprint on the ground; Investigated whether the influence of acoustic waves on the ionosphere can be used for the detection of anomalous events. *FY 2013 Plans:* 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; 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; 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; perform multidisciplinary theoretical investigations for the remote sensing of precursors to atmospheric events affecting Army Operations to enhance force protection; 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. 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; 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. *FY 2014 Plans:* Will investigate and model atmospheric water vapor impacts on Terahertz band communications propagation statistics for digital link quality for AMRDEC covert local wireless communications technology applications. Will measure and model optical turbulence to improve the prediction of strong turbulence effects on high energy laser propagation in complex terrain.			
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 2012 Accomplishments:*	1.389	1.444	1.459

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Verified and validated the 3D Atmospheric Boundary Layer Environment (ABLE) model against well established measured and modeled data from complex and urban domain; investigated modeling techniques deriving probabilistic weather impacts forecasts for future decision support tools; and developed new approaches to adverse weather route optimization algorithms for air and ground applications. *FY 2013 Plans:* Enhance the 3D ABLE model's 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; 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; 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. *FY 2014 Plans:* Will formulate and evaluate numerical methods to improve ABLE model performance for Army decision aid applications. Will investigate biologically-inspired fast patterned responses to control surface wind flow changes to more effectively predict and mitigate boundary layer wind gust effects on micro air vehicle hover and stability. Will investigate and develop an experimental hybrid data assimilation approach to improve fine-scale weather forecast performance.			
Accomplishments/Planned Programs Subtotals	3.412	3.534	3.572

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
74A: *Human Engineering*	-	7.886	8.265	8.413	-	8.413	8.642	8.816	8.880	9.040	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 for 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), Human Research and Engineering Directorate, Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Research to characterize and enhance Soldier performance	1.921	2.022	2.025

UNCLASSIFIED

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Description: Characterize and enhance human auditory performance of the dismounted warrior in complex environments while protecting the hearing of the Soldier. *FY 2012 Accomplishments:* Determined the effects of ear coverage, from wearing infantry helmets, on auditory localization for modeling of Soldier mission performance. *FY 2013 Plans:* Investigate the sound characteristics of weapon firing signatures to enable Soldiers' future ability to identify the specific weapons being fired and location of attack. *FY 2014 Plans:* Will quantify the effects of compression type on relative distance perception when wearing tactical communication and protection systems (TCAPS).			
Title: Soldier performance	2.175	2.570	2.656
Description: 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. *FY 2012 Accomplishments:* 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). *FY 2013 Plans:* 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 "conceptual navigation", development of a genericlong-term memory capability to store collections of environmental data sets, and advances in object recognition and tracking; switch focus of research on the correlation of electroencephalograph data with response times to decision making studies which will further the validation of higher-level components of the Adaptive Control of Thought-Rational (ACT-R) cognitive modeling system. *FY 2014 Plans:*			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Will enhance object recognition of places and objects for the Symbolic and Sub-symbolic Robotics Intelligence Control System project by integrating multiple independent cues for perpetual processing to include contextual processing, depth processing, and color processing; will perform Engineering evaluation tests of key autonomous robotic functions for indoor navigation and recon such as navigation, object recognition, short- and long-term memory, and understanding and acting on verbal operator commands through natural language processing. Will expand the project on temporal network dynamics for the social-cognitive network science initiative by identifying specific behaviors of complex dynamical systems (i.e., networks) and by implementing techniques for capturing those behaviors using an enhanced version of the computer model C3TRACE, which will then allow us to develop a			
Title: Translational Neuroscience *Description:* Integrating neuroscience with traditional approaches to understanding Soldier behavior to enable systems designs that maximize Soldier performance. Formerly titled Research in Neuroergonomics. *FY 2012 Accomplishments:* Investigated closed loop interaction between emotional/fatigue state monitors and computer systems that adapt to the emotion/ fatigue state of the user; developed normative models that account for the variability in individual differences on performance; explored functional connectivity of multivariate datasets for assessment of performance measures; investigated predictive metrics for neural processing and/or cognitive performance that are linked to particular cognitive differences among individuals. *FY 2013 Plans:* Investigate sensory and motor neural processes with respect to effect on Soldier-systems within dynamic environments; examine validation techniques for measures of task performance in operational environments to develop future Soldier metrics; evaluate efficacy of predictive metrics for neural processing and/or cognitive performance among individuals for quantifying cognitive loads. *FY 2014 Plans:* Will enhance neuroimaging technologies for increased resolution, greater wearability by Soldiers, and enhanced interpretability of neural signatures in realistic environments; Will investigate the relationships between neuromodulators, brain electrical activity, and behavior for improved understanding of Soldier neurocognitive function.	3.020	2.412	2.459
Title: Cognition and Neuroergonomics *Description:* 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. *FY 2012 Accomplishments:* Investigated closed loop interaction between emotional/fatigue state monitors and computer systems that adapt to the emotion/ fatigue state of the user; developed normative models that account for the variability in individual differences on performance;	0.770	1.261	1.273

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
explored functional connectivity of multivariate datasets for assessment of performance measures; and investigated predictive metrics for neural processing and/or cognitive performance that are linked to particular cognitive differences among individuals.			
FY 2013 Plans: Explore neural representations and develop novel measures for assessing individual differences in decision making, cognitive performance, and/or anatomical structure; explore network connectivity measures and patterns in both model simulations and empirical datasets.			
FY 2014 Plans: Will investigate sensitivity of identified individual difference measures to variability in performance across individuals, tasks, and cognitive states; will evaluate predictive capability of structural networks and/or functional processing for individualized performance assessment.			
Accomplishments/Planned Programs Subtotals	7.886	8.265	8.413

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
74F: *Pers Perf & Training*	-	5.560	7.094	5.719	-	5.719	5.838	5.958	6.083	6.219	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Human Behavior	4.086	5.024	3.909
Description: Funding is provided to better select, classify, train, and/or develop Soldiers and leaders.			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** 74F: *Pers Perf & Training*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
FY 2012 Accomplishments: Conducted research in the areas of the leadership and team performance in complex environments; analyze the impact of training methods on learner performance; investigated how a neurophysiologic state (i.e., affect) influences perception; identified cognitive strategies of experts that can be used to develop efficient training protocols. *FY 2013 Plans:* Developing data-driven models to assess the impact of training methods on task performance; identifying approaches to enhance experiential learning for guided self-development; and investigating tacit acquisition of cultural knowledge. *FY 2014 Plans:* Will investigate factors influencing on-the-job learning; will identify predictors of leader development and retention; and will identify contextual facets that influence decision making.			
Title: Network-Human Science *Description:* Funding is provided for better understanding individual, unit, and organizational behavior within the context of complex networked environments. *FY 2012 Accomplishments:* Conducted research to understand organizational dynamics and unit cohesion; conducted research on how language usage influences social dynamics; and analyzed the influences of human performance in complex networked environments. *FY 2013 Plans:* Investigating organizational leadership as transmitted through social network links; developing models of unit cohesion within multi-level organizational units. *FY 2014 Plans:* Will conduct research to understand social and organizational network variables that affect contextual control; will develop real-time assessment and feedback mechanisms to shape group relationships.	1.474	2.070	1.810
Accomplishments/Planned Programs Subtotals	5.560	7.094	5.719

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

Remarks

D. Acquisition Strategy
  N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

E. Performance Metrics

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army											**DATE:** April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013**#	**FY 2014 Base**	**FY 2014 OCO** ##	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
F20: *Adv Propulsion Rsch*	-	3.940	4.211	4.256	-	4.256	4.307	4.283	4.357	4.435	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 for 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 Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Title: Thermal Materials	2.418	2.495	2.522
Description: Investigate new materials needed to withstand the higher temperature regimen of advanced high performance engines, and evaluate 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. *FY 2012 Accomplishments:*			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** F20: *Adv Propulsion Rsch*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Investigated 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 investigated the design of more fuel efficient propulsion systems. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will investigate surface engineering techniques to reduce engine and transmission friction losses to improve vehicle fuel economy, reduce maintenance cost, and reduce logistic burden; and will establish the capabilities to assess high temperature materials and components for next-generation Army wheeled tactical and combat vehicle power train concepts.			
Title: Reliable Small Engines for Unmanned Systems *Description:* Develop 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. *FY 2012 Accomplishments:* Evaluated the performance of a representative Army unmanned vehicle engines at simulated altitude conditions. *FY 2013 Plans:* Establish the capability to experimentally evaluate advanced heavy fuel injection spray characteristics under simulated engine conditions to optimize combustion performance in future engine concepts. *FY 2014 Plans:* Using the capabilities established in FY13, will evaluate advanced heavy fuel injection spray characteristics under simulated engine conditions to optimize combustion performance and using modeling and simulation coupled with experimentation will assess unmanned vehicle engines fueled with JP-8 and other heavy fuels. Will evaluate the performance of Army unmanned vehicle engines and small heavy fuel injectors to enable heavy fuel operability and to optimize performance and efficiency	1.522	1.716	1.734
Accomplishments/Planned Programs Subtotals	3.940	4.211	4.256

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

Remarks

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

D. Acquisition Strategy

   N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army										DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
F22: *Rsch In Veh Mobility*	-	0.577	0.606	0.612	-	0.612	0.621	0.630	0.642	0.654	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, vehicle-terrain interaction and advanced track and suspension concepts. Advanced propulsion research will dramatically improve power density, performance and thermal efficiency for advanced 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 mobility concepts. 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 unique mobility approaches, 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)	FY 2012	FY 2013	FY 2014
Title: Advanced Mathematical Algorithms for Improved Vehicle Efficiency	0.577	0.606	0.612
Description: Funding is provided for the following effort:			
FY 2012 Accomplishments: Expanded JP-8 ignition models to include wide varying ignition quality fuels; explored and developed robust multidisciplinary design optimization techniques with advanced materials for reducing ground vehicle weight while improving or maintaining ground vehicle mobility, reliability and survivability.			
FY 2013 Plans: Research ignition under high pressure injection conditions, and analyze heat release data for synthetic JP-8 fuel; research importance sampling techniques for accelerated testing for reliability quantification under stochastic input conditions; explore quantification of model uncertainty with enhanced identification ability; and research mobility models for small robot terra-mechanics, i.e. the interaction of wheeled or tracked vehicles on various surfaces.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** F22: *Rsch In Veh Mobility*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Research ignition under high-pressure injection conditions, and analyze heat release data for new fuels; research new analytical tools for characterizing vehicle duty cycles and physics-based vehicle and powertrain dynamics,; explore power available for mobility; and research mobility for small platforms (i.e. the interaction of wheeled or tracked vehicles on various surfaces).			
Accomplishments/Planned Programs Subtotals	0.577	0.606	0.612

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

D. Acquisition Strategy
 N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H42: *Materials & Mechanics*	-	8.262	8.644	8.907	-	8.907	8.998	9.053	9.208	9.374	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 for 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)	FY 2012	FY 2013	FY 2014
Title: Microscopic/Nanostructural Materials	2.386	2.571	2.615
Description: Devise new materials and design capabilities, based upon fundamental concepts derived at the microscopic and nano-structural levels, for the future force.			
FY 2012 Accomplishments: Provided a theoretical basis for the selection of kinetically stabilizing alloying elements in nanocrystalline materials; and proved grain size stabilization in nanocrystalline metallic systems by experimental methods for better performing ceramic armor materials.			
FY 2013 Plans:			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** H42: *Materials & Mechanics*	

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Research novel composite materials that demonstrate self-healing capability using bio-engineered concepts emerging basic research; and advance the principles of inverse materials design and apply to emerging material models for future armor designs. *FY 2014 Plans:* Will develop mathematical descriptions of full non-linear and transient coupling in armor grade piezoelectric ceramics for novel protection; report on the full-field penetration response of ultra high molecular weight polyethylene (UHMWPE) fabric and fabric systems for application to soldier protection; establish patterned thin film techniques to fabricate a metamaterial lens for corrosion detection under dielectric and paint coatings with high sensitivity; for composite armors, improve adhesion bioinspired polymer adhesives.			
Title: High Deformation Rate Materials *Description:* Develop fundamental understanding necessary to design, process and characterize materials specifically intended for high loading rate applications. *FY 2012 Accomplishments:* Modeled and experimentally determined property relationships in piezoelectric materials; and described the chemical state of emerging high rate materials with a view toward optimizing materials properties for ballistic environments. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will investigate first-principles modeling and simulation of clean and doped grain boundaries in boron-based armor ceramics; design novel, thermodynamically stable nanocrystalline alloys for shaped charge liners; determine the importance of composition and microstructure on rate dependent properties of epoxy resins; complete an initial 3D microstructural model of lightweight magnesium or aluminum alloys.	2.413	3.009	3.113
Title: Materials Research and Processing at Small Scale *Description:* 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. *FY 2012 Accomplishments:*	3.463	3.064	3.179

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Developed tools for the characterization of hierarchically structured materials for an understanding of the synthesis and mechanics of bio-inspired materials; and determined quantum effects on materials design to enable unprecedented performance improvements in materials properties. ***FY 2013 Plans:*** Develop novel polymeric materials which are thermally and chemically stable under extreme operating conditions; investigate and develop modeling and simulation methods specifically designed for materials used in extreme dynamic environments. ***FY 2014 Plans:*** Will validate new multi-axial mechanical characterization methods and apply to conventional and novel ballistic fibers to elucidate the effect of nanostructure; develop in-situ capabilities for electron microscopy to elucidate the mechanical response of soft tissue and polymer gels; characterize the water transport properties of polymer electrolyte materials.			
Accomplishments/Planned Programs Subtotals	8.262	8.644	8.907

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

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 2014 Army | **DATE:** April 2013

| 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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H43: *Research In Ballistics*	-	8.867	9.103	9.383	-	9.383	9.546	9.607	9.769	9.945	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 for 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)	FY 2012	FY 2013	FY 2014
Title: National Advanced Energetics Initiative	2.890	2.913	3.011

Description: 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.

FY 2012 Accomplishments:
Investigated rapid energy release from new classes of materials subjected to extreme physical constraints and characterized through high performance computer models and experiments.

FY 2013 Plans:

PE 0601102A: *DEFENSE RESEARCH SCIENCES*
Army

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Extend quantum mechanical based models to enable prediction of key performance and vulnerability properties; determine feasibility of nontraditional energetic materials containing stored structural energy (e.g. extended solids), and identify factors influencing stabilization for designing future disruptive energetic materials. *FY 2014 Plans:* Will synthesize and fabricate gram quantities of disruptive energetic materials that have two-fold energy content compared to conventional explosives. Will develop reactive variants of the dissipative particle dynamics method with multi-step chemical reactions and perform simulations of multi-scale coarse grain models to determine pressure dependent stress-strain behavior for input into plasticity model. Will refine and validate FY12 model via comparison with nano-indentation experiments.			
Title: Launch and flight of gun launched projectiles as well as missiles *Description:* 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. *FY 2012 Accomplishments:* Explored non-linear aerodynamics of complex shapes to advance next generation extended range precision munitions; Investigated nontraditional modeling techniques for using on-board projectile flight information to enable affordable non-GPS guidance; and performed 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. *FY 2013 Plans:* 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; characterize theoretically and experimentally coupled GPS and navigation concepts for the next generation of highly dynamic, spinning projectiles; investigate the fundamental mechanical interaction of human brain tissue with shock waves that occur during ballistic events. *FY 2014 Plans:* Will continue to develop first principles state-of-the-art computational aerodynamics techniques using coupled computational fluid dynamics (CFD), rigid body dynamics (RBD) and flight control systems (FCS) to exploit novel flow physics and enable a magnitude maneuverability increase for next generation, low cost, hyper-accurate munitions. Will add structural dynamics model to simulate guided maneuvers and unsteady effects and then compute a coupled calculation of a canard-controlled finned projectile using a skid-to-turn maneuver, compute and validate a roll maneuver with dynamic wind tunnel data, and simulate uncontrolled and controlled trajectories of a long flexible finned body.	2.429	1.732	1.768
Title: Extramural research in non-lethal (NL) control methods	0.976	1.262	1.275

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013		
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 2012**	**FY 2013**	**FY 2014**
Description: Extramural research in non-lethal (NL) control methods to exploit potentially innovative approaches that offer unique battlefield and homeland defense capabilities. *FY 2012 Accomplishments:* Focused 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; studied 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. *FY 2013 Plans:* Study the decomposition pathways of energetic materials to elucidate the molecular decomposition behavior at the individual molecule scale; 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. *FY 2014 Plans:* Will develop statistical methods to analyze spatially and temporally evolving patterns designed to provide decision makers with the capability to distill concise meaning from large quantities of experimental observations.				
Title: Armor Research *Description:* Develop fundamental knowledge of mechanisms that can be exploited to ensure the next generation of lightweight and efficient armor technologies. *FY 2012 Accomplishments:* Evaluated novel reactive armor and electromagnetic armor mechanisms to include inferring real-time geometry of penetration into thick armor sections induced with electromechnical stresses. *FY 2013 Plans:* Develop the capability to measure electromechnical 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; develop fundamental underpinnings of the electrical conductivity within the shock cone that forms around hypervelocity penetrators. *FY 2014 Plans:*		2.572	3.196	3.329

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Will develop a model for thermo-physical properties of plasmas and explore advanced electro-magnetic effects using hydrocodes and experimentation to better understand conductivity and fields in order to optimize electromagnetic armors. Will advance computational models by exploring dynamic effects in 3D. Will study the physics of using electromagnetic fields to enhance the detonation of energetic materials to include designing a new diagnostic tool to study the detonation zone.			
Accomplishments/Planned Programs Subtotals	8.867	9.103	9.383

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

Remarks

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013	

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	PROJECT
2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	PE 0601102A: *DEFENSE RESEARCH SCIENCES*	H44: *Adv Sensors Research*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013[#]	FY 2014 Base	FY 2014 OCO [##]	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H44: *Adv Sensors Research*	-	9.778	10.219	10.347	-	10.347	10.658	10.943	11.127	11.327	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
[##] The FY 2014 OCO Request will be submitted at a later date

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 for 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.

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Title: Adaptive, Active, and Intelligent Optical Systems	1.700	1.833	1.860
Description: Adaptive, active, and intelligent optical systems for high-data-rate military communications and directed energy applications. *FY 2012 Accomplishments:* Developed image processing software that includes super resolution, fusion, and adaptive optics for application to enhance laser communication technologies and validated image processing software in realistic battlefield conditions to improve real-time situational awareness through greater fidelity of battlefield imagery. *FY 2013 Plans:* 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. Develop novel processing techniques to extend the use of quantum imaging to tactical environments in order to improve battlefield communications. *FY 2014 Plans:* Will develop application of advanced Army battle-space tactical, short-haul, and long-range atmospheric laser ultraviolet/ light-emitting diode/radio frequency (/UV/LED/RF) communication and imaging technologies to achieve high bandwidth communication, high fidelity visualization, and allow utilization of advanced command and control techniques; including improving comprehensive link modeling and prediction of ultraviolet communication (UVC) and visible light communication (VLC), including atmospheric propagation, source and detection technology, and modulation and coding strategies. Will investigate advanced Army battle-space tactical and long-range atmospheric laser communication and imaging technologies to achieve high bandwidth communication, high fidelity visualization. Will investigate and develop novel quantum physics and coupled processing techniques to provide tactically superior quantum imaging and battlefield communications particularly in obscured, obstructed, or adverse tactical environments			
Title: Improving Sensor and Display Capabilities	2.632	2.775	2.817
Description: 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. *FY 2012 Accomplishments:* Fabricated and investigated metamaterial inspired antennas based on theoretical simulations; developed, applied and validated 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; researched phenomenology of features associated with sensing human motion and concepts for fusion of new features to reduce false alarms; optimized conductive			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
organic materials and high stability Organic Light Emitting Diodes (OLEDs) for transition into OLED displays to include developing thin-film transistors and transparent electrodes for flexible electronics applications. *FY 2013 Plans:* Develop sensor fusion algorithms to enable the aggregation of data features into information within the context of Data-to-decision (D2D). Develop theoretical understanding of metaferrites (using analytical and computer simulations) as an enabling technology for low-profile and embedded antenna enhancements. Analyze and develop algorithms to exploit co-registered video and radar imagery to enhance detection of landmines and IEDs with reduced false alarms. Enhance acoustic sensor and array performance through wind mitigation and adaptive algorithms for improved event classification. Evaluate conductive organic materials and high stability OLEDs for transition into OLED displays and emerging sensor applications. Develop 1/f noise resistant magnetic sensors to improve signal-to-noise ratio (SNR) and detection range for counter IED technologies. *FY 2014 Plans:* Will develop time-domain acoustic models that incorporate ground impedance and atmospheric effects to create synthetic sensor waveform data in various environments for training and evaluating acoustic classification algorithms. Will investigate utilization of spin-torque-oscillators for reading non-erasable magnetic memory. Develop algorithms and software for modeling non-linear signature response of RF devices in complex urban environments. Will perform theoretical and experimental analysis on metamaterials with randomly oriented unit cells and investigate the viability of their use in RF lens structures (e.g., a Rotman lens). Research organic devices and materials and diodes for large-area radiation and particle sensors utilizing charge-transfer electro-chemical designs.			
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 2012 Accomplishments:* Investigated methods to redesign cellular proteins to converge the signaling from different cellular receptors to a common output signal suitable for electronic device detection; manipulated bio-assembled electronic structures by controlled deposition of infrared (IR) sensitive materials and characterized the resulting complexes; completed characterization of 2-D assembly of nucleic acid templates in non-aqueous solvents for patterning of semiconductor seed particles for IR and photovoltaic devices; continued 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:* Evaluate biofilm contaminate-sensing genetic constructs against actual logistics fluid specimens for both JP-8 and potable water; manipulate bio-assembled electronic structures by controlled deposition of infrared (IR) sensitive materials and characterize	2.999	3.068	3.113

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
the resulting complexes; transition to larger 2-D assemblies appropriate for traditional electronic manufacturing; and analyze engineered strains against models for generation of organic fuels to evaluate information collected from systems biology approaches. Investigate the improvement of advanced modeling techniques through the use of an iterative approach of multi-scale modeling and increased biological characterization. Examine genotype to phenotype relationship of laboratory bacterial cultures to determine a means for identification. *FY 2014 Plans:* Will use synthetic biology building off of previous genetic sensing constructs, to engineer sense and respond module for neutralizing biological contamination; will develop 2nd generation peptide recognition elements using iterative process involving computational modeling coupled with experimental characterization for materials that perform in extreme environments; will use synthetic microbiology to engineer second generation strains for production commodity chemicals based upon predictions made in FY13; will use biological characterization data generated in FY13 to refine advanced modeling techniques of multi-scale modeling for prediction of improved biological interactions.			
Title: Multi-Scale Modeling for Novel Materials *Description:* Explore and develop multiscale modeling techniques to support fundamental studies of electronic and structural materials properties from the atomistic to the continuum. Resulting models are needed to design/ develop materials for more efficient, longer lifetime sensors and power and energy devices, and lighter materials for vehicle and soldier protection.. *FY 2012 Accomplishments:* Performed 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. Developed interface physics between nano- and meso-scales up to the continuum; expanded upon and created new multi-scale experimental techniques and characterization methods to probe materials nano- and microstructure, including defects and at interfaces, and response under extreme conditions; developed web-based security scheme for external and internal project users; developed multi-scale computational science environment to facilitate coupling of different software; established methods to support high performance computing users and software developers. *FY 2013 Plans:* Conduct fundamental studies of materials to identify and model physics and atomic interactions that define their electronic and optical properties and characteristics. Evolve 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. Evolve web-based security schemes for external and internal project users to foster multi-disciplinary collaboration; examine multi-scale computational science	2.447	2.543	2.557

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
environment to facilitate coupling of different software programs/algorithms; advance methods to support high performance computing users and software developers.			
FY 2014 Plans: Will Perform fundamental studies to identify and model physics and atomic interactions that define their structural, mechanical, electronic, and optical properties and characteristics and control material deformation, progressive / catastrophic failure, and phase response across length scales. Will establish fundamental underpinnings of physics between nano- and meso-scales up to the continuum. Will create new multi-scale experimental techniques and characterization methods to probe materials microstructure, including defects and interfaces, and response under extreme conditions. Will develop advanced computational models for multiscale modeling of electrochemical systems. Will investigate and develop scalable interdisciplinary data models to address spatial one-way coupling of software on massively parallel petaflop systems, and multi-core computing systems. Will create and disseminate web-based security schemes for external and internal project users to foster multi-disciplinary collaboration; conduct research in multi-scale computational sciences and couple different modeling paradigms at the algorithm level; advance methods to support high performance computing users and software developers.			
Accomplishments/Planned Programs Subtotals	9.778	10.219	10.347

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** H45: *Air Mobility*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H45: *Air Mobility*	-	2.393	2.515	2.552	-	2.552	2.588	2.625	2.671	2.719	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 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 Research, Development and Engineering Center, Aero-Flight Dynamics Directorate at NASA Ames Research Center, CA and Langley Research Center, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Rotary Wing Aerodynamics	2.393	2.515	2.552
Description: Funding is provided for the following effort			
FY 2012 Accomplishments: Assessed facility effects on existing highest-quality single-rotor hover data; investigated natural laminar flow wings for improved rotorcraft performance; and explored high performance computing methodology for difficult rotorcraft phenomenon.			
FY 2013 Plans: Experimentally investigate detailed helicopter wake structure for the existence of worm-like fluid phenomena seen in computational fluid dynamics (CFD) calculations; analytically/numerically investigate the oscillation encountered in CFD prediction			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
for hover performance; and assess the importance of the fuselage impedance on rotor blade structural loads and helicopter vibration. *FY 2014 Plans:* Will continue computational aero-science investigations using numerical methods including work on validation and development testing the physical assumptions forming the building blocks of the underlying theory. Will continue fundamental experiments aimed at the underlying physics of rotor downwash flow fields and rotorcraft testing techniques such as pressure sensitive paint.			
Accomplishments/Planned Programs Subtotals	2.393	2.515	2.552

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013	

APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H47: *Applied Physics Rsch*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013[#]	FY 2014 Base	FY 2014 OCO [##]	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H47: *Applied Physics Rsch*	-	4.977	5.222	5.270	-	5.270	5.535	5.980	6.001	6.109	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

[##] The FY 2014 OCO Request will be submitted at a later date

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 (ARDEC); the Communications-Electronics Research, Development, and Engineering Center (CERDEC); and the Natick Soldier Research, Development, and Engineering Center (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)	FY 2012	FY 2013	FY 2014
Title: Nanoelectronic Devices and Sensors	3.018	3.188	3.235
Description: 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			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** H47: *Applied Physics Rsch*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
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. *FY 2012 Accomplishments:* Studied the coherence properties of a split cold atom cloud in an atom chip waveguide; investigated energetic energy conversion methods for on-chip pulsed power; examined existing models for graphene materials growth for potential use in nanoelectronic devices; investigated next generation wide band gap power device materials such as Aluminum Nitride (AlN) and diamond, conducted modeling of electron transport in alkaline membrane electrode assemblies, and modeled physical properties of Silicon (Si) anodes for Lithium ion batteries and the structure property relationships of Si anodes. *FY 2013 Plans:* 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. Examine large area growth, material transfer, and substrate interactions of carbon based nanoelectronics for increased capabilities and reduced power consumption of battlefield electronics ; investigate 3-dimensional growth and patterning of piezoelectric materials for low power large displacement MEMS actuators; investigate methods and formulations for detonation using on-chip energetic materials; investigate, emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, diamond) for energy storage electrodes, thin films, and energy conversion applications. Characterize interference fringes using cold atoms on an atom chip; Investigate Gallium Nitride/Aluminium Galium Nitride (GaN/AlGaN) and other wide-bandgap materials and device structure characteristics under high power conditions for improved electrical efficiency and associated thermal management. *FY 2014 Plans:* Will study decoherence mechanisms and optical Raman techniques to coherently control cold atoms and atomic spin to improve the sensitivity of a chip-scale atom interferometer for inertial navigation in GPS denied environments. Will investigate and evaluate actuator designs using piezoelectric actuators using 3-dimensional growth and patterning techniques. Will investigate modes of propagation for on-chip energetic materials and determining factors that influence reaction rate. Will develop novel 2-Dimensional material growth, characterization, transfer and processing tech, and will conduct experiments to achieve electronic device quality materials for nanoelectronics and supercapacitors. Will investigate solid electrolyte interphase (SEI) formation on Si anodes for Li ion batteries, Will investigate GaN for high power conditions by improving breakdown voltage and crystalline via reduced contaminants with improved electrical efficiency and associated thermal management. Investigate materials structures for catalyst activities for energy conversion.			
Title: Advanced Energy Science Research	1.959	2.034	2.035
Description: 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.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Conducted research to design, fabricate and characterize materials properties in coordination with planned modeling and theoretical computations for energy storage and conversion materials; conducted research in developing computational tools in multi-scale modeling supporting electrochemical energy materials development; designed and experimented with novel energy harvesting (light, heat, vibration, isotope, biological energy, sources) methods; investigated emerging nanostructured materials (carbon nanotube, graphene, silicon carbide, and diamond) for energy storage electrodes, thin films, and energy conversion applications. *FY 2013 Plans:* Conduct research on the design, fabrication and characterization of material properties in coordination with modeling and theoretical computations for energy storage and conversion materials; Investigate methods for developing multi scale computational and simulation tools supporting the development of materials for electrochemical energy conversion and generation; 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. Investigate advanced device architectures for thermoelectric and photovoltaic devices for increased energy conversion efficiency. *FY 2014 Plans:* Will investigate wide bandgap semiconductor materials for direct photoelectrochemical production of hydrogen gas for use as fuel. Research novel device archetectures for solar energy conversion.			
Accomplishments/Planned Programs Subtotals	4.977	5.222	5.270

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H48: *Battlespace Info & Comm Rsc*	-	15.399	21.519	21.557	-	21.557	22.177	22.446	22.752	23.180	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

Note
  Not applicable to this item

A. Mission Description and Budget Item Justification

This project supports basic research to enable intelligent and survivable command and control, communication, computing, and intelligence (C4I) systems for the future force. As the combat force structure 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.

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)

	FY 2012	FY 2013	FY 2014
Title: Communication for Tactical Networks	1.706	1.810	1.820
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.			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
FY 2012 Accomplishments: Developed techniques to characterize the quality of information and developed an understanding and potential metrics for impact on network behavior. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will develop a formal framework for modeling quality of information. This will enhance the communications capabilities of the Soldier by delivering more relevant information thereby enhancing decision making. Investigate non-traditional communication techniques (optical & ultra-violet (UV)) which will provide connectivity in RF-challenged environments. Will establish fundamental limits, and develop techniques and algorithms for unicast and multicast communications over hybrid networks (comprising fixed infrastructure and mobile ad hoc networks).			
Title: Data to Knowledge to Support Decision Making *Description:* 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. *FY 2012 Accomplishments:* Extended scene recognition to scene understanding algorithms, assessing them and their associated machine learning approaches on collaborating mobile platforms. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will investigate algorithms and techniques (in-house, academia, and industry) for exploiting context and value of information from unstructured full motion imagery and text including the leveraging of industry investment in graphic processing units (GPU) and cluster-based computing architectures. Will investigate adaptive data collection on collaborating mobile platforms in relevant environments. These efforts will improve current decision making capabilities.	1.469	2.632	2.653
Title: Information Protection for Mobile Ad-Hoc Networks (MANET)s	1.724	4.953	4.998

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Description: 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. *FY 2012 Accomplishments:* Investigated and developed techniques for securing information flows in mobile wireless tactical environments. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will enhance security techniques and algorithms to decrease detection time and ensure information protection while maintaining suitability for operation in both tactical mobile and hybrid networking environments. These methods will improve the capability of Soldiers to detect and defeat malicious activities of adversaries on mobile tactical networks.			
Title: Multi-Lingual Computing Research *Description:* Establishes formal methods for bridging language barriers in tactical environments, incorporating state of the art techniques in machine translation and natural language processing. *FY 2012 Accomplishments:* Formalized techniques for adapting data flows to increase the effectiveness of multi-engine translation techniques; and developed methods to support decision making from machine translated segments. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will investigate use of extracted information from machine translated text in constructing task-based metrics and predictive models of machine translation quality for low resource languages and domains. This will enable situation awareness when information sources are multi-lingual in nature.	1.082	1.163	1.169
Title: Network Science for MANETs and Tactical Communications	0.968	1.022	1.027

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: 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. *FY 2012 Accomplishments:* Developed algorithms for the analysis of complicated large-scale network structures. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will develop methodologies, techniques and algorithms for the analysis of realistic finite networks (finite size, finite spatial extent). This will lead to insights for the design and provisioning of tactical mobile ad hoc networks to improve network performance. Develop mathematical models of dynamic networks that will enable the representation of group interactions, the analysis of the behaviors of such networks, and the characterization of the fundamental limits on information flow within such networks.			
Title: Advanced Computing *Description:* Investigate computing and networking architectures, algorithms, as well as visualization for advanced battle command applications of C4I system. *FY 2012 Accomplishments:* Validated 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; developed new methods for battle command information visualization; investigated scalable programming models and battle command applications for the next generation Intel high performance computing architectures, namely, cloud on a chip, and secure enclaves. *FY 2013 Plans:* 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. *FY 2014 Plans:*	3.652	3.563	3.756

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Will explore uncertainty quantification based mathematical approaches to assist the verification and validation methodologies. Closely work with CERDEC and ATEC in formulating the rudimentary scenarios for this verification and validation process. Will perform verification and validation of scalable programming models and software developed for tactical computing concept. These results will contribute to the development of new tools for the Soldier.			
Title: Network Science Technology Experimental Center *Description:* Supports in-house Network Science studies in conjunction with the Network Sciences CTA (0601104A/Project H50). *FY 2012 Accomplishments:* Expanded capabilities toward extensive integration of wireless communications emulation with academic and industrial experimental facilities developed under the Network Sciences CTA; Initiated a comprehensive program of multi-disciplinary experiments with wireless emulation utilized as hardware in the loop; documented 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; researched social network analysis metrics and techniques for integrating these with traditional communications and information network analysis methods. *FY 2013 Plans:* Develop and validate approaches and techniques to characterize, assess, model, and predict the performance of a notional composite network. 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. *FY 2014 Plans:* Will expand the wireless emulation capabilities to include the interactions among communication, social, & information networks. Continue to develop techniques for modeling the performance of hybrid (wired & wireless) networks. These efforts will enable improved understanding of tactical network behaviors and improved network designs enabling Soldiers to communicate more efficiently. Will design, develop, analyze and validate composite trust management techniques and metrics that consider the interactions between social, information and communication networks. These techniques will enable secure information flows and decision making in tactical coalition networks and enhance mission command.	4.798	6.376	6.134
Accomplishments/Planned Programs Subtotals	15.399	21.519	21.557

C. Other Program Funding Summary ($ in Millions)

  N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H52: *Equip For The Soldier*	-	1.096	1.135	1.146	-	1.146	1.157	1.172	1.189	1.210	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Equipment for the Soldier	1.096	1.135	1.146
Description: 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. *FY 2012 Accomplishments:* Investigated the aerodynamics and structural behavior of permeable structures under dynamic loads; explored the cognitive behavior of non-spatial influences on navigation through complex environments; and performed fundamental biomechanical research on exoskeleton design and human sciences towards optimization of user performance. *FY 2013 Plans:* Explore different methods to extract a concise feature vector to describe the shape of the human body: implement computational algorithms to extract the shape- vectors of three-dimensional (3D) scans from the US Army and Marine Corps 3D scan database;			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
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.			
FY 2014 Plans: Will explore the permeation phenomena of multilayer films leading to improved barrier properties for the myriad needs for effective polymer films; investigate the cognitive foundations of spatial navigation for route planning through complex environments; continue to explore the aerodynamics and structural behavior of permeable structures under dynamic loads for improving parachute performance.			
Accomplishments/Planned Programs Subtotals	1.096	1.135	1.146

C. Other Program Funding Summary ($ in Millions)

 N/A

Remarks

D. Acquisition Strategy

 N/A

E. Performance Metrics

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*	PROJECT H57: *Single Investigator Basic Research*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H57: *Single Investigator Basic Research*	-	76.109	78.050	80.385	-	80.385	80.047	82.675	84.357	85.875	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, countermine, compact power, and other mission-driven areas will lead to a Future Force that is more strategically deployable, more agile, more lethal, and more survivable. The breadth of this basic research program covers approximately 900 active, ongoing research grants and contracts with leading academic researchers and approximately 1,600 graduate students yearly, supporting research at nearly 250 institutions in 50 states.

The cited work is consistent with the 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 2012	FY 2013	FY 2014
Title: Basic Research in Life Sciences (formerly titled Basic research in molecular, physiological, and systems biology)	6.715	8.343	8.190
Description: Pursue 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 investigate 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			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
pursues studies in microbial physiology, ecology, and evolution, and v) social science research aims to elucidate the social, 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. *FY 2012 Accomplishments:* Efforts continued to improve Soldier protection; investigated potential mechanisms to improve Soldier cognitive and physical performance; and methods to harness biological mechanisms for energy and fuel production were explored. *FY 2013 Plans:* 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; elucidating 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 *FY 2014 Plans:* Will investigate the genetic plasticity of bacterial genomes during long-term stationary phase growth and develop an empirical understanding of the general mechanisms by which genomic (gene-based), transcriptomic (RNA-based), and proteomic (protein-based) prokaryotic features respond to alterations in the population-genetic environment, to ultimately enable accurate identification of the origin of biological threats; will investigate and characterize sensory auditory processing to determine how Soldiers can separate several streams of sounds into meaningful sequences in order to develop algorithms to augment both natural and automated hearing in noisy and confused environments; will assemble and characterize a synthetic biological receptor and signaling program within a bacterial strain capable of encapsulating itself within a natural cellulose filter, which may ultimately enable new chemical/biological detection applications; will characterize the resolution of holographic microscopy for visualizing microbes based on recent discoveries in lens-less holographic imaging, which in the long term may replace optical microscopes, enabling low-cost, rugged microscopes for field use; will design and validate robust optimal social system interventions based on a more formal understanding of feedback mechanisms with the objective of avoiding failed negotiations, socio-economic crises and societal collapse.			
Title: Basic Research in Environmental Sciences *Description:* 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	3.495	3.807	3.774

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
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. *FY 2012 Accomplishments:* Environmental sciences addressed 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 further examined the evolution of the nocturnal boundary layer structure using up to three Tethered Lift Systems with multiple, redesigned, sensor packages trailing from each; the focus was on quantifying the turbulent processes as a function of separation scales; both experimental and modeling work continued to be performed that investigated 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. *FY 2013 Plans:* Environmental sciences is developing new approaches to improve the resolution and tradeoffs in high fidelity modeling of atmospheric and terrestrial physical processes; developing 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; optimizing and enhancing the performance of the sensor modalities used in UXO, landmine, and explosive device detection as well as developing constitutive models for near-surface processes. *FY 2014 Plans:* Will pursue atmospheric examinations in the convective boundary layer using vertically pointing clear-air Doppler radars and sodars to measure mean vertical velocities; will improve estimates of soil moisture throughout the vertical soil column at the hillslope scale through a data assimilation approach that utilizes remotely sensed soil moisture information at coarse spatial resolution and combines it with a physics-based land surface process model to produce soil moisture estimates at the fine spatial scales of Army operational interest.			
Title: Basic Research in Chemical Sciences *Description:* 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	9.788	9.545	9.418

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013	
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 2012**	**FY 2013**	**FY 2014**
inorganic chemistry, which will lead to advances that provide advance warning of explosive, chemical, and biological weapons and dangerous industrial chemicals. *FY 2012 Accomplishments:* Investigated how material and morphology can effect electron transfer and electro catalysis; investigated novel approaches and designs for functionalized morphology, novel reactive monomers, and environmentally stable self-assembled materials; novel mechanophores previously integrated into composites were evaluated for responses to mechanical damage; initiated modeling and experimental studies to begin to uncover the physical properties that control chemical reactivity. *FY 2013 Plans:* 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; 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; 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. *FY 2014 Plans:* Will explore and characterize the reaction pathways for nitroaromatics and nitramines (classes of compounds that include explosives) to determine mechanisms by which these molecules undergo dissociation to initial product species, which will enable the more efficient design of future explosives or propellants that are more powerful while also safer during transport and storage; will investigate nanoscale patterning of protein-based fibers on non-biological surfaces to understand how these surface properties can be manipulated to control the structure and function of biological molecules, and will test novel single-molecule probes to investigate proteins in near-surface environments at the molecular level, for potential long-term applications in chemical and biological defense; will investigate electrochemical systems utilizing new materials with controllable structures and chemical properties that may ultimately enable lighter, more efficient batteries or fuel sources.			
Title: Basic Research in Physics *Description:* 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. *FY 2012 Accomplishments:*	10.604	12.290	12.324

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Research continued advancing transformation optics toward eventual uses in cloaking applications and omni-directional light collection; developed new ultra-cold chemistry concepts heralding novel chemical synthesis routes; explored cross-platform qubit entanglement and evaluated potential applications in quantum entanglement-enhanced metrology and stealth imaging; assessed and improved theories to better understand and control defects in complex oxides, especially at interfaces. *FY 2013 Plans:* Investigate quantum optics of metamaterials including exploration of fundamentally new quantum effects including the photon spin and the interaction with negative index materials; explore the control of light filaments and long distance propagation; continuing attempts to demonstrate a 25 atto-second laser pulse; will begin studies of high intensity laser light; design and test alternative cooling techniques for use on molecules not amenable to traditional laser-cooling approaches; investigate protected states of matter in condensed matter as well as atomic and molecular systems; investigate non-equilibrium states in ultra-cold atomic optical lattices; implementing and characterizing multi-qubit states; seeking methodology for the rational design of novel quantum many-body states in complex oxide heterostructures; identifying the defect tolerance in a series of complex oxides; perform in-situ chemical analysis of complex oxides; identify and characterize new candidate materials for topological insulators with strong electronic interactions. *FY 2014 Plans:* Will investigate dynamics of thermally-isolated systems in atomic systems which will facilitate the future engineering of new materials with dynamic properties for the future warfighter; will design and demonstrate laser-plasma beams using ultra-short pulsed lasers and investigate the unique light-propagation characteristics in the atmosphere not possible with conventional lasers, which may ultimately enable standoff detection of explosive residue; will explore high-intensity lasers as a method for creating gamma ray beams that may ultimately provide a source of gamma rays obviating the need for conventional large, expensive, immobile, reactors or extremely hazardous reactive materials; will design and explore quantum systems, such as nitrogen in synthetic diamond, for low-power high-precision sensing and imaging exceeding the capabilities of current classical systems; will design and synthesize topological insulators (i.e., a novel type of material that changes electrical properties based on its three-dimensional structure); will discover and characterize the properties of these new topological insulators under varying magnetic and electrical conditions, which may enable new ultra-sensitive detectors and ultra-low power electronics.			
Title: Basic Research in Electronics and Photonics *Description:* 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. *FY 2012 Accomplishments:*	11.369	11.218	10.905

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Determined the effect of antidote lattices (a novel material structure) on the bandgap in graphene; Evaluated vertical lasing based on photonic crystal Fano resonances using nanomembrane broadband reflectors. Designed and fabricated photonic bandgap structures for use in multifunctional radio, radar, and sensor systems; Used novel probes to investigate biological cells and large scale nano-materials..			
FY 2013 Plans: Synthesize mercury cadmium selenide on gallium antimonide substrates and investigate its optical and structural characteristics for infrared detection. Develop novel vertical cavity transistor lasers with high modulation rates. Develop biologically-inspired RF direction finding antenna arrays and associated signal processing techniques based on the operation of the human auditory system. Investigating nanoscale constructs within cells and engineered nano-structures.			
FY 2014 Plans: Will improve optical quality and coherency of mid infrared lasers to facilitate free space optical communications, ladar and infrared countermeasures; will show feasibility of semiconductor-less infrared detection that utilizes electron tunneling; will explore time-frequency and non-laplacian phenomena to understand and extend the fundamental performance limits of radio, radar, and electronic warfare systems; will develop terahertz frequency photomixing arrays with 10x improvement in output powers to enable the remote detection of chemical, biological and explosive threats.			
Title: Basic Research in Materials Sciences (formerly titled Basic research in mechanical and material sciences) *Description:* 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. *FY 2012 Accomplishments:* Developed an understanding at the microscopic level (single layer) for reaction processes and kinetics of reactive materials undergoing high speed impact; developed materials with stress-activated molecules that enhance macroscopic properties of interest when elastic force is applied; investigated a predictive theoretical framework to identify promising 2D free -standing crystalline oxides/ nitrides and nanocomposites; characterized 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. *FY 2013 Plans:* Demonstrate novel materials with large electro-caloric effects for thermal management; achieve rapid fabrication and densification of nanostructured materials with unique combinations of high-pressure and electrical field; establish theory to guide the design and fabrication of multifunctional materials incorporating programmable responses and hierarchical constructs; fabricate novel	13.946	7.097	7.067

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
3D topological insulators with unsurpassed bulk resistivity and surface electron mobility; demonstrate the ability to translate biochemical activity onto inorganic surfaces. In FY13, the Mechanical Sciences research description and associated funding moves to the Mechanical Sciences section within this Project. *FY 2014 Plans:* Will establish the use of resonant optical effects to achieve size sorting of microspheres in solution with unprecedented precision; will demonstrate a new class of materials for low power sensing based on variable temperature conduction; will provide a robust computational methodology to predict the relationships between a material's electronic structure, its local elastic properties, and its composition for the vast majority of transition metal critical points; will fabricate novel fully transparent materials with record hardness and toughness for advanced protection.			
Title: Basic Research in Computing Sciences (formerly titled basic research in mathematical sciences and computing sciences) *Description:* 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. *FY 2012 Accomplishments:* Investigated trusted computing that is adaptive to both social and culture influences, and developed new capabilities for warfighters deployed in areas of different social and culture interactions; investigated adaptive change detection procedures for composite hypotheses in cyber security for comparison of several change point detection methods; developed computer network security and surveillance, clutter rejection and nonlinear filtering algorithms. *FY 2013 Plans:* Continue to explore and investigate new effective computing architectures, computational methods and software tools, and 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 development of structural methods for automatic machine translation are ongoing. In FY13, the Mathematical Sciences research description and associated funding moves to the Mathematical Sciences section within this Project. *FY 2014 Plans:* Will explore the establishing of robust computational methodologies for large dataset processing and analysis with optimized data representations and obtaining optimal realization of Real-Time Multi-core Systems to support complex, resource-demanding, real-time Intelligence, Surveillance, and Reconnaissance (ISR) applications. Will create new image data feature analysis and pattern classification methods for object detection, recognition, and long-term tracking under challenging dynamic conditions, and develop	11.113	6.054	7.724

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
quantification and metrics for effective analysis of social-interaction phenomena and for better prediction of unusual social events in asymmetric defense			
Title: Basic Research In Network Sciences	3.040	6.663	8.260
Description: 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. *FY 2012 Accomplishments:* Emphasis was on the understanding of human networks and, in particular, how information mathematically spreads through a network; the impact of the work provided 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 were investigated, and how they can be analyzed in tandem. *FY 2013 Plans:* Experimental evaluation of mathematical models of how information spreads through groups/networks using a Behavioral Game Theory framework. Develop mathematical models of decision making using neuroscience experiments in collaboration with Life Sciences with attention being paid to errors in human judgment. Investigate game theory derived from observational data to understand microbe adaptations and micro-scale locomotion and control for micro-bio-robots. *FY 2014 Plans:* The notion of tipping point, when a society changes its views, will be studied from a Statistical Mechanics perspective and from a Behavioral Game Theory perspective, with attendant efforts to reconcile the two views. Ongoing mathematical modeling of neuronal structures informed by experiments to grow neurons will be extended to capture cognitive intelligence that arises from networks of neurons. Games derived from observation will be studied with respect to equilibrium and robustness properties and validated on problems related to reasoning about adversarial networks. Study of Micro-scale locomotion and control of micro-robots will be extended to turbulent fluid flow. Finally, effect of human networks on communication networks will be studied with the goal of finding effective bandwidth/spectrum/resource utilization.			
Title: Basic Research in Bioforensics - in FY13 this effort moves to Life Sciences and Chemical Sciences	1.813	0.000	0.000
Description: 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			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
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. *FY 2012 Accomplishments:* Efforts determined the locations and compositions of palindromic repeats (i.e., structures acting as bacterial 'gene memory'); methods were investigated to control individual bacteria with external stimuli (chemical, optical or electrical) with appropriate spatial and temporal resolution; bacteria were transferred from natural environments to the laboratory and identified mutations that arose after transfer to laboratory culture environment; gene expression patterns of bacterial outer membrane proteins in multiple combinations of environmental factors, including temperature, pH, and iron limitation were mapped.			
Title: Basic Research in Oxide Electronics and Brain-electronic Interfaces - in FY13 this effort moves to Life Sciences *Description:* 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. *FY 2012 Accomplishments:* Research expanded predictive theories to accurately model materials and then verified accuracy; expansion of heteroepitaxial capabilities continued; solutions to eliminate or mitigate dominant defects were explored; luminescence diagnostic studies of material defects were pursued; experimental methods for potential to 'decode' brain signals to determine how particular thoughts can be used as control inputs for engineered systems were developed and examined; and potential methods for interfacing electronics with the brain were investigated.	1.813	0.000	0.000
Title: Basic Research in Quantum Imaging and Defect State Enabled Spintronics - in FY13 this effort moves to Physics. *Description:* 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. *FY 2012 Accomplishments:*	2.413	0.000	0.000

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Research expanded predictive theories to accurately model materials and then verified accuracy; continued to expand heteroepitaxial capabilities with molecular beam epitaxy and pulsed laser deposition; explored solutions to eliminating or mitigating dominant defects; pursued luminescence diagnostic studies of material defects; explored topological insulator material quality improvements to uncover unique physical phenomena; investigated the application of new optical spectroscopic techniques to topological insulators.			
Title: Basic Research in Mechanical Sciences **Description:** 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. **FY 2013 Plans:** Establish the differential geometry (geometric mechanics) of multi-body/granular media interactions; develop an understanding to enable JP-8 surrogate fuels for diesel engine cycle studies; investigate novel nano-thermodynamic corrections for prediction of hot spots in energetic material; investigate the flow mechanisms associated with transitory aerodynamic loading effected by flow control on the boundaries of stationary and moving platforms. **FY 2014 Plans:** Will conduct counter-flow burner studies for investigating high molecular weight hydrocarbon fuel and jet fuel chemistry at elevated pressures up to 2.5MPa; will investigate novel transparent fully cross-linked Molecular Interpenetrating Polymer Composites (MIPCs) under high strain rate loading conditions; will develop a new representation of the Navier-Stokes equations providing rapid convergence when compared to existing solvers for equivalent flow field models, grid types and grid sizes; will elucidate the fundamental physical interactions responsible for energy dissipation and quality factor magnification within prototypical nano-electromechanical systems.	0.000	6.498	6.445
Title: Basic Research in Mathematical Sciences **Description:** 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.	0.000	6.535	6.278

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
FY 2013 Plans: Create new numerical methods and algorithms that facilitate improved aerodynamic performance of helicopters in adverse conditions as well as enabling optimal design of supersonic projectiles. Continue to develop a multivariate heavy-tail statistical theory and develop algorithms to improve modeling capability for complex systems. Create new mathematical tools, computational algorithms, and capabilities that deepen understanding of protein-ligand docking.			
FY 2014 Plans: Will conduct innovative basic research in statistical analysis, commutative and quantum stochastics and control, multiscale computational methods, computational cell and molecular biology and fundamental laws of biology in order to revolutionize methodologies for information assurance, counter-terrorism, next generation communication networks, weapon design, testing, and evaluation, and coordination and collective decision-making.			
Accomplishments/Planned Programs Subtotals	76.109	78.050	80.385

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army										**DATE:** April 2013	
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COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
H66: *Adv Structures Rsch*	-	1.929	1.999	2.018	-	2.018	2.046	2.069	2.022	2.058	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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), using facilities located at NASA Langley Research Center, Hampton, VA, and at Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Title: Structural Analysis and Vibration Methods	1.929	1.999	2.018

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Description: 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. *FY 2012 Accomplishments:* Used 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; investigated Prognostics & Diagnostics (P&D) frameworks for remaining useful life computations using flight evaluation data; validated emerging P&D methods to establish probability of damage/flaw detection, analyzed usage credits, and established fracture mechanics-based P&D technology. *FY 2013 Plans:* 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. 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. Investigate an advanced sensing method used for prognostics and diagnostics to reduce maintenance man-hours and to increase the availability of Army weapon systems. *FY 2014 Plans:* Will investigate adaptive seat damper materials and strategies for improved vibration reduction on different types of terrains and for different gross vehicle weight configurations; will develop and demonstrate a virtual testing capability by integrating probabilistic methods, reliant on current and historical data, into existing physics-based models for lightweight composite structures; will develop signal processing algorithm for tracking damage transients; and will investigate three-dimensional printing of novel multifunctional materials for micro air and ground vehicle applications.			
Accomplishments/Planned Programs Subtotals	1.929	1.999	2.018

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

D. Acquisition Strategy
   N/A

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E. Performance Metrics

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

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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H67: *Environmental Research*	-	0.987	1.020	1.031	-	1.031	1.054	1.065	1.084	1.104	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)

	FY 2012	FY 2013	FY 2014
Title: Industrial Pollution Prevention	0.987	1.020	1.031
Description: This effort conducts research on innovative environmentally- friendly technologies that support the warfighter (focusing on pollution prevention technologies).			
FY 2012 Accomplishments:			

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Began a new three year cycle of projects with a full call for proposals sent to the RDECOM laboratories. ***FY 2013 Plans:*** Continue research efforts that were reviewed by the Peer Panel during the Gate Reviews in September 2012; conduct research on mechanics of antibiotic and disinfectant resistance from wastewater treatment and research into synthesis of biofuels. ***FY 2014 Plans:*** Will review FY13 efforts and accept new start proposals to be reviewed by the Peer Panel during Gate Reviews in September 2013: research includes gasification/biofuels technology, green technologies for energetic/propellants to eliminate hazardous materials, next generation of bio-based materials from sustainable resources and microbial resistance to disinfectants.			
Accomplishments/Planned Programs Subtotals	0.987	1.020	1.031

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research					R-1 ITEM NOMENCLATURE PE 0601102A: DEFENSE RESEARCH SCIENCES					PROJECT S13: Sci BS/Med Rsh Inf Dis		

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
S13: Sci BS/Med Rsh Inf Dis	-	10.693	12.099	10.702	-	10.702	10.656	11.119	11.249	11.657	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 five areas:
(1) Prevention/Treatment of Parasitic (living in or on another organism) Diseases
(2) Vaccines for the Prevention of Malaria
(3) Bacterial Disease Threats
(4) Viral Disease Threats
(5) Diagnostics and Disease Transmission Control

Work is managed by USAMRMC in coordination with the Naval Medical Research Center (NMRC). The Army is responsible for programming and funding all Department of Defense 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 NMRC, Silver Spring, MD, and their overseas laboratories.

B. Accomplishments/Planned Programs ($ in Millions)

	FY 2012	FY 2013	FY 2014
Title: Prevention/Treatment of Parasitic Diseases	3.644	4.203	3.810

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army			**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Description: 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. Because 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. *FY 2012 Accomplishments:* Identified compounds to down-select for advance screening studies and evaluated their potential for future development as anti-parasitic drugs. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will continue optimization of candidate anti-parasitic drugs by chemically modifying them to improve their safety, efficacy, and bio-availability. These modified compounds will be evaluated in animal models for down-selection of best compounds of interest.			
Title: Vaccines for Prevention of Malaria *Description:* 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. *FY 2012 Accomplishments:* Identified new protein molecules as vaccine candidates against malaria to down-select for advance screening studies and evaluate their potential for future development; studied the mechanism of developing antibodies against these new molecules in animal models; conducted research to develop methods of formulating new vaccine candidates for effective delivery inside the human body by using cutting-edge technologies. *FY 2013 Plans:* Formulate and evaluate newly identified vaccine candidates and assess mechanisms of protection in animal models and compare novel formulations of malaria vaccines for protective effectiveness in animal models. *FY 2014 Plans:*	2.188	2.440	2.307

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Will assess immunogenicity (immunity or an immune response) and protective effectiveness of new vaccine candidates in small-animal models to determine suitability in formulations of multiple antigen vaccines (an antigen is a substance, usually a protein, on the surface of a cell or bacterium that stimulates the production of an antibody).			
Title: Bacterial Disease Threats *Description:* 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). *FY 2012 Accomplishments:* Assessed 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 and transitioned best basic wound management measures to preclinical (animal model) testing. *FY 2013 Plans:* Undertake discovery of and evaluate new vaccine components needed for vaccine protection for severe bacterial diarrhea based on prior studies; evaluate different components from pathogens causing diarrhea for their ability to induce protection against these organisms; and develop further knowledge of bacterial wound infection pathogens to develop effective treatments. *FY 2014 Plans:* Will study the mechanism by which diarrheal pathogens stick to the wall of the intestine to develop countermeasures against these pathogens and will study novel methods of formulating vaccine candidates to effectively deliver them inside the human body. Will study mechanism of bacterial wound infection pathogens to develop effective treatments.	1.450	1.432	1.537
Title: Viral Threats Research *Description:* 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, life cycle, and interactions with the environment), the disease process, and disease interaction with the human body. *FY 2012 Accomplishments:* Continued to study and evaluated the basis of the dengue disease and how the immune system reacts to it; conducted research on defining factors that contribute to causing dengue hemorrhagic fever that occurs in a subset of infected individuals only; and	1.706	2.109	1.577

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
also developed methods of distinguishing between protective and non-protective antibodies that will be used as surrogate markers of protection when evaluating vaccines against dengue infection. ***FY 2013 Plans:*** Study and evaluate the basis of dengue disease and how the immune system reacts to it; evaluate factors that contribute to causing dengue hemorrhagic fever that occurs in a subset of infected individuals only; 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; determine the contribution of various cells present in human body to provide protection against dengue infection and/or dengue disease; study and evaluate pathogenesis of hemorrhagic fever caused by hantaviruses (a family of deadly viruses transmitted by rodents); and study the biology of HIV to understand the impact of human genes on HIV acquisition and progression to inform vaccine development. ***FY 2014 Plans:*** Will study the role of human cells and antibodies to develop medical countermeasures to prevent and/or treat diseases caused by hantaviruses (a deadly virus responsible of hemorrhagic fever with renal syndrome) and dengue; will conduct epidemiological studies (study of the causes and transmission of disease within a population) to determine the prevalence and incidence of dengue fever and dengue hemorrhagic fever over time in diverse populations; and will use the epidemiological information to develop and/or maintain vaccine test site infrastructure for the purpose of evaluating promising dengue vaccine candidates for safety and effectiveness.			
Title: Diagnostics and Disease Transmission Control *Description:* 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. ***FY 2012 Accomplishments:*** Developed new trapping methods to improve sand fly surveillance; developed tools to identify mosquito species that transmit malaria parasites; and developed 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. ***FY 2013 Plans:***	1.705	1.915	1.471

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Identify novel fast-acting, directly targeted, insecticides that rapidly degrade to harmless by-products; investigate next-generation risk assessment tools for evaluating potential infectious disease transmission in insects (beyond modeling); and develop identification keys for medically important insect vectors. *FY 2014 Plans:* Will develop identification keys for the medically important arthropod (e.g., ticks, mosquitos, and sandflies) vectors in alternative geographic areas not previously studied but potentially deployable locations and will evaluate new technologies selected as part of the new-generation diagnostic systems for use in the deployed setting for detection of pathogens in humans.			
Accomplishments/Planned Programs Subtotals	10.693	12.099	10.702

C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											**DATE:** April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*					**PROJECT** S14: *Sci BS/Cbt Cas Care Rs*		
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013**#	**FY 2014 Base**	**FY 2014 OCO** ##	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
S14: *Sci BS/Cbt Cas Care Rs*	-	9.424	10.197	9.172	-	9.172	9.302	9.161	9.721	9.607	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project supports basic research to understand the fundamental mechanisms of severe trauma to advance treatment and surgical procedures to save lives and improve medical outcomes for the Soldier. Experimental models are developed to support in-depth trauma research studies. 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) TBI
(5) Clinical and Rehabilitative Medicine

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 WRAIR, Silver Spring, MD; the U.S. Army Dental Trauma Research Detachment and 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)	FY 2012	FY 2013	FY 2014
Title: Damage Control Resuscitation	1.303	1.433	1.618
Description: 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. **FY 2012 Accomplishments:**			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Conducted studies of immune system interaction with the coagulation (blood clotting) system and the effect of trauma on fibrinogen (a blood clot component) formation. ***FY 2013 Plans:*** 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. ***FY 2014 Plans:*** Will perform studies of re-engineered blood products to control traumatic bleeding and treat shock and will perform studies to better understand the genetic basis of survival from hemorrhage.			
Title: Combat Trauma Therapies ***Description:*** 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 (facial and oral) injuries, extremity wounds and fractures, and burns. ***FY 2012 Accomplishments:*** Realigned 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 and researched potential bone defect models to find one that is clinically relevant to combat trauma. ***FY 2013 Plans:*** Continue to study the relevant model of bone defect to create a model for use in evaluating new therapies and identify factors capable of minimizing the development of chronic inflammation. ***FY 2014 Plans:*** Will study mechanisms to manipulate the molecules, cells, and structure of the skin to optimize healing, appearance, and function..	0.929	0.836	0.784
Title: Combat Critical Care Engineering ***Description:*** 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 started in FY2012. ***FY 2012 Accomplishments:***	0.748	0.699	0.858

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 2012	FY 2013	FY 2014
Began basic research studies to investigate differences in physiological responses between individuals with high- and low-tolerance to blood loss. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will perform research on decision support algorithms that use non-traditional vital signs to assess patient physiologic status and will continue studies of algorithms for early identification of individuals with high- and low-tolerance to blood loss to optimize resuscitation.			
Title: Traumatic Brain Injury *Description:* This effort conducts basic research in poly-trauma (multiple injuries)/Traumatic Brain Injury (TBI) model, cellular mechanisms of cell death, and the discovery of novel drugs and medical proceedures to mitigate the effects of TBI. *FY 2012 Accomplishments:* Realigned neuroprotection research from the Combat Trauma Therapies task area to the TBI task area; continued basic research in poly-trauma (multiple injuries)/TBI model, cellular mechanisms of cell death and discovery of novel drugs to mitigate TBI. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will apply systems biology metrics to models of mild and severe TBI to aid in discovery of novel proteins in the blood that appear as a result of traumatic injury, which may aid in diagnosis of TBI; will perform basic research to study the brain and nervous system during the first 2 months following head injury to identify predictors of long-term consequences of TBI; and will continue research to understand cell death and neuroprotection (protection of the brain) mechanisms and determine critical thresholds for secondary injuries (polytrauma) complicating TBI.	0.959	0.660	0.991
Title: Clinical and Rehabilitative Medicine *Description:* 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, face (including eye), and genitalia, abdomen and burns. *FY 2012 Accomplishments:*	5.485	6.569	4.921

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Continued research in eye trauma to understand the cellular and neuronal mechanisms of eye injury and continued the process of exploring innovative regenerative tissue strategies and advancing promising approaches to the applied research phase.			
FY 2013 Plans: Explore the mechanisms of eye trauma injury and the epidemiology (studying incidence or prevalence of injury) of eye trauma wounds and explore innovative strategies to regenerate tissues and advance promising approaches to the applied research phase.			
FY 2014 Plans: Will evaluate the cellular mechanisms of eye trauma injuries to identify promising therapies for eye trauma wounds and explore the epidemiology (studying incidence or prevalence of injury) (including severity) of eye trauma injuries and will explore innovative strategies to regenerate tissues and advance promising approaches to the applied research phase to repair extremities (arms and legs), craniomaxillofacial (head, neck, face, and jaw), genital, and abdominal regions.			
Accomplishments/Planned Programs Subtotals	9.424	10.197	9.172

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army										DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
S15: *Sci BS/Army Op Med Rsh*	-	6.246	5.683	7.370	-	7.370	7.320	6.977	7.056	7.307	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 project includes research on the neurobehavioral aspects of post-traumatic stress and suicide and develops 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 four areas:
(1) Injury Prevention and Reduction
(2) Physiological Health
(3) Environmental Health and Protection
(4) 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 WRAIR, Silver Spring, MD; USAISR, San Antonio TX; and the U.S. Army Research Institute of Environmental Medicine (USARIEM), Natick, MA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Injury Prevention and Reduction	1.083	0.970	1.185
Description: This effort identifies biological patterns of change in Soldiers during states of physical exertion, identifies physiological mechanisms of physical injury and exertion that will predict musculoskeletal injury, and establishes laser dose-response for eye tissue.			
FY 2012 Accomplishments:			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Examined the prevalence of Warrior eye injuries sustained in recent operations in Iraq and Afghanistan by category and outcome which can be applied to the development of protective technologies, diagnostic tools, and treatment strategies. Investigated how near-infrared wavelengths can be used to non-invasively detect retinal injury caused by blast, laser insult or other ocular (eye) trauma. Examined the mechanisms of laser-induced retinal injury and their dependence on pulse duration, pulse repetition and total number of pulses. *FY 2013 Plans:* Identify indicators of cellular responses to determine efficacy of intervention strategies related to injury susceptibility in the skeletal muscle; diagnose and characterize repeated and long-duration exposure from military lasers; and characterize ocular injury as a function of shock wave (resulting from explosion of an improvised explosive device) impulse in a large-eye animal model to establish advanced triage, treatment, and prevention methodologies. These data will lead to our understanding of multiple ocular injuries from a single blast or laser exposure and will also anchor predictive biophysical models to prevent or mitigate Soldier eye injury from blast. *FY 2014 Plans:* Will explore musculoskeletal injury and repair mechanisms to identify possible therapeutic targets that regulate skeletal muscle and bone function; will assess damage to the retina (a light-sensitive membrane in the back of the eye that receives an image from the lens and sends it to the brain through the optic nerve) of the eye following changes to long-duration exposures using advanced ophthalmic (eye) imaging systems and retinal scanning devices; and will establish ocular (eye) injury metrics for blast exposures.			
Title: Physiological Health **Description:** This effort conducts research on the physiological mechanisms of sleep, fatigue, and nutrition on Soldier performance and well-being. *FY 2012 Accomplishments:* Identified menus, food service practices, and labeling and educational materials to promote healthy eating behavior in military dining facilities and identified the hormonal and metabolic responses of human fat tissue during periods of underfeeding, followed by overfeeding. Investigated the mechanism of preventing cellular toxicity (cell death) caused by environmental factors can be inhibited by a certain group of phytonutrients (plant-derived compounds that interact with cells in the body). Examined the correlation between protein synthesis (proteins being made inside the cell) in the brain and different phases of sleep and how this contributes to recuperative sleep patterns. Also investigated the impact of caffeine on performance sustainment. *FY 2013 Plans:*	2.748	3.068	3.045

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Determine muscle metabolic responses to nutritional deficit; identify the relationship between micronutrient and bone adaptation during military training; and 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. *FY 2014 Plans:* Will determine whether electrical brain stimulation can be used to induce sleep; will explore promoting sleep during intervals between missions when sleep is not physiologically required; will establish nutritional requirements for optimizing muscle formation and repair; will determine the effects of various nutritional interventions on cell function; will explore various nutritional interventions that might enhance resistance to cellular injury; and will explore nutritional interventions that might promote physiological improvements to training and enhance recovery from physical injury.			
Title: Environmental Health and Protection *Description:* This effort conducts research on the physiological mechanisms of exposure to extreme heat, cold, altitude, and other environmental stressors. *FY 2012 Accomplishments:* Identified mechanisms of heat stroke-induced organ damage in a mouse model. *FY 2013 Plans:* 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, and the results will be used to develop protective treatments against damage to internal organs resulting from heat exposure. *FY 2014 Plans:* Will identify metabolic pathways that are regulated by inflammation, which increases heat stroke susceptibility and/or alters the time course and extent of organ damage following heat injury that results in multi-organ failure, and will explore treatments to protect against organ damage resulting from heat injuries.	1.187	0.245	0.804
Title: Psychological Health and Resilience *Description:* 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 and includes determination of suicide risk and understanding underlying mechanisms driving suicidal behavior, as well as underlying neurobiological mechanisms related to post-traumatic stress disorder (PTSD) and depression. *FY 2012 Accomplishments:*	1.228	1.400	2.336

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Identified deployment-related measures to assess intervention effectiveness (e.g., mitigating functional impairment, transition, risky behaviors) for the treatment of PTSD; examined underlying psychosocial and biological theories of suicidal behavior; and examined underlying neural systems' response to depression treatment. *FY 2013 Plans:* Identify markers to indicate the effectiveness of candidate medications for PTSD treatments, and through exploration with an animal model, existing candidate compounds are evaluated for efficacy in the treatment of PTSD. Neural systems' response to depression treatment is used to inform development of optimized treatment regimen for depression. *FY 2014 Plans:* Will determine whether a sleep-related intervention strategy can enhance resilience to concussion/mild TBI effects in a proof-of-concept rodent model and will evaluate the extent to which sleep is effective for enhancing resilience to concussion, which will potentially provide a preventative strategy to decrease negative consequences of concussions; will establish cellular mechanisms for regulation of PTSD symptoms associated with increased stress sensitivity and increased anxiety in a rodent model of PTSD.			
Accomplishments/Planned Programs Subtotals	6.246	5.683	7.370

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

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army									DATE: April 2013		
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T22: Soil & Rock Mech	-	4.824	4.034	4.579	-	4.579	4.780	4.978	5.056	5.147	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Military Engineering Basic Research	2.372	2.209	2.320
Description: Funding is provided for this activity			
FY 2012 Accomplishments: Completed a particle scale model to study the effects of two naturally occurring bonding agents on the suspension of particulates from naturally occurring soils.			
FY 2013 Plans: 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.			
FY 2014 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T22: *Soil & Rock Mech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Will quantify the amplitude, frequency content, and time series of seismic loads caused by the impact of tools on granular media; determine the effect of snow grain shape on near-infrared reflectance; estimate soil texture and moisture from polarimetric imaging.			
Title: Materials Modeling for Force Protection	2.452	1.825	2.259
Description: 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 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. *FY 2012 Accomplishments:* Performed 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. *FY 2013 Plans:* 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. *FY 2014 Plans:* Will model deformation and change in particles using a novel Mixed Least Squares method for Finite Elements that permits discontinuities in the displacement field of the particles; determine if polycrystalline ceramics can theoretically be improved by multiple-fold current values of fracture toughness and tensile strength; determine energy dissipation mechanisms in nano-coiled vertically aligned carbon nanotubes with a stiffness gradient under dynamic loading conditions.			
Accomplishments/Planned Programs Subtotals	4.824	4.034	4.579

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

D. Acquisition Strategy
  N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		**DATE:** April 2013
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*

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*						**PROJECT** T23: *Basic Res Mil Const*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T23: *Basic Res Mil Const*	-	1.863	1.659	1.773	-	1.773	1.715	1.732	1.964	1.999	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Facilities Research	1.863	1.659	1.773
Description: Funding is provided for the following effort.			
FY 2012 Accomplishments: Explored the controlled dissociation of either methane or ammonia in order to produce pure hydrogen gas; determined the effects of temperature on the quantum dot output spectrum in order to increase understanding for improved sensor development.			
FY 2013 Plans:			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T23: *Basic Res Mil Const*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Complete investigations of enhanced heat transfer of hybrid surfaces and switching mechanisms in bioinspired polymers. ***FY 2014 Plans:*** Will determine the relationship between amino acid sequence and nanostructure self-assembly properties in a unique protein motif; redirect electron flux from highly reduced organic fermentation products towards hydrogenase production.			
Accomplishments/Planned Programs Subtotals	1.863	1.659	1.773

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

D. Acquisition Strategy
  N/A

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

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| APPROPRIATION/BUDGET ACTIVITY
2040: *Research, Development, Test & Evaluation, Army*
BA 1: *Basic Research* | | | | R-1 ITEM NOMENCLATURE
PE 0601102A: *DEFENSE RESEARCH SCIENCES* | | | | PROJECT
T24: *Signature Physics And Terrain State Basic Research* | | | |

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T24: *Signature Physics And Terrain State Basic Research*	-	1.605	1.495	1.601	-	1.601	1.539	1.547	1.656	1.686	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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/inferring subsurface properties. The signature physics area of terrestrial sciences focuses on understanding the dynamic changes to electromagnetic, acoustic and seismic signatures, and energy propagation in response to changing terrain state and near surface atmosphere.

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 2012	FY 2013	FY 2014
Title: Analysis for Signal and Signature Phenomenology (Previously titled - Terrain State and Signature Physics)	1.605	1.495	1.601
Description: Funding is provided for the following effort. *FY 2012 Accomplishments:* Determined if radars can better detect subsurface disturbances through improved coherent waveform detection, and understanding of volume scatter loss rates; formulated methods for near real-time calculation of sound fields in complex environments; constructed a 3D numerical model of gas transport in soil that incorporates convection and diffusion and will			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T24: *Signature Physics And Terrain State Basic Research*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
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; investigated 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. *FY 2013 Plans:* 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; formulate a methodology for assessing motivational intensities (cognitive-based processes) contributing to movement patterns in constrained landscapes. *FY 2014 Plans:* Will investigate and quantify full waveform Light Detection and Ranging (LiDAR) backscatter characteristics and known system response to enhance sensor calibration models for increased target identification in variable terrain environments; research and define annually repeating spatial snow patterns as a function of topography, vegetation, and weather, and determine the efficacy and utility of this new knowledge to improve satellite derived snow mapping estimates of depth and density for enhancing water storage estimates and mobility products.			
Accomplishments/Planned Programs Subtotals	1.605	1.495	1.601

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

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 2014 Army										DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T25: *Environmental Science Basic Research*	-	8.027	6.888	7.175	-	7.175	7.170	7.293	8.254	8.403	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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 2012	FY 2013	FY 2014
Title: Environmental and Ecological Fate of Explosives, Energetics, and Other Contaminants	3.879	3.272	2.798
Description: Funding is provided for the following effort. *FY 2012 Accomplishments:* Investigated bioassay response to climate and contaminant stress on a standard laboratory organism (Daphnia) to elucidate impacts on other species of concern to Military installations; characterized metals-rich granules (MRG) produced by lead (Pb)			

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013		
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 2012	FY 2013	FY 2014
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 contaminates; investigated the linkage of oxidative stress to behavior and animal survival impacts using real time-time imaging of gene expression and behavioral tracking. *FY 2013 Plans:* 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; develop an understanding of transport of compounds through cellular channels that will allow information for more sensitive nano-sensors; investigate the new insensitive munitions behavior and persistence in environmental condition and media. *FY 2014 Plans:* Will understand the fundamental physics that control transport of both ionic and neutral species through nanochannels; rapidly characterize structural changes in integral membrane proteins upon ligand binding; determine soil mobility and bioavailability of IMX-101 in terrestrial systems; expand the metabolic capacity of aerobic RDX- degrading bacteria to enable degradation of 4-nitro-2,4-diazabutanal.			
Title: Remediation of Explosives, Energetics, and UXO *Description:* Funding is provided for the following effort. *FY 2012 Accomplishments:* Determined the potential for abiotic and biotic degradation of insensitive explosives, NTO and FOX-7, potential insensitive replacements for RDX; investigated non-traditional concentration response relationships for prediction of environmental risks supporting development of novel energetics. *FY 2013 Plans:* Investigate the mineralization of depleted uranium munitions and effects on solubility, sorption, and mobility; 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. *FY 2014 Plans:* Will determine the potential for bioaccumulation and food-chain transfer of 2,4 Dinitroanisole; isolate and chemically identify predominant phytosiderophores and/or organic acids exuded by two grass plants that may serve to complex lead; identify	2.297	1.967	2.296

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
and characterize novel biocatalysts involved in the direct incorporation of molecular oxygen into amines resulting in a green biosynthesis route to energetics			
Title: Training Land Natural Resources	0.749	0.616	1.007

Description: Funding is provided for the following effort.

FY 2012 Accomplishments:
Defined multiple-stressor assessment techniques to identify and evaluate the relative contribution of interacting stressors that impact military lands and critical natural resources; investigated 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; through dermal and dietary exposure in plant and animal tissue determined the magnitude of tungsten bioavailability impacting firing range sustainability as well as advanced ecological assessment capabilities.

FY 2013 Plans:
Investigate how climate induced change affects the adsorption and biotransformation characteristics of northern peat-land ecosystems; 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; 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 rate and endemic plant and pollinator species on Army ranges.

FY 2014 Plans:
Will devise a mathematical description of multiple scattering of impulsive signals that includes variability due to spatial and size distributions of scattering objects; determine how climate induced change affects the adsorption and biotransformation characteristics of peatland ecosystems; characterize and compare munitions compounds and insensitive munitions impacts on critically sensitive larval stages of amphibian development.

| *Title:* Network Science | 1.102 | 1.033 | 1.074 |

Description: Funding is provided for the following effort.

FY 2012 Accomplishments:
Investigated first principle phenomenology describing spontaneous formation of highly regular biological networks by bacteria to determine spatial pattern relationships in bacteria colonies; determined cognitive elements associated with attention and memory

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		**DATE:** April 2013
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 2012	FY 2013	FY 2014
allowing heterogeneity in vigilance across a population to emerge naturally in a form conducive to social network resilience and adaptive behavior under predatory threat. *FY 2013 Plans:* Investigate the molecular architecture that dictates the highly specific ligand preference of insect pheromone receptors based on amino acid networks for intelligent receptor design; investigate genetic and genomic basis of intra-species variance in sensitivity to munitions and reduced uncertainty in risk/toxicity assessment of military sites; explore the trade-offs between adaptability and susceptibility within self-organizing biological networks. *FY 2014 Plans:* Will investigate genetic and genomic basis for differences in chemical sensitivity between different asexually or sexually reproducing populations; characterize sensitivity to traditional (lead) and insensitive (dinitroanisole) munitions over time under ideal and stressful conditions; quantify the long-term contribution of environmental stress to sensitivity drifting in age stratified, reproducing populations.			
Accomplishments/Planned Programs Subtotals	8.027	6.888	7.175

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY
2040: *Research, Development, Test & Evaluation, Army*
BA 1: *Basic Research*

R-1 ITEM NOMENCLATURE
PE 0601102A: *DEFENSE RESEARCH SCIENCES*

PROJECT
T63: *Robotics Autonomy, Manipulation, & Portability Rsh*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T63: *Robotics Autonomy, Manipulation, & Portability Rsh*	-	1.797	1.956	1.991	-	1.991	2.025	2.059	2.094	2.132	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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.

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T63: *Robotics Autonomy, Manipulation, & Portability Rsh*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Title: Robotics autonomy and human robotic interface research	1.797	1.956	1.991
Description: 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. *FY 2012 Accomplishments:* Evaluated novel modes of air and ground mobility for micro-mechanical systems. *FY 2013 Plans:* Conduct experimental studies to create a fundamental model of flapping wing locomotion to enable future micro-scale unmanned aerial vehicle systems. Examine basic concepts and underpinning mechanics of grasping and manipulating unknown and arbitrarily shaped objects. *FY 2014 Plans:* Will conduct experimental studies to investigate the fundamental flow behavior of small scale flyers as it impacts range and endurance; will investigate cognitive approaches for machine perception; will explore concepts from game theory and machine learning to determine adversarial intent from sensor observations; will examine mechanics and control related to whole body manipulation; and will examine novel locomotion mechanisms focusing upon energy efficiency and mobility.			
Accomplishments/Planned Programs Subtotals	1.797	1.956	1.991

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601102A: *DEFENSE RESEARCH SCIENCES*				PROJECT T64: *Sci BS/System Biology And Network Science*			

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
T64: *Sci BS/System Biology And Network Science*	-	2.128	2.824	2.959	-	2.959	2.930	2.972	3.022	3.038	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 USAMRMC, Fort Detrick, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Network Sciences Initiative	2.128	2.824	2.959
Description: 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. *FY 2012 Accomplishments:* Validated the accuracy of the models and applied the models to identify markers for TBI. *FY 2013 Plans:* Expand the identification of TBI biomarkers to include key biological pathways, leading to the development of diagnostic assays and identification of potential drug targets. *FY 2014 Plans:* Will validate and extend algorithm for discovery of biomarkers (key molecular or cellular events that link a specific environmental exposure to a health outcome) for severe TBI to include moderate and mild TBI; will develop systems biology algorithms to			

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601102A: *DEFENSE RESEARCH SCIENCES*	**PROJECT** T64: *Sci BS/System Biology And Network Science*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
establish new strategies to identify drug targets and therapeutics for malaria- and trauma-induced coagulopathy (abnormal blood clotting); will exploit novel in-silico (performed on computer via simulation) models to identify sensitive biomarkers and determine the time course of wound healing; and will develop mathematical models to characterize how viruses escape immune response to support the development of anti-viral drugs.			
Accomplishments/Planned Programs Subtotals	2.128	2.824	2.959

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

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 2014 Army										**DATE:** April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013**[#]	**FY 2014 Base**	**FY 2014 OCO**[##]	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
VR9: *Surface Science Research*	-	2.178	1.936	2.010	-	2.010	2.328	2.631	2.675	2.723	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

[##] The FY 2014 OCO Request will be submitted at a later date

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 andTtechnology 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 2012**	**FY 2013**	**FY 2014**
Title: Surface Science Research	2.178	1.936	2.010
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 Accomplishments: Investigated the complex behavior of mass transport in microporous systems; designed rational molecular and nano-system functional abiotic structures; conducted fundamental studies and modeling of the interfacial phenomena of particulate matter			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
(solid/liquid) with surfaces and the interaction of matter and mechanisms of transfer of energy at the nanoscale and at biological interfaces.			
FY 2013 Plans: 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.			
FY 2014 Plans: Will perform structural determination and computational modeling of trans-membrane proteins; building on FY13 efforts, continue to develop a set of surface science tools that further our understanding of surface properties and interfacial dynamics of complex materials; continue to investigate rational design approaches to metal-metal oxide nano-architectures; continue to systematically model engineered functional systems; investigate the mechanisms governing specific binding or adherence of biological molecules to abiotic surfaces.			
Accomplishments/Planned Programs Subtotals	2.178	1.936	2.010

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

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-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*							
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	78.380	80.986	79.359	-	79.359	79.679	79.977	80.156	81.159	Continuing	Continuing
D55: *University Research Initiative*	-	75.149	77.650	76.021	-	76.021	76.339	76.637	76.759	77.701	Continuing	Continuing
V72: *Minerva*	-	3.231	3.336	3.338	-	3.338	3.340	3.340	3.397	3.458	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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.

Project support Minerva Research Initiative (MRI), a university based social science research project initiated by the Secretary of Defense in FY09.

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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Exhibit R-2, **RDT&E Budget Item Justification:** PB 2014 Army				**DATE:** April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*			**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*		
B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	80.850	80.986	82.953	-	82.953
Current President's Budget	78.380	80.986	79.359	-	79.359
Total Adjustments	-2.470	0.000	-3.594	-	-3.594
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.470	-			
• Adjustments to Budget Years	-	-	-3.594	-	-3.594

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army										DATE: April 2013	

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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
D55: *University Research Initiative*	-	75.149	77.650	76.021	-	76.021	76.339	76.637	76.759	77.701	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Multidisciplinary University Research Initiative (MURI)	58.872	59.410	56.743
Description: MURI programs are typically 5 years in length at a cost of $1.25M/yr. **FY 2012 Accomplishments:** Supported MURI with 8 new awards that are critical to the Army's future operating capabilities. MURI topics and lead institutions were High-Resolution Quantum Control of Chemical Reactions (Yale Univ), The Physics of Surface States with Interactions			

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601103A: *University Research Initiatives*	PROJECT D55: *University Research Initiative*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
mediated by Bulk Properties, Defects and Surface Chemistry (Princeton), Translating Biochemical Pathways to Non-Cellular Environments (Arizona State), Multivariate Heavy -Tail Phenomena: Modeling, Diagnostics, and Applications in Tactical Operations (Cornell), Imaging how a neuron computes (Columbia), Associating growth conditions with cellular composition in Gram-negative bacteria (UT-Austin), Coherent effects in hybrid nanostructures for lineshape engineering of electromagnetic media (Rice), and Evolution of Cultural Norms and Dynamics of Socio-Political Change (Univ Penn). *FY 2013 Plans:* Support MURI awards made in prior years and initiated 8 FY13 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. *FY 2014 Plans:* Will provide support for MURI awards made in prior years will continue and will start 7-8 new FY14 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, U.S. Army Research, Development and Engineering Command, the Research, Development, and Engineering Centers (RDECs) the Center of Excellences, including Engineer Research and Development Center (ERDC), U.S. Army Medical Research and Materiel Command, and the U.S. Army Research Institute, and industry.			
Title: Presidential Early Career Awards for Scientists and Engineers (PECASE) *Description:* Supports PECASE investigators started in prior years. *FY 2012 Accomplishments:* Continued support for prior year awardees and selected four new awards. *FY 2013 Plans:* Select four new awardees and supported prior year's awardees. *FY 2014 Plans:* Will continue support for prior year PECASE awards and select new FY14 PECASE awardees.	3.600	4.559	5.414
Title: Defense University Research Instrumentation Program (DURIP) *Description:* Supports basic research through competitive grants for research instrumentation. *FY 2012 Accomplishments:*	12.677	13.681	13.864

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*	**PROJECT** D55: *University Research Initiative*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Awarded competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation. *FY 2013 Plans:* Award competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation. *FY 2014 Plans:* Will award competitive grants for research instrumentation to enhance universities' capabilities to conduct world class research critical to Army transformation.			
Accomplishments/Planned Programs Subtotals	75.149	77.650	76.021

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

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.

PE 0601103A: *University Research Initiatives*
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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army | **DATE:** April 2013

APPROPRIATION/BUDGET ACTIVITY	R-1 ITEM NOMENCLATURE	PROJECT
2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	PE 0601103A: *University Research Initiatives*	V72: *Minerva*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
V72: *Minerva*	-	3.231	3.336	3.338	-	3.338	3.340	3.340	3.397	3.458	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

Note
Not applicable for this item.

A. Mission Description and Budget Item Justification

This project 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 disruption and instability, the nature of crowd dynamics, group violence, community belief structures, the potential to influence public opinion 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 and national security. 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 are open source.

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 Office.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Minerva Outreach and In-house Capability	0.033	0.000	0.000
Description: Supports Minerva basic research projects and establishment of a Chairs program at principally military educational institutions. *FY 2012 Accomplishments:* This effort was transferred to the Office of the Secretary of Defense (OSD) in FY2012 and will be executed by OSD in FY2013			
Title: The Minerva Research Initiative (MRI)	3.198	3.336	3.338

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Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601103A: *University Research Initiatives*	**PROJECT** V72: *Minerva*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Description: 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. *FY 2012 Accomplishments:* Continued large university consortium research projects which were initiated in FY09 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. Support was provided to OSD in managing the program in social science studies related to strategy and policy via research chairs and fellowships at Service schools and universities, and directed by previous Congressional language on the Minerva program from authorization and appropriations committees. *FY 2013 Plans:* Continue efforts on 3 existing projects described above and focused on social science and cultural issues affecting US military warfighting capabilities. Continue providing support to OSD in managing the program in social science studies related to strategy and policy via research chairs and fellowships at Service schools and universities. Validate predictive models developed in previous research with extensive field research and extended by new theoretical development. Collaborations with combatant commands, DoD policy staff, and governmental activities are being extended and strengthened. Increase the number of workshops and training courses for high level policy staff. *FY 2014 Plans:* The 3 university consortium projects started in FY09 (and described in FY2012 above) will be completed. Funds will also support new and ongoing Minerva social science research of strategic importance to the Army and U.S. national security policy. Research efforts will focus on understanding group belief formation, factors causing or influencing social change and violence, societal resilience, theories of deterrence, and new approaches to conflict and cooperation.			
Accomplishments/Planned Programs Subtotals	3.231	3.336	3.338

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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*

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research					R-1 ITEM NOMENCLATURE PE 0601104A: University and Industry Research Centers							
COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
Total Program Element	-	102.084	123.045	113.662	-	113.662	118.502	120.840	123.136	125.736	Continuing	Continuing
EA6: Cyber Collaborative Research Alliance	-	0.000	0.000	3.010	-	3.010	2.966	2.972	2.982	2.993	Continuing	Continuing
F17: Neuroergonomics Collaborative Technology Alliance	-	4.995	5.251	5.381	-	5.381	5.462	5.659	5.595	5.696	Continuing	Continuing
H04: HBCU/MI Programs	-	2.215	18.507	2.960	-	2.960	3.010	3.061	3.112	3.168	Continuing	Continuing
H05: Institute For Collaborative Biotechnologies	-	11.823	12.326	12.458	-	12.458	12.877	12.976	13.234	13.437	Continuing	Continuing
H09: Robotics CTA	-	5.115	5.550	6.649	-	6.649	5.945	5.842	5.940	6.047	Continuing	Continuing
H50: Network Sciences CTA	-	12.494	12.968	14.201	-	14.201	14.879	14.844	14.894	15.033	Continuing	Continuing
H53: Army High Performance Computing Research Center	-	4.215	4.516	4.902	-	4.902	6.193	6.991	7.109	7.237	Continuing	Continuing
H54: Micro-Autonomous Systems Technology (MAST) CTA	-	7.689	8.127	8.096	-	8.096	8.348	8.381	8.419	8.630	Continuing	Continuing
H59: International Tech Centers	-	6.175	7.503	7.609	-	7.609	7.708	7.832	7.964	8.107	Continuing	Continuing
H62: Institude for Advanced Technology (IAT)	-	1.378	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
H64: MATERIALS CENTER	-	2.826	0.758	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
H73: Automotive Research Center (ARC)	-	3.870	4.092	4.195	-	4.195	4.197	4.251	4.321	4.399	Continuing	Continuing
J08: Institute For Creative Technologies (ICT)	-	7.764	8.003	8.104	-	8.104	8.751	9.355	9.623	9.805	Continuing	Continuing
J12: Institute For Soldier Nanotechnology (ISN)	-	10.441	10.706	10.558	-	10.558	10.646	10.689	10.884	11.096	Continuing	Continuing
J14: Army Educational Outreach Program	-	6.029	9.593	9.738	-	9.738	9.864	9.935	10.038	10.219	Continuing	Continuing

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Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*								
J15: *Network Sciences ITA*	-	7.453	4.048	4.125	-	4.125	4.192	4.221	4.301	4.384	Continuing	Continuing
J17: *Vertical Lift Research Center Of Excellence*	-	2.569	2.771	3.062	-	3.062	3.026	3.189	3.243	3.301	Continuing	Continuing
VS2: *Multi-Scale Materials Modeling Centers*	-	5.033	8.326	8.614	-	8.614	9.263	9.462	9.990	10.441	Continuing	Continuing
VS3: *Center For Quantum Science Research*	-	0.000	0.000	0.000	-	0.000	1.175	1.180	1.487	1.743	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

FY12 reprogramming to move Historically Black Colleges and Universities program to RDTE,DW.

Fy14 decrease to support other higher priority efforts.

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 / Collaborative Research Alliances (CTAs/CRAs), University Centers of Excellence (COE), and University Affiliated Research Centers (UARCs). The Army formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs 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, Cognition and Neuroergonomics, and Multi-Scale Materials Modeling. COEs focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs and 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 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 three Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. 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 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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army	**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research 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 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; Aviation and Missile Research, Development and Engineering Center (AMRDEC), in Huntsville, AL, and Research, Development and Engineering Command (RDECOM), in Aberdeen, MD.

B. Program Change Summary ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014 Base**	**FY 2014 OCO**	**FY 2014 Total**
Previous President's Budget	140.715	123.045	128.947	-	128.947
Current President's Budget	102.084	123.045	113.662	-	113.662
Total Adjustments	-38.631	0.000	-15.285	-	-15.285
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-34.967	-			
• SBIR/STTR Transfer	-3.664	-			
• Adjustments to Budget Years	-	-	-15.285	-	-15.285

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army											DATE: April 2013	
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** EA6: *Cyber Collaborative Research Alliance*		

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013 #	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
EA6: *Cyber Collaborative Research Alliance*	-	0.000	0.000	3.010	-	3.010	2.966	2.972	2.982	2.993	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Cyber Security Collaborative Research Alliance (CRA), a competitively selected consortium, is formed to advance the theoretical foundations of cyber science in the context of Army networks. This CRA consists of academia, industry and government researchers working jointly with the objective of developing a fundamental understanding of cyber phenomena so that fundamental laws, theories, and theoretically grounded and empirically validated models can be applied to a broad range of Army domains, applications, and environments. This research will focus on three interrelated aspects of cyber security and will be conducted using a trans-disciplinary approach that takes into account the human element of the network. The three aspects of cyber that are considered are: 1)vulnerabilities and risks of cyber networks to malicious activities, 2)anticipating, detecting and analyzing malicious activities, and 3) agile cyber maneuver to thwart and defeat malicious activities. Overarching goals of cyber security are to significantly decrease the adversary's return on investment when considering cyber attack on Army networks, and minimizing the impact on (Army) network performance related to implementing cyber security. The CRA research creates a framework that effectively integrates the knowledge of cyber assets and potential adversary capabilities and approaches, and provides defense mechanisms that dynamically adjust to changes related to mission, assets, vulnerability state, and defense mechanisms.

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 and Aberdeen Proving Grounds, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Cyber Security Collaborative Research Alliance	0.000	0.000	3.010
Description: The Cyber Security CRA focuses on three Research Areas (Risk, Detection, Agility), and on Cross Cutting Research Issue (CCRI) (Psychosocial Effects). Research in Risk will develop theories and models that relate fundamental properties and features of dynamic risk assessment algorithms to the fundamental properties of dynamic cyber threats, Army's networks, and defensive mechanisms. Research in Detection will develop theories and models that relate properties and capabilities of cyber threat detection and recognition processes/mechanisms to properties of a malicious activity, and of properties of Army networks. Research in Agility will develop theories and models to support planning and controls of cyber maneuver (i.e., "maneuver" in the space of network characteristics and topologies) that would describe how control and end-state of the maneuver are influenced by fundamental properties of threats, such as might be rapidly inferred from limited observations of a new, recently observed threat.			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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** EA6: *Cyber Collaborative Research Alliance*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
The Psychosocial Effects CCRI is studied in each of the three Research Areas and will develop theories and models related to user, operator and adversary behavior in risk assessment, detection, and cyber maneuver. Research Areas will develop theories and models related to user, operator and adversary behavior in risk assessment, detection, and cyber maneuver. ***FY 2014 Plans:*** Will competitively select a consortium consisting of academia, industry and government researchers to advance the theoretical foundations of cyber science in the context of Army networks. Will investigate new holistic conceptualizations and definitions of risk, resiliency and robustness under an adversarial setting. Will study and create theory and techniques for effective non-signature based detection of advanced persistent threats. Will develop mathematical theories and models leading to algorithms to affect a desired maneuver end-state in dynamic environments and deliberate obfuscation attempts by the adversary. Will explore theoretical models of the cyber defender leading to improved defender effectiveness.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	3.010

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

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 2014 Army											**DATE:** April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*					**PROJECT** F17: *Neuroergonomics Collaborative Technology Alliance*			

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
F17: *Neuroergonomics Collaborative Technology Alliance*	-	4.995	5.251	5.381	-	5.381	5.462	5.659	5.595	5.696	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

Note
  Not applicable for this item.

A. Mission Description and Budget Item Justification
  This project fosters research through the Cognition and 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.

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Title: Neurocognitive performance in operational environments	1.862	1.965	2.047
Description: This effort is intended to understand fundamental principles underlying Soldier neurocognitive performance in operational environments. **FY 2012 Accomplishments:** Transitioned lessons learned to the design and creation of simulation experiments to capture neurocognitive performance while embedded in military-relevant operational contexts; utilized simulation environments to evaluate predictions made from formal models; elaborated and refined models of neurocognitive function developed based on results generated during simulation experiments. **FY 2013 Plans:** Complete execution of large scale simulation evaluations to generate data for addressing issues of individual differences in neurocognitive performance; 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. **FY 2014 Plans:** Will develop and transition lessons learned on individual differences in neurocognitive performance from large scale simulation evaluations to second phase of evaluation with increased military relevance/realism; will develop simulation evaluations with increased military relevance/realism to evaluate formal models of neurocognitive performance issues of individuals in neurocognitive performance.			
Title: Computational neural analysis	1.510	1.586	1.609
Description: This effort advances computational approaches for the analysis and interpretation of neural functioning. **FY 2012 Accomplishments:** Analyzed 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. **FY 2013 Plans:** 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; and design extensions of databases to enable further analysis and modeling of individual differences in neurocognitive function. **FY 2014 Plans:**			

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Will conduct data mining explorations of large-scale simulation evaluations using novel computational methods for identification and clustering of predictive features of inter- and intra-subject variability; and will implement extensible database designs for enabling data exploration and modeling of individual differences in neurocognitive function.			
Title: Neurotechnologies *Description:* This effort provides a fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance. *FY 2012 Accomplishments:* Refined online signal processing methods as well as expanded methods for analysis of electroencephalogram (EEG) data; identified key biomechanical measures based on the inertial fatigue-monitoring sensors and investigated 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. *FY 2013 Plans:* Mature and assess online signal processing methods for analysis of EEG data; validate methods and sensor performance for remote monitoring of Soldier fatigue; implement and evaluate algorithms for a neuro-computer vision system for automated environmental appraisal; implement and assess user feedback / alerting system relating to saliency and attention modeling, object detection, object tracking for automation and Soldier training technology design. *FY 2014 Plans:* Will refine methods, sensor performance, and system designs for on-line monitoring and assessment of Soldier fatigue and neurocognitive state; will validate performance of algorithms for a neuro-computer vision for automated environment appraisal; will evaluate and validate methods for Soldier monitoring and assessment in human-computer interaction technologies for Soldier intentional and target detection performance and adaptive automation systems.	1.623	1.700	1.725
Accomplishments/Planned Programs Subtotals	4.995	5.251	5.381

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

D. Acquisition Strategy
  N/A

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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E. Performance Metrics

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

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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H04: *HBCU/MI Programs*	-	2.215	18.507	2.960	-	2.960	3.010	3.061	3.112	3.168	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

FY 14 OSD funding for Historically Black Colleges and Univerisites and Minority Institutions was realigned from the RDT&E,Army appropriation to RDT&E, Defense-wide appropriation. Army specific efforts continue to be funded in this project.

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 to 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 if 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)	FY 2012	FY 2013	FY 2014
Title: Centers of Excellence for Battlefield Capability Enhancements (BCE)	2.215	2.908	2.960
Description: Five new Partnership in Research Transition (PIRT) Centers of Excellence were established in 2011 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			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
capacity of the HBCUs to provide excellence in education; and to conduct research critical to the national security functions of the DoD. *FY 2012 Accomplishments:* Continued research efforts at the five new Centers of Excellence. *FY 2013 Plans:* Continue research efforts at the PIRT Centers of Excellence; conduct major program-wide review of all center research progress. *FY 2014 Plans:* Will continue research efforts at PIRT Centers of Excellence that began in FY11 and continued in FY12 and FY13 for centers showing sufficient progress toward research goals and transition.			
Title: Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) *Description:* 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. *FY 2013 Plans:* Conduct a Broad Agency Announcement and solicitations to execute funding for grants and awards following legislative and executive policy and guidance when Congress directs.	0.000	15.599	0.000
Accomplishments/Planned Programs Subtotals	2.215	18.507	2.960

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*				**PROJECT** H05: *Institute For Collaborative Biotechnologies*			

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H05: *Institute For Collaborative Biotechnologies*	-	11.823	12.326	12.458	-	12.458	12.877	12.976	13.234	13.437	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Institute for Collaborative Biotechnologies *Description:* Perform sustained multidisciplinary basic research supporting technology to provide the Army with bio-inspired materials and biomolecular sensor platforms. *FY 2012 Accomplishments:* Research efforts pursued development of mass-based assays for detecting molecular, viral and cell-based pathogens relevant to the Army; developed shell and bone-inspired passive actuators aimed toward dissipating energy targeted against buildings,	10.795	10.908	11.014

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*	**PROJECT** H05: *Institute For Collaborative Biotechnologies*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
barracks and bunkers; expanded use of synthetic biology for engineering novel materials and fuels; developed first-principles molecular design rules to create honeycomb micro-trusses for fabrication into composite blast-resistant materials. *FY 2013 Plans:* Investigate engineering glucosidases (enzyme class responsible for catalyzing breakdown of plant and other biomaterials into nutrients) and assessing bio- mixtures with thermally-stable cellulases for potential future applications in biofuel production; research concepts and designs for bio-inspired energy-dispersive composites. *FY 2014 Plans:* Will investigate methods for designing and characterizing bio-inspired materials such as exploring new architectures for mechanical strength which can form the basis for new protective materials for the Soldier; will expand computational tools that allow for improved selection of engineered enzymes as candidates for potential use in biofuel production; will design biomolecular circuitry and control systems within cells to enable rapid detection and response to environmental effects; will examine the effects of oligoelectrolyte insertion within the membranes of a variety of bacterial species to better determine the effects of membrane modification on the potential for generating power from wastewater remediation.			
Title: Neuroscience *Description:* Perform multidisciplinary basic research in the area of neuroscience. *FY 2012 Accomplishments:* Continued 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 multimodel imaging to further develop enabling technologies that support improved methods for Soldier training; continued investigations of genetic markers that can be linked to abilities in classification learning; investigated the shared neural substrates for action simulation and intention understanding. *FY 2013 Plans:* Study genetic, anatomic, and strategic differences of cognitive performance using EEG and fMRI methods to characterize individual differences of brain activity; begin design and validation of new methods to characterize brain anatomic networks and dynamical patterns relevant to neuroimaging studies. *FY 2014 Plans:* Will assess the relationship between brain structural and functional connections with behavior to gain a better understanding of the relationship between a Soldier's hardwired brain structure and cognitive ability; will assess whether neural measurements (e.g., functional magnetic resonance imaging or electroencephalography) can predict the performance of an individual to	1.028	1.418	1.444

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*	**PROJECT** H05: *Institute For Collaborative Biotechnologies*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
correctly perceive and detect targets placed at unusual locations within natural environments; will identify neural and physiological biomarkers associated with adaptive cognitive capacity under stress and fatigue.			
Accomplishments/Planned Programs Subtotals	11.823	12.326	12.458

C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

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APPROPRIATION/BUDGET ACTIVITY
2040: *Research, Development, Test & Evaluation, Army*
BA 1: *Basic Research*

R-1 ITEM NOMENCLATURE
PE 0601104A: *University and Industry Research Centers*

PROJECT
H09: *Robotics CTA*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H09: *Robotics CTA*	-	5.115	5.550	6.649	-	6.649	5.945	5.842	5.940	6.047	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Autonomous systems	5.115	5.550	6.649
Description: 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.			
FY 2012 Accomplishments: Explored 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; evaluated the learned recognition of terrain and			

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
objects with placement into context; assessed situational awareness within human-robot teams; and explored methodologies for coordinated manipulation.			
FY 2013 Plans: Investigate incorporation of learning into recognition of relationships between both static and dynamic elements of the environment; Explore mechanisms for common understanding between humans and machines to enable effective teaming; Examine fundamental principles and mechanics of grasping, manipulation, and ambulation.			
FY 2014 Plans: Will expand investigation of learning and recognition of relationships to include more complex dynamic environments and adversarial intent; will continue investigation of cognitive approaches to machine perception and creation of a shared mental model to reduce reliance upon communication between humans and robots; will continue exploration of whole body (dynamic) manipulation of objects in the environment; and will continue exploration of novel ground locomotion techniques to enable rapid mobility in three-dimensional and confined environments			
Accomplishments/Planned Programs Subtotals	5.115	5.550	6.649

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: Research, Development, Test & Evaluation, Army BA 1: Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A: University and Industry Research Centers	PROJECT H50: Network Sciences CTA

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H50: Network Sciences CTA	-	12.494	12.968	14.201	-	14.201	14.879	14.844	14.894	15.033	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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), formed to leverage commercial research investments to provide solutions to Army's requirements for robust, survivable, and highly mobile wireless communications networks, while 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 network science research 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)	FY 2012	FY 2013	FY 2014
Title: Network Sciences Collaborative Technology Alliance (NS CTA) Description: 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	12.494	12.968	14.201

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H50: *Network Sciences CTA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
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 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. *FY 2012 Accomplishments:* Developed models of network performance that capture the complex interactions between social, cognitive, information and communication networks; Extended the initial trust model that will improve network fidelity and reliability in the tactical mobile ad hoc network (MANET) environment; developed theoretically grounded empirical models of emergence and propagation of trust and beliefs in insurgent-civilian populations and in battle command decision-making; produced experimentally-confirmed results in dynamics and stability of large-scale, dynamic, distributed, human-centric networks of information; and investigated the impacts of mobility and adversarial attacks on the dynamics of information quality delivered through mobile communication networks. *FY 2013 Plans:* Using human-in-the-loop and simulation-emulation experiments, along with collections of empirical data, 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. *FY 2014 Plans:* Will explore mathematical representations of dynamic communications, information, and social networks that enable the analysis of their joint behavior. Techniques will be developed for discovering node roles and hierarchical structures in noisy, uncertain social networks, and techniques to maximize information (not bits) delivered based on quality of information needs and the context of decisions (semantics). Techniques will also be developed for social and information-aware caching to improve performance and robustness of composite networks. These efforts will result in analytical techniques for the design of better Army tactical networks that are more resilient in disruptive environments.			
Accomplishments/Planned Programs Subtotals	12.494	12.968	14.201

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

D. Acquisition Strategy
  N/A

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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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 2014 Army										DATE: April 2013	
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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H53: *Army High Performance Computing Research Center*	-	4.215	4.516	4.902	-	4.902	6.193	6.991	7.109	7.237	Continuing	Continuing

\# FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
\#\# The FY 2014 OCO Request will be submitted at a later date

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 2012	FY 2013	FY 2014
Title: AHPCRC **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 2012 Accomplishments:**	4.215	4.516	4.902

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Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*	**PROJECT** H53: *Army High Performance Computing Research Center*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Developed 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. *FY 2013 Plans:* Continue to 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; develop scalable approaches for drug delivery through non-fluidic methods for Army medical applications; validate preliminary simulations for all electron battery; validate ion of back projection applications for battle command applications on new hybrid computing architecture; and investigate scalable algorithms for large-scale graphene modeling software and associated validation approaches with Army Research Laboratory experiments. *FY 2014 Plans:* Will implement reduced order modeling (ROM) approach for underbody blast application. This application will include occupant in addition to IED blast and vehicle structural response. Will reinforce simple verification and validation with RDEC's on the ROM approach and will implement nano-fluidic based multi-scale/multi-physics approach on scalable computers. Will work with US MRMC in validating this approach for blood flow and drug delivery. Will develop domain specific language (DSL) for Finite Element based approaches, and will explore emerging hybrid and memory hierarchy computer systems. Beginning in FY14, will support education and outreach activities formerly funded in PE/Project 65803/731.			
Accomplishments/Planned Programs Subtotals	4.215	4.516	4.902

C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*					**PROJECT** H54: *Micro-Autonomous Systems Technology (MAST) CTA*			
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013**#	**FY 2014 Base**	**FY 2014 OCO** ##	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
H54: *Micro-Autonomous Systems Technology (MAST) CTA*	-	7.689	8.127	8.096	-	8.096	8.348	8.381	8.419	8.630	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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, Development, and Engineering Center (TARDEC); the Natick Soldier Research, Development, and Engineering Center (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 2012**	**FY 2013**	**FY 2014**
Title: Micro Autonomous Systems Technology CTA	7.689	8.127	8.096
Description: Enhance tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional mobile Microsystems. *FY 2012 Accomplishments:*			

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*	**PROJECT** H54: *Micro-Autonomous Systems Technology (MAST) CTA*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Experimentally validated 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 conducted experiments on the ability of small air and ground platforms to navigate to a waypoint based on sensor input. *FY 2013 Plans:* 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. Conduct experiments on the ability of small air and ground platforms to work collaboratively to enter and explore an urban structure. *FY 2014 Plans:* Will study and develop bio-inspired robotic platform mobility and control methods for Micro Autonomous Systems in real world environments, sensors for on-board state estimation and perception, architectures and algorithms for heterogenous teaming, and study trades between increased risk and uncertainty and increased operational tempo. Will conduct joint experiments on emerging technology to assess the ability of small air and ground platforms to work collaboratively to enter and explore urban and complex 3D environments.			
Accomplishments/Planned Programs Subtotals	7.689	8.127	8.096

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

D. Acquisition Strategy
  N/A

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

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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H59: *International Tech Centers*	-	6.175	7.503	7.609	-	7.609	7.708	7.832	7.964	8.107	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: International Technology Centers (ITC)	5.273	6.514	6.602
Description: Funding is provided for the following effort.			

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Continued 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. *FY 2013 Plans:* 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. *FY 2014 Plans:* 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.			
Title: Basic Research Center in Network Science at the United States Military Academy (USMA) *Description:* Network science research at USMA in coordination with the NS CTA. *FY 2012 Accomplishments:* Greater emphasis was 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. *FY 2013 Plans:* Investigate cooperation networks and how these theoretical frameworks can improve systems and organizations; continue to research biological networks and implement these insights towards improvement in communication and organizational networks; study economic cascading events in order to better understand obstacles to the economic development of a country. *FY 2014 Plans:* Develop an algorithm based on the convergence of "vertex probabilities" that will improve the ability to "influence" a social network; will refine initial findings concerning cooperation networks and how these theoretical frameworks can improve systems and organizations; study network topologies and features linked to network vulnerabilities and efficient network-level power management will occur; development of a new network classification model that assists policy makers with economic development strategy will be another focus of this research.	0.902	0.989	1.007
Accomplishments/Planned Programs Subtotals	6.175	7.503	7.609

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

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

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H62: *Institude for Advanced Technology (IAT)*	-	1.378	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 ended. New efforts beginning in FY12 will be conducted via competitive solicitation and performed under PE 0601104/Project VS2, Center for Advanced ResearchMulti-Scale Materials Modeling 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 project is monitored and guided by the Army Research Laboratory (ARL) in Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Electromagnetic Lethality	1.378	0.000	0.000
Description: Funding is provided for the following effort. *FY 2012 Accomplishments:* Completed theoretical investigations of novel lethal concepts and document findings; and finalized contract obligations.			
Accomplishments/Planned Programs Subtotals	1.378	0.000	0.000

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C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT H64: *MATERIALS CENTER*

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H64: *MATERIALS CENTER*	-	2.826	0.758	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 built fundamental knowledge supporting ARL in-house materials research projects (PE 0601102A, project H42) and accelerated the transition of technology to PE 0602105A (Materials Technology). In FY12, work in this effort concluded. In FY13, the advanced materials emphasis for the Army focuses on multi-disciplinary, multi-scale materials behavior in extreme environments conducted in PE 0601104A Project VS2 titled Multi-Scale Materials Modeling 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 project is performed by the Army Research Laboratory (ARL) in Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Materials Research for vehicle protection	2.826	0.758	0.000
Description: 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.			

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
FY 2012 Accomplishments: Investigated 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. *FY 2013 Plans:* Finalize mechanism-based multi-scale approach to microstructure design for dynamic applications; and develop understanding of size effects in magnesium vis-a -vis etching and orientation for quantifying demonstrated enhanced mechanical properties. Complete effort in FY13.			
Accomplishments/Planned Programs Subtotals	2.826	0.758	0.000

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*					PROJECT H73: *Automotive Research Center (ARC)*		

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H73: *Automotive Research Center (ARC)*	-	3.870	4.092	4.195	-	4.195	4.197	4.251	4.321	4.399	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 Iowa, 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 2012	FY 2013	FY 2014
Title: Automotive Research Center (ARC)	3.870	4.092	4.195
Description: Funding is provided for the following effort.			
FY 2012 Accomplishments:			

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*	**PROJECT** H73: *Automotive Research Center (ARC)*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Researched fundamental challenges synthesizing and advancing ground vehicle technologies as well as power systems to improve mobility and reliability; addressed novel electronic architectures, alternative fuels and advanced materials for weight reduction. *FY 2013 Plans:* 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 targeting key areas such as fuel economy, safety, system compactness, soldier/vehicle performance, cost savings, vehicle control (including autonomous vehicles), and system optimality/reliability. *FY 2014 Plans:* Will synthesize and test new hybrid propulsion concepts with novel energy conversion and storage devices; perform engine experiments with combustion modeling to characterize JP-8 performance; design lightweight and safe structures to address impact protection and reliability; integrate physical and cognitive human models to represent driving behavior; classify driver distraction, fatigue and stress; characterize Soft Soil Terra-mechanics and effects on mobility, safety and fuel economy; perform vehicle system integration through verification, validation and certification of vehicle tests, and multi-level vehicle design.			
Accomplishments/Planned Programs Subtotals	3.870	4.092	4.195

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

D. Acquisition Strategy
  N/A

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

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| APPROPRIATION/BUDGET ACTIVITY
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BA 1: *Basic Research* | | | | R-1 ITEM NOMENCLATURE
PE 0601104A: *University and Industry Research Centers* | | | | PROJECT
J08: *Institute For Creative Technologies (ICT)* | | | |

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J08: *Institute For Creative Technologies (ICT)*	-	7.764	8.003	8.104	-	8.104	8.751	9.355	9.623	9.805	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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. 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, health and medical, and distance learning. The ICT actively performs research and engages industry to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable technologies into military systems. In addition the ICT works with creative talent from the entertainment industry to leverage techniques and capabilities and adapt concepts of story and character to increase the degree of participant immersion in synthetic environments in order to improve the realism and usefulness of these experiences. In developing a true synthesis of the creativity, research, technology, and capability of industry and the research and development community, the ICT is revolutionizing capabilities for the Army by making it more effective in terms of cost, time, range of experiences and the quality of the result. Resulting research, techniques, and technologies and techniques are transitioned for maturation to PE 0602308A /project D02.

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 2012	FY 2013	FY 2014
Title: Immersive Environments	3.016	3.063	3.116
Description: 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, simulation and application solutions and tools.. Research includes investigation of techniques and methods to address the rapid development of synthetic environments and the study of perception and cognition to help direct the development of new technologies and techniques that evoke more realistic responses from users. *FY 2012 Accomplishments:*			

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Investigated the use of large scale 3D displays for immersive simulation and learning environments; and completed social perception as well as reactivity studies to improve virtual human responsiveness and rapport. *FY 2013 Plans:* Implement psychophysiology measures to improve the simulation fidelity of virtual immersive environments; and continue evaluation of techniques and methods to address the rapid development of synthetic environments. *FY 2014 Plans:* Will investigate integrated augmented reality environments that add virtual elements (people, objects, and events) onto real world visualization for training and learning purposes. Will examine techniques for the creation of virtual training content from sources such as mobile devices, mobile sensors, public databases, and sensor networks to make training and distance learning more accessible.			
Title: Graphics and Animations *Description:* 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. *FY 2012 Accomplishments:* Researched novel approaches for using specialized light sources to facilitate 3D modeling; and developed algorithms that provided real-time reconstruction of geometric shapes using a single photographic view of an object. *FY 2013 Plans:* Further research the creation of photo-real characters and environments and demonstrate these capabilities; develop comprehensive facial performance capture techniques; develop software for rendering multiple faces; and complete the research investigation of high-fidelity eye models for virtual characters. *FY 2014 Plans:* Will develop facial animation techniques that accurately mimic human facial expressions. Will develop a pipeline which combines automated rigging based on high-fidelity facial scans.	1.698	1.788	1.878
Title: Techniques and Human-virtual Human Interaction *Description:* Conduct basic research to investigate methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans. *FY 2012 Accomplishments:*	3.050	3.152	3.110

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
Enhanced toolkits for virtual humans to accelerate the development of virtual humans via collaborations with external organizations; and developed statistical models of culture-specific behaviors for conversations.			
FY 2013 Plans: 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; and develop group behavior prediction models and algorithms to include social cognition, social perception and social reactivity models and algorithms for virtual humans.			
FY 2014 Plans: Will conduct evaluations of the social impact of virtual humans on human users and will develop social cues that predict cooperative/competitive orientation in a bargaining task to expand understanding of effectiveness of virtual characters as role players in training exercises. Will implement graphical cognitive architecture into Virtual Humans that will lead to less complex but more human-like systems.			
Accomplishments/Planned Programs Subtotals	7.764	8.003	8.104

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

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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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)* | | | |

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J12: *Institute For Soldier Nanotechnology (ISN)*	-	10.441	10.706	10.558	-	10.558	10.646	10.689	10.884	11.096	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

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. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Nanomaterials	2.639	2.705	2.700
Description: Nanomaterials research efforts focus on light-weight, multifunctional nanostructured fibers and materials.			
FY 2012 Accomplishments: Designed and fabricated photoconducting and photodiode fibers with bandwidth and noise equivalent power commensurate with communication system specifications; investigated the electrical tunability of conductive electrospun fibers establishing a clear			

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*	PROJECT J12: *Institute For Soldier Nanotechnology (ISN)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
processing-structure-property relationship for these fibers; examined properties of nanoparticle-containing layer-by-layer films, including films designed to be self-cleaning and with decontamination properties. *FY 2013 Plans:* Examine carbon nanotube/conducting polymer composite films assembled onto electrospun nanofibers to determine sensing properties; study properties conferred by various functional group additions/modifications to polymers for potential sensing applications; investigate the range of electrical robustness of conductive electrospun fibers for future signal communications; investigating mechanical properties of electrospun materials. *FY 2014 Plans:* Will characterize a variety of quantum dot and graphene-based structures as detection elements for night vision applications; will perform preliminary characterization of thermal properties at ceramic/polymer interfaces that may provide materials for improved cooling and power generation from waste heat; will model hybrid structure architectures of semiconductor materials within pre-drawn fibers to optimize the semiconductor performance within a fiber; will investigate methods for imaging light and sound within arrays of fibers designed for optical and acoustic detection.			
Title: Blast Effects on Soldier *Description:* Blast Effects on Soldier research involves the areas of Battle Suit Medicine and Blast and Ballistic Protection. *FY 2012 Accomplishments:* Modeled shock propagation in new polymeric materials; examined 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; examined properties of new aluminum nanoscale crystalline alloys and developed underpinning theory for stabilizing these alloys; continued development of nanostructured contractile polymers to serve as new actuator material technologies. *FY 2013 Plans:* Investigate natural armor systems to determine related mechanical behavior and penetration resistance; explore how new biological-design concepts can be scaled to resist forces proportional to blast or ballistic impact; assess new membranes for peptide immobilization and potential as a high-throughput assay of peptide activity; synthesizing and characterize continuous shape memory alloy fibers. *FY 2014 Plans:* Will synthesize a library of brain-lipid nanoparticles as a potential encapsulating agent for potential use in targeted therapies to treat traumatic brain injury; will measure structure and properties of two-layer aluminum-alloy nanostructures for future design of improved lightweight materials with optimized strength, hardness and toughness; will synthesize new protein-based hydrogels as tissue stimulants and test the effects of these hydrogels against blast and ballistic impact; will design and test atomistic level	5.166	5.295	5.250

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
models for ceramic and polymer systems toward an ultimate multi-scalar model that provides more accurate predictive tools for material failure under blast and ballistic loading conditions.			
Title: Soldier Protection *Description:* Soldier Protection research efforts focus on Soldier Survivability and Protection and Nanosystems Integration. *FY 2012 Accomplishments:* Optimized 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 characterized novel nanoscale virucidal and bactericidal coatings for equipment surface protection. *FY 2013 Plans:* Investigate nanotube-based assemblies for detection of DNA and determine whether structures can be adapted to detect other chemicals and biological warfare agents; synthesize and characterize high-quality nanoscale virucidal and bactericidal coatings of sensory polymers using photochemical grafting and other fabrication methods; develop and characterize new fiber designs to determine structures that improve fiber sensing functionality; functionalize surface of graphene sensing devices to confer different electrochemistries and determine changes in selectivity. *FY 2014 Plans:* Will investigate modification of a graphene surface toward the design, fabrication and testing of a first-generation graphene sensor optimized for the detection of food pathogens; will determine various polymeric structures bound to carbon nanotubes and to screen these complexes against a panel of explosive compounds to potentially enable the future design of a highly-sensitive chemical detection platform, and will investigate methods for fabrication and testing of artificial protein polymer hydrogels for potential use as a biodegradable hemostat that can stop blood flow from a wound.	2.636	2.706	2.608
Accomplishments/Planned Programs Subtotals	10.441	10.706	10.558

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

D. Acquisition Strategy
  N/A

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E. Performance Metrics

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					**R-1 ITEM NOMENCLATURE** PE 0601104A: *University and Industry Research Centers*					**PROJECT** J14: *Army Educational Outreach Program*		

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J14: *Army Educational Outreach Program*	-	6.029	9.593	9.738	-	9.738	9.864	9.935	10.038	10.219	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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 PE65803/729 into this PE 61104/J14.

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), and the United States Military Academy (USMA).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: eCYBERMISSION	3.628	3.628	3.892
Description: This program supports a nation-wide, web-based, science, technology, engineering and mathematics (STEM) competition for students in grades 6 through 9, designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Increased participation from existing levels and increased geographic diversity; sustained eCYBERMISSION and implemented enhancements based on lessons learned from previous years. *FY 2013 Plans:* Continue to increase participation from existing levels with a concentrated effort in underserved populations and geographic diversity; sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years. *FY 2014 Plans:* Will work to further 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.			
Title: Educational Outreach and Workforce Development *Description:* In FY13, funds for this effort transferred from PE 0605803 Project 729 to align educational outreach program elements within a single Project. *FY 2013 Plans:* 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. Provide direct mentorship to students to broaden their interest in and their development of STEM education. *FY 2014 Plans:* 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.	0.000	2.416	2.430
Title: Army Educational Outreach Program Cooperative Agreement *Description:* The youth science cooperative outreach agreement (COA) encompasses a variety of outreach activities under 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. *FY 2012 Accomplishments:*	2.401	3.211	3.073

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army		**DATE:** April 2013
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 2012**	**FY 2013**	**FY 2014**
Funding was executed for the Army Educational Outreach program support. Efforts for this were fully rolled into 0601104 J14 from 0605803 729 in 2013. *FY 2013 Plans:* Continue to increase Army lab and research center sponsorship of students and STEM education opportunities. Provide competition incentives in STEM competitions that include scholarships, experiences, and mentorships as well as exposing students to DoD career opportunities; streamline processes, leverage funding and building educational partnerships. *FY 2014 Plans:* 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. Will continue annual comprehensive review and educational assessments for programs to make data driven decisions and support best practices.			
Title: West Point Cadet Research *Description:* In FY13, funds for this effort are transferred fromPE 0605803 Project 729 to align educational outreach program elements within a single Project. *FY 2013 Plans:* Conducting West Point cadet research internship programs to enhance cadet training through field experience within Army research labs and centers. *FY 2014 Plans:* Will conduct West Point cadet research internship program to enhance cadet training through field experience within Army research labs and centers.	0.000	0.338	0.343
Accomplishments/Planned Programs Subtotals	6.029	9.593	9.738

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

D. Acquisition Strategy
  N/A

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

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APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*				R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*				PROJECT J15: *Network Sciences ITA*				

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J15: *Network Sciences ITA*	-	7.453	4.048	4.125	-	4.125	4.192	4.221	4.301	4.384	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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)	FY 2012	FY 2013	FY 2014
Title: Network and information science basic research for US/UK coalition operations information.	7.453	4.048	4.125
Description: 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. *FY 2012 Accomplishments:* Devised mathematical models to reason about network behaviors and composite security metrics to improve the security of heterogeneous coalition networks; investigated efficient and effective distributed federated database techniques to fuse and aggregate data from heterogeneous networks in support of dynamic coalition operations. *FY 2013 Plans:*			

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
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.). Develop techniques for the management and control of hybrid coalition networks and techniques for the security of distributed services. These efforts 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. *FY 2014 Plans:* Will develop controlled natural language that enables information extraction from structured and unstructured data sources to improve interactions between analyst and machine processing. This research will develop techniques to enable dynamic group coalition information exchange in hybrid mobile ad hoc and cellular networks. This research will also develop efficient and secure access to distributed data as a service among coalition partners without disclosure of security policies. These efforts will enhance network security and information sharing in coalition operations.			
Accomplishments/Planned Programs Subtotals	7.453	4.048	4.125

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

D. Acquisition Strategy
    N/A

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

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COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J17: *Vertical Lift Research Center Of Excellence*	-	2.569	2.771	3.062	-	3.062	3.026	3.189	3.243	3.301	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

Note
Not applicable for this item.

A. Mission Description and Budget Item Justification

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 is 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 extramurally by the Aeroflightdynamics Directorate of the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) (located at the NASA Ames Research Center, Moffett Field, CA).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Vertical Lift Research Center of Excellence	2.569	2.771	3.062
Description: Funding is provided for the following effort			
FY 2012 Accomplishments: Fully implemented multiple new VLRCOE agreements, with substantial participation by Navy and NASA that included experimental and analytic work toward basic research applicable to future DoD rotorcraft fleet requirements.			
FY 2013 Plans: Implement year two of new VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology; secure Navy and NASA funding to supplement a robust experimental and analytic basic research program in			

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B. Accomplishments/Planned Programs ($ in Millions)	**FY 2012**	**FY 2013**	**FY 2014**
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. *FY 2014 Plans:* Will implement year three of VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology to conduct 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.			
Accomplishments/Planned Programs Subtotals	2.569	2.771	3.062

C. Other Program Funding Summary ($ in Millions)

  N/A

Remarks

D. Acquisition Strategy

  N/A

E. Performance Metrics

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army										DATE: April 2013	

| APPROPRIATION/BUDGET ACTIVITY
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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)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
VS2: *Multi-Scale Materials Modeling Centers*	-	5.033	8.326	8.614	-	8.614	9.263	9.462	9.990	10.441	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note
Not applicable for this item.

A. Mission Description and Budget Item Justification

This project supports two competitively awarded Collaborative Research Alliances (CRAs) 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. The Materials in Extreme Dynamic Environments consortium, led by Johns Hopkins University partnered with CalTech, Rutgers University, and University of Delaware, focuses on understanding materials under high strain-rates. The Multiscale/Multidisciplinary Modeling of Electronic Materials consortium, led by University of Utah partnered with Boston University, and Rensselaer Polytechnic Institute, focuses on microscale properties to design macroscale behavior for electronics. Research at both CRAs 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 2012	FY 2013	FY 2014
Title: Multi-Disciplinary, Multi-Scale Materials Behavior in Extreme Environments. *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	5.033	8.326	8.614

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
disciplines to facilitate revolutionary advances in materials for coupled environments (electromagnetic, high rate, high pressure and other extreme environments). *FY 2012 Accomplishments:* An external center was competitively awarded to establish first- generation modeling and experimental techniques for multi-scale materials modeling. *FY 2013 Plans:* Demonstrate real-time microstructural interrogation of materials during high-rate experiments; 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). *FY 2014 Plans:* Will experimentally and computationally model and characterize the in-situ materials response to extreme dynamic environments in metallic, polymeric, ceramic and composite material systems through the incorporation of selected algorithms to enhance the fidelity of continuum simulation codes that optimize hybrid multi-material protection for soldier and vehicle systems. Will implement physics based modeling of electronic materials by developing a set of multiscale algorithms/theories for a range of electronic materials that enable better understanding of material, electronic, optical and opto-electronic properties. Will develop multiscale models and algorithms that predict the bulk and interfacial properties of fuel cells and electrochemical energy sources. Resulting models and algorithms will enable the advancement of the next generation sensors and power and energy devices on the battlefield.			
Accomplishments/Planned Programs Subtotals	5.033	8.326	8.614

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

Remarks

D. Acquisition Strategy
  N/A

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2014 Army										**DATE:** April 2013	

| **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**
VS3: *Center For Quantum Science Research* | | |

COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013**#	**FY 2014 Base**	**FY 2014 OCO** ##	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
VS3: *Center For Quantum Science Research*	-	0.000	0.000	0.000	-	0.000	1.175	1.180	1.487	1.743	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012
The FY 2014 OCO Request will be submitted at a later date

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
Remarks

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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