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**Department of Defense
Fiscal Year (FY) 2024 Budget Estimates**

March 2023



Army

Justification Book Volume 1b of 1

Research, Development, Test & Evaluation, Army

RDT&E – Volume I, Budget Activity 2

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Army • Budget Estimates FY 2024 • RDT&E Program

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RESEARCH, DEVELOPMENT, TEST AND EVALUATION, ARMY
APPROPRIATION LANGUAGE

For expenses necessary for basic and applied scientific research, development, test and evaluation, including maintenance, rehabilitation, lease, and operation of facilities and equipment, \$15,772,215,000.00 to remain available for obligation until September 30, 2025.

The FY 2024 Overseas Operations accounted for in the base budget are as follows:

In-theater and in-CONUS expenses that remain after combat operations cease and have been previously funded in Overseas Operations \$3,166,000.00.

COST STATEMENT

The following Justification Books were prepared at a cost of \$365,839.52: Aircraft (ACFT), Missiles (MSLS), Weapons & Tracked Combat Vehicles (WTCV), Ammunition (AMMO), Other Procurement Army (OPA) 1 – Tactical & Support Vehicles, Other Procurement Army (OPA) 2 – Communications & Electronics, Other Procurement Army (OPA) 3 & 4 - Other Support Equipment & Spares, Research, Development, Test and Evaluation (RDTE) for: Budget Activity 1, Budget Activity 2, Budget Activity 3, Budget Activity 4, Budget Activity 5A, Budget Activity 5B, Budget Activity 5C, Budget Activity 5D, Budget Activity 6, Budget Activity 7, and Budget Activity 8.

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FY 2024 RDT&E, ARMY PROGRAM ELEMENT DESCRIPTIVE SUMMARIES
Introduction and Explanation of Contents

1. **General.** The purpose of this document is to provide summary information concerning the Research, Development, Test and Evaluation, Army program. The descriptive summaries are comprised of R-2 (Army RDT&E Budget Item Justification – program element level), R-2A (Army RDT&E Budget Item Justification – project level), R-3 (Army RDT&E Cost Analysis), R-4 (Schedule Profile Detail) and R-5 (Termination Liability Funding for MDAPs) Exhibits, which provide narrative information on all RDT&E program elements and projects through FY 2024.

2. **Relationship of the FY 2024 Budget Submitted to Congress to the FY 2023 Budget Submitted to Congress.** This paragraph provides a list of program elements/projects that are major new starts, restructures, developmental transitions, and terminated programs. Explanations for these changes can be found in the narrative sections of the Program Element R-2A Exhibits.

New Start Programs:

<u>Budget Activity</u>	<u>OSDPE / Project</u>	<u>Project Title</u>
02	0602146A / AM6	Modular RF Communications Technology
02	0602148A / CI4	Adaptive Avionics Technologies
02	0602141A / CIC	Fire Control Lethality Technology
02	0602182A / DA8	Quantum PNT & Radio Frequency Sensing
02	0602182A / DB4	Enabling Long Standoff 3D (ELS3D) Tech
02	0602002A / DC6	Sci & Analysis for Autonomous Sys & Counter-Auton
02	0602183A / DE2	Airborne Threat Defeat
02	0602150A / DE3	Adv Beam Control Component Development for C-CM
02	0602182A / DE6	Understanding Environment as a Threat Tech
03	0603044A / CW1	Technical-SAVVY Soldier Advanced Research
03	0603116A / DB2	Future Armaments Scalable Technologies
03	0603042A / DB5	Enabling Long Standoff 3D (ELS3D) Adv Tech
03	0603463A / DB6	Pathfinder 3D Advanced Technology
04	0604103A / DG4	NAVWAR SA
04	0603779A / DH6	Installation Resilience
05	0604802A / DC9	30mm MMPA M-SHORAD INC 3

05	0604818A / DD1	Unified Network Technology Trans & Integ (UNTTI)
05	0605206A / DG3	CI and HUMINT Equipment Program-Army (CIHEP-A)
05	0605013A / DH1	Operational Medicine Information System
05	0605216A / EFA	Joint Target Integrated Cmd & Coordination Suite
05	0605036A / EQ5	Combating Weapons of Mass Destruction (CWMD)
05	0605049A / XT4	Advanced Threat Detection System (ATDS)
06	0605601A / WD1	West Desert Test Center
07	0203735A / DD4	AMPV Improvement Program
07	0607315A / DD5	Army Power Systems Modernization

Program Element/Project Restructures:

<u>Budget Activity</u>	<u>Old OSDPE / Project: Title</u>	<u>New OSDPE / Project</u>
02	0602145A / CU5: Next Generation Combat Vehicle Technolog	0602141A / CIA
02	0602181A / CM7: All Domain Convergence Applied Research	0602141A / CIB
02	0602143A / AZ9: Soldier Lethality Technology	0602143A / BB4
02	0602143A / BBG: Soldier Lethality Technology	0602143A / BC2
02	0602145A / BG8: Next Generation Combat Vehicle Technology	0602144A / DG1
02	0602180A / CL7: Artificial Intelligence and Machine Learning Technologies	0602180A / DE8
03	0603040A / CL6: Artificial Intelligence and Machine Learning Technologies	0603040A / DE9
03	0603463A / AR6: Network C3I Advanced Technology	0603042A / DE7
03	0603041A / CM8: All Domain Convergence Advanced Technology	0603116A / CID
03	0603462A / BH6: Next Generation Combat Vehicle Advanced Technology	0603118A / BD9
03	0603462A / BG9: Next Generation Combat Vehicle Advanced Technology	0603119A / DG2
03	0603464A / CZ8: Long Range Precision Fires Advanced Technology	0603464A / AF2
04	0604036A / BY9: Multi-Domain Sensing System (MDSS) Adv Dev	0604036A / DD6
04	0604036A / BY9: Multi-Domain Sensing System (MDSS) Adv Dev	0604036A / DD6

05	0604818A / EJ5: Family of Heavy Vehicles	0604622A / DG7
05	0605224A / CK4: Long-Range Hypersonic Weapon	0604182A / HX2
05	0605224A / CK4: All Up Round and Canister (AUR+C)	0604182A / HX2
05	0605457A / S40: Common Hypersonic Glide Body (CHGB)	0604182A / HX2
05	0605601A / F30: Ground Support Equipment (GSE)	0604182A / HX2
05	0203744A / EB6: HX6: Test and Evaluation	0604182A / HX2
05	0605224A / CK4: Multi-Domain Intelligence	0604805A / 593
05	0605224A / CK4: Multi-Domain Intelligence	0605224A / DD8
05	0605457A / S40: Multi-Domain Intelligence	0605224A / DD9
05	0605601A / F30: Army Integrated Air and Missile Defense (AIAMD)	0605457A / SS1
06	0605601A / F30: Army Integrated Air and Missile Defense (AIAMD)	0605702A / 128
07	0203744A / EB6: Army Test Ranges and Facilities	0305219A / MQ2

Program Terminations (including transfers to Procurement and Sustainment):

<u>Budget Activity</u>	<u>OSDPE / Project</u>	<u>Project Title</u>
03	0603465A / AI8	Future Vertical Lift Advanced Technology / Alternative Concept Engine Advanced Technology
03	0603463A / AV4	Network C3I Advanced Technology / Foundational S&T for Network C3I Advanced Tech
04	0305251A / DD3	Cyberspace Operations Forces and Force Support / Joint Cyber Warfighting Architecture Cyber Train
04	0604115A / AX8	Technology Maturation Initiatives / Adv Leth and Accuracy Sys for Med Calber (ALAS-MC)
04	0604115A / AX9	Technology Maturation Initiatives / Adv Mobility Experimental Prototype Adv Tech
05	0604802A / CE3	Weapons and Munitions - Eng Dev / Precision Munition (Sniper)
05	0604802A / EU4	Weapons and Munitions - Eng Dev / 40mm HV Improved High Explosive Dual Purpose
05	0604804A / FG4	Logistics and Engineer Equipment - Eng Dev / Ultra-Lightweight Camouflage Net System (ULCANS)
05	0604822A / DV6	General Fund Enterprise Business System (GFEBs) / General Fund Enterprise Business System
05	0604854A / HB6	Artillery Systems - EMD / Mobile 155MM Howitzer
05	0605013A / 184	Information Technology Development / Installation Support Modules
07	0305204A / 11A	Tactical Unmanned Aerial Vehicles / Advanced Payload Develop & Spt

07	0305206A / EH2	Airborne Reconnaissance Systems / EMARSS ADV DEV
07	0305206A / EH3	Airborne Reconnaissance Systems / EMARSS Payloads ADV DEV
08	0608041A / DD2	Defensive CYBER - Software Prototype Development / Joint Cyber Warfighting Architecture Software

3. **Classification:** This document contains no classified data. Appropriately cleared individuals can obtain further information on Classified/Special Access Programs by contacting the Department of the Army.

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Department of Defense
 FY 2024 President's Budget
 Exhibit R-1 FY 2024 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

Mar 2023

<u>Appropriation</u>	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment	FY 2024 Request
Research, Development, Test and Evaluation, Army	14,660,654	17,142,121	9,100	17,151,221	15,775,381
Total Research, Development, Test, & Evaluation	14,660,654	17,142,121	9,100	17,151,221	15,775,381

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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Department of Defense
 FY 2024 President's Budget
 Exhibit R-1 FY 2024 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

Mar 2023

	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment	FY 2024 Request
<u>Summary Recap of Budget Activities</u>					
Basic Research	590,078	635,395		635,395	497,455
Applied Research	1,521,472	1,823,330		1,823,330	948,358
Advanced Technology Development	2,145,309	2,532,690		2,532,690	1,455,986
Advanced Component Development & Prototypes	3,799,417	4,631,111	6,000	4,637,111	4,420,315
System Development & Demonstration	3,178,005	4,317,752	600	4,318,352	5,639,364
Management Support	1,901,655	1,820,502		1,820,502	1,624,585
Operational Systems Development	1,416,677	1,286,510	2,500	1,289,010	1,105,748
Software And Digital Technology Pilot Programs	108,041	94,831		94,831	83,570
Total Research, Development, Test, & Evaluation	14,660,654	17,142,121	9,100	17,151,221	15,775,381
<u>Summary Recap of FYDP Programs</u>					
General Purpose Forces	559,789	372,120		372,120	404,375
Intelligence and Communications	262,480	248,995		248,995	212,694
Research and Development	13,733,825	16,382,072	9,100	16,391,172	15,055,009
Central Supply and Maintenance	101,466	132,270		132,270	75,317
Administration and Associated Activities	101				
Classified Programs	2,993	6,664		6,664	27,986
Total Research, Development, Test, & Evaluation	14,660,654	17,142,121	9,100	17,151,221	15,775,381

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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Department of the Army
 FY 2024 President's Budget
 Exhibit R-1 FY 2024 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

Mar 2023

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<u>Summary Recap of Budget Activities</u>					
Basic Research	590,078	635,395		635,395	497,455
Applied Research	1,521,472	1,823,330		1,823,330	948,358
Advanced Technology Development	2,145,309	2,532,690		2,532,690	1,455,986
Advanced Component Development & Prototypes	3,799,417	4,631,111	6,000	4,637,111	4,420,315
System Development & Demonstration	3,178,005	4,317,752	600	4,318,352	5,639,364
Management Support	1,901,655	1,820,502		1,820,502	1,624,585
Operational Systems Development	1,416,677	1,286,510	2,500	1,289,010	1,105,748
Software And Digital Technology Pilot Programs	108,041	94,831		94,831	83,570
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Research and Development	13,733,825	16,382,072	9,100	16,391,172	15,055,009
Central Supply and Maintenance	101,466	132,270		132,270	75,317
Administration and Associated Activities	101				
Classified Programs	2,993	6,664		6,664	27,986
Total Research, Development, Test, & Evaluation	14,660,654	17,142,121	9,100	17,151,221	15,775,381

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Department of the Army
 FY 2024 President's Budget
 Exhibit R-1 FY 2024 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

Mar 2023

Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
1	0601102A	Defense Research Sciences	01	U	358,521	391,642		391,642
2	0601103A	University Research Initiatives	01	U	88,797	107,160		107,160
3	0601104A	University and Industry Research Centers	01	U	122,521	121,160		121,160
4	0601121A	Cyber Collaborative Research Alliance	01	U	5,067	5,355		5,355
5	0601601A	Artificial Intelligence and Machine Learning Basic Research	01	U	15,172	10,078		10,078
	Basic Research				590,078	635,395		635,395
6	0602002A	Army Agile Innovation and Development-Applied Research	02	U		1,000		1,000
7	0602115A	Biomedical Technology	02	U	11,489			
8	0602134A	Counter Improvised-Threat Advanced Studies	02	U	1,904	6,192		6,192
9	0602141A	Lethality Technology	02	U	89,285	194,717		194,717
10	0602142A	Army Applied Research	02	U	28,654	27,833		27,833
11	0602143A	Soldier Lethality Technology	02	U	201,221	253,539		253,539
12	0602144A	Ground Technology	02	U	214,489	264,523		264,523
13	0602145A	Next Generation Combat Vehicle Technology	02	U	239,284	277,445		277,445
14	0602146A	Network C3I Technology	02	U	161,759	212,115		212,115
15	0602147A	Long Range Precision Fires Technology	02	U	107,454	128,529		128,529
16	0602148A	Future Verticle Lift Technology	02	U	130,108	104,348		104,348
17	0602150A	Air and Missile Defense Technology	02	U	92,926	88,768		88,768
18	0602180A	Artificial Intelligence and Machine Learning Technologies	02	U	14,486	16,068		16,068

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Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2024 Request
1	0601102A	Defense Research Sciences	01	U	296,670
2	0601103A	University Research Initiatives	01	U	75,672
3	0601104A	University and Industry Research Centers	01	U	108,946
4	0601121A	Cyber Collaborative Research Alliance	01	U	5,459
5	0601601A	Artificial Intelligence and Machine Learning Basic Research	01	U	10,708
	Basic Research				497,455
6	0602002A	Army Agile Innovation and Development-Applied Research	02	U	5,613
7	0602115A	Biomedical Technology	02	U	
8	0602134A	Counter Improvised-Threat Advanced Studies	02	U	6,242
9	0602141A	Lethality Technology	02	U	85,578
10	0602142A	Army Applied Research	02	U	34,572
11	0602143A	Soldier Lethality Technology	02	U	104,470
12	0602144A	Ground Technology	02	U	60,005
13	0602145A	Next Generation Combat Vehicle Technology	02	U	166,500
14	0602146A	Network C3I Technology	02	U	81,618
15	0602147A	Long Range Precision Fires Technology	02	U	34,683
16	0602148A	Future Verticle Lift Technology	02	U	73,844
17	0602150A	Air and Missile Defense Technology	02	U	33,301
18	0602180A	Artificial Intelligence and Machine Learning Technologies	02	U	24,142

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Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
19	0602181A	All Domain Convergence Applied Research	02	U	25,019	27,360		27,360
20	0602182A	C3I Applied Research	02	U	11,954	27,868		27,868
21	0602183A	Air Platform Applied Research	02	U	6,356	41,588		41,588
22	0602184A	Soldier Applied Research	02	U	10,660	15,716		15,716
23	0602213A	C3I Applied Cyber	02	U	12,119	13,605		13,605
24	0602386A	Biotechnology for Materials - Applied Research	02	U	19,889	21,811		21,811
25	0602785A	Manpower/Personnel/Training Technology	02	U	18,414	19,649		19,649
26	0602787A	Medical Technology	02	U	124,002	80,656		80,656
Applied Research					1,521,472	1,823,330		1,823,330
27	0603002A	Medical Advanced Technology	03	U	147,287	31,588		31,588
28	0603007A	Manpower, Personnel and Training Advanced Technology	03	U	13,865	15,598		15,598
29	0603025A	Army Agile Innovation and Demonstration Artificial Intelligence and Machine Learning Advanced Technologies	03	U	21,420	20,900		20,900
30	0603040A		03	U	876	6,395		6,395
31	0603041A	All Domain Convergence Advanced Technology	03	U	20,095	45,377		45,377
32	0603042A	C3I Advanced Technology	03	U	3,036	12,716		12,716
33	0603043A	Air Platform Advanced Technology	03	U	727	17,946		17,946
34	0603044A	Soldier Advanced Technology	03	U	858	479		479
35	0603115A	Medical Development	03	U	25,540			
36	0603116A	Lethality Advanced Technology	03	U	7,772	9,796		9,796
37	0603117A	Army Advanced Technology Development	03	U	76,815	134,874		134,874

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Line No	Program Element Number	Item	Act	Se c	FY 2024 Request
19	0602181A	All Domain Convergence Applied Research	02	U	14,297
20	0602182A	C3I Applied Research	02	U	30,659
21	0602183A	Air Platform Applied Research	02	U	48,163
22	0602184A	Soldier Applied Research	02	U	18,986
23	0602213A	C3I Applied Cyber	02	U	22,714
24	0602386A	Biotechnology for Materials - Applied Research	02	U	16,736
25	0602785A	Manpower/Personnel/Training Technology	02	U	19,969
26	0602787A	Medical Technology	02	U	66,266
	Applied Research				948,358
27	0603002A	Medical Advanced Technology	03	U	4,147
28	0603007A	Manpower, Personnel and Training Advanced Technology	03	U	16,316
29	0603025A	Army Agile Innovation and Demonstration Artificial Intelligence and Machine Learning Advanced Technologies	03	U	23,156
30	0603040A		03	U	13,187
31	0603041A	All Domain Convergence Advanced Technology	03	U	33,332
32	0603042A	C3I Advanced Technology	03	U	19,225
33	0603043A	Air Platform Advanced Technology	03	U	14,165
34	0603044A	Soldier Advanced Technology	03	U	1,214
35	0603115A	Medical Development	03	U	
36	0603116A	Lethality Advanced Technology	03	U	20,582
37	0603117A	Army Advanced Technology Development	03	U	136,280

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Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
38	0603118A	Soldier Lethality Advanced Technology	03	U	148,458	154,639		154,639
39	0603119A	Ground Advanced Technology	03	U	281,637	415,846		415,846
40	0603134A	Counter Improvised-Threat Simulation	03	U	23,920	21,486		21,486
41	0603386A	Biotechnology for Materials - Advanced Research	03	U	51,774	56,853		56,853
42	0603457A	C3I Cyber Advanced Development	03	U	61,426	41,354		41,354
43	0603461A	High Performance Computing Modernization Program	03	U	222,220	301,964		301,964
44	0603462A	Next Generation Combat Vehicle Advanced Technology	03	U	294,491	471,434		471,434
45	0603463A	Network C3I Advanced Technology	03	U	205,576	177,917		177,917
46	0603464A	Long Range Precision Fires Advanced Technology	03	U	138,482	202,830		202,830
47	0603465A	Future Vertical Lift Advanced Technology	03	U	255,323	272,551		272,551
48	0603466A	Air and Missile Defense Advanced Technology	03	U	125,027	99,147		99,147
49	0603920A	Humanitarian Demining	03	U	18,684	21,000		21,000
Advanced Technology Development					2,145,309	2,532,690		2,532,690
51	0603305A	Army Missile Defense Systems Integration	04	U	56,579	118,001		118,001
52	0603308A	Army Space Systems Integration	04	U	25,401	30,945		30,945
53	0603327A	Air and Missile Defense Systems Engineering	04	U	15,000	15,000		15,000
54	0603619A	Landmine Warfare and Barrier - Adv Dev	04	U	44,933	55,953	6,000	61,953
55	0603639A	Tank and Medium Caliber Ammunition	04	U	61,641	51,488		51,488
56	0603645A	Armored System Modernization - Adv Dev	04	U	154,010	135,122		135,122
57	0603747A	Soldier Support and Survivability	04	U	2,791	4,060		4,060
58	0603766A	Tactical Electronic Surveillance System - Adv Dev	04	U	113,365	72,314		72,314

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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Mar 2023

Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2024 Request
38	0603118A	Soldier Lethality Advanced Technology	03	U	102,778
39	0603119A	Ground Advanced Technology	03	U	40,597
40	0603134A	Counter Improvised-Threat Simulation	03	U	21,672
41	0603386A	Biotechnology for Materials - Advanced Research	03	U	59,871
42	0603457A	C3I Cyber Advanced Development	03	U	28,847
43	0603461A	High Performance Computing Modernization Program	03	U	255,772
44	0603462A	Next Generation Combat Vehicle Advanced Technology	03	U	217,394
45	0603463A	Network C3I Advanced Technology	03	U	105,549
46	0603464A	Long Range Precision Fires Advanced Technology	03	U	153,024
47	0603465A	Future Vertical Lift Advanced Technology	03	U	158,795
48	0603466A	Air and Missile Defense Advanced Technology	03	U	21,015
49	0603920A	Humanitarian Demining	03	U	9,068
		Advanced Technology Development			1,455,986
51	0603305A	Army Missile Defense Systems Integration	04	U	12,904
52	0603308A	Army Space Systems Integration	04	U	19,120
53	0603327A	Air and Missile Defense Systems Engineering	04	U	
54	0603619A	Landmine Warfare and Barrier - Adv Dev	04	U	47,537
55	0603639A	Tank and Medium Caliber Ammunition	04	U	91,323
56	0603645A	Armored System Modernization - Adv Dev	04	U	43,026
57	0603747A	Soldier Support and Survivability	04	U	3,550
58	0603766A	Tactical Electronic Surveillance System - Adv Dev	04	U	65,567

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 (Dollars in Thousands)

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Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment	FY 2023 Total Enactment
59	0603774A	Night Vision Systems Advanced Development	04	U	62,534	97,478		97,478
60	0603779A	Environmental Quality Technology - Dem/Val	04	U	22,491	76,749		76,749
61	0603790A	NATO Research and Development	04	U	3,639	3,805		3,805
62	0603801A	Aviation - Adv Dev	04	U	1,138,457	1,157,472		1,157,472
63	0603804A	Logistics and Engineer Equipment - Adv Dev	04	U	10,797	24,638		24,638
64	0603807A	Medical Systems - Adv Dev	04	U	27,768	5,598		5,598
65	0603827A	Soldier Systems - Advanced Development	04	U	25,288	23,444		23,444
66	0604017A	Robotics Development	04	U	78,309	26,555		26,555
67	0604019A	Expanded Mission Area Missile (EMAM)	04	U	26,855	258,320		258,320
68	0604020A	Cross Functional Team (CFT) Advanced Development & Prototyping	04	U		77,000		77,000
69	0604035A	Low Earth Orbit (LEO) Satellite Capability	04	U	18,922	35,509		35,509
70	0604036A	Multi-Domain Sensing System (MDSS) Adv Dev	04	U	50,548	47,915		47,915
71	0604037A	Tactical Intel Targeting Access Node (TITAN) Adv Dev	04	U	28,347	863		863
72	0604100A	Analysis Of Alternatives	04	U	9,723	10,659		10,659
73	0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04	U	892	1,425		1,425
74	0604103A	Electronic Warfare Planning and Management Tool (EWPMT)	04	U				
75	0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	U	76,349	134,719		134,719
76	0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	U	408,766	380,147		380,147
77	0604115A	Technology Maturation Initiatives	04	U	127,725	219,742		219,742
78	0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	U	37,939	274,838		274,838

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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59	0603774A	Night Vision Systems Advanced Development	04	U	73,675
60	0603779A	Environmental Quality Technology - Dem/Val	04	U	31,720
61	0603790A	NATO Research and Development	04	U	4,143
62	0603801A	Aviation - Adv Dev	04	U	1,502,160
63	0603804A	Logistics and Engineer Equipment - Adv Dev	04	U	7,604
64	0603807A	Medical Systems - Adv Dev	04	U	1,602
65	0603827A	Soldier Systems - Advanced Development	04	U	27,681
66	0604017A	Robotics Development	04	U	3,024
67	0604019A	Expanded Mission Area Missile (EMAM)	04	U	97,018
68	0604020A	Cross Functional Team (CFT) Advanced Development & Prototyping	04	U	117,557
69	0604035A	Low Earth Orbit (LEO) Satellite Capability	04	U	38,851
70	0604036A	Multi-Domain Sensing System (MDSS) Adv Dev	04	U	191,394
71	0604037A	Tactical Intel Targeting Access Node (TITAN) Adv Dev	04	U	10,626
72	0604100A	Analysis Of Alternatives	04	U	11,095
73	0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04	U	5,144
74	0604103A	Electronic Warfare Planning and Management Tool (EWPMT)	04	U	2,260
75	0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	U	53,143
76	0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	U	816,663
77	0604115A	Technology Maturation Initiatives	04	U	281,314
78	0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	U	281,239

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Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
79	0604119A	Army Advanced Component Development & Prototyping	04	U	179,483	198,111		198,111
80	0604120A	Assured Positioning, Navigation and Timing (PNT)	04	U	80,858	57,620		57,620
81	0604121A	Synthetic Training Environment Refinement & Prototyping	04	U	198,815	242,468		242,468
82	0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04	U	12,891	14,840		14,840
83	0604135A	Strategic Mid-Range Fires	04	U		404,291		404,291
84	0604182A	Hypersonics	04	U	305,406	238,168		238,168
85	0604403A	Future Interceptor	04	U	6,643	8,179		8,179
86	0604531A	Counter - Small Unmanned Aircraft Systems Advanced Development	04	U	18,449	35,110		35,110
87	0604541A	Unified Network Transport	04	U	33,879	36,966		36,966
88	0604644A	Mobile Medium Range Missile	04	U	275,989			
89	0604785A	Integrated Base Defense (Budget Activity 4)	04	U	2,040			
90	0305251A	Cyberspace Operations Forces and Force Support	04	U	55,895	55,599		55,599
999	999999999	Classified Programs	04	U				
		Advanced Component Development & Prototypes			3,799,417	4,631,111	6,000	4,637,111
91	0604201A	Aircraft Avionics	05	U	6,411	3,335		3,335
92	0604270A	Electronic Warfare Development	05	U	29,683	4,140		4,140
93	0604601A	Infantry Support Weapons	05	U	77,027	83,329		83,329
94	0604604A	Medium Tactical Vehicles	05	U	9,177	22,163		22,163
95	0604611A	JAVELIN	05	U	8,202	16,186		16,186

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79	0604119A	Army Advanced Component Development & Prototyping	04	U	204,914
80	0604120A	Assured Positioning, Navigation and Timing (PNT)	04	U	40,930
81	0604121A	Synthetic Training Environment Refinement & Prototyping	04	U	109,714
82	0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04	U	16,426
83	0604135A	Strategic Mid-Range Fires	04	U	31,559
84	0604182A	Hypersonics	04	U	43,435
85	0604403A	Future Interceptor	04	U	8,040
86	0604531A	Counter - Small Unmanned Aircraft Systems Advanced Development	04	U	64,242
87	0604541A	Unified Network Transport	04	U	40,915
88	0604644A	Mobile Medium Range Missile	04	U	
89	0604785A	Integrated Base Defense (Budget Activity 4)	04	U	
90	0305251A	Cyberspace Operations Forces and Force Support	04	U	
999	999999999	Classified Programs	04	U	19,200
		Advanced Component Development & Prototypes			4,420,315
91	0604201A	Aircraft Avionics	05	U	13,673
92	0604270A	Electronic Warfare Development	05	U	12,789
93	0604601A	Infantry Support Weapons	05	U	64,076
94	0604604A	Medium Tactical Vehicles	05	U	28,226
95	0604611A	JAVELIN	05	U	7,827

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96	0604622A	Family of Heavy Tactical Vehicles	05	U	27,406	53,014		53,014
97	0604633A	Air Traffic Control	05	U	4,244	2,623		2,623
98	0604641A	Tactical Unmanned Ground Vehicle (TUGV)	05	U		109,849		109,849
99	0604642A	Light Tactical Wheeled Vehicles	05	U	1,980			
100	0604645A	Armored Systems Modernization (ASM) - Eng Dev	05	U	118,296	63,131		63,131
101	0604710A	Night Vision Systems - Eng Dev	05	U	41,831	92,951		92,951
102	0604713A	Combat Feeding, Clothing, and Equipment	05	U	1,598	1,566		1,566
103	0604715A	Non-System Training Devices - Eng Dev	05	U	28,605	18,588		18,588
104	0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	U	58,633	55,541		55,541
105	0604742A	Constructive Simulation Systems Development	05	U	21,424	29,481		29,481
106	0604746A	Automatic Test Equipment Development	05	U	8,486	5,178		5,178
107	0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	U	12,182	8,189		8,189
108	0604798A	Brigade Analysis, Integration and Evaluation	05	U	20,976	21,086		21,086
109	0604802A	Weapons and Munitions - Eng Dev	05	U	287,787	285,778	600	286,378
110	0604804A	Logistics and Engineer Equipment - Eng Dev	05	U	49,201	75,669		75,669
111	0604805A	Command, Control, Communications Systems - Eng Dev	05	U	19,372	44,993		44,993
112	0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	U	43,023	5,513		5,513
113	0604808A	Landmine Warfare/Barrier - Eng Dev	05	U	28,622	37,150		37,150
114	0604818A	Army Tactical Command & Control Hardware & Software	05	U	146,291	131,190		131,190
115	0604820A	Radar Development	05	U	124,832	71,259		71,259

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96	0604622A	Family of Heavy Tactical Vehicles	05	U	44,197
97	0604633A	Air Traffic Control	05	U	1,134
98	0604641A	Tactical Unmanned Ground Vehicle (TUGV)	05	U	142,125
99	0604642A	Light Tactical Wheeled Vehicles	05	U	53,564
100	0604645A	Armored Systems Modernization (ASM) - Eng Dev	05	U	102,201
101	0604710A	Night Vision Systems - Eng Dev	05	U	48,720
102	0604713A	Combat Feeding, Clothing, and Equipment	05	U	2,223
103	0604715A	Non-System Training Devices - Eng Dev	05	U	21,441
104	0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	U	74,738
105	0604742A	Constructive Simulation Systems Development	05	U	30,985
106	0604746A	Automatic Test Equipment Development	05	U	13,626
107	0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	U	8,802
108	0604798A	Brigade Analysis, Integration and Evaluation	05	U	20,828
109	0604802A	Weapons and Munitions - Eng Dev	05	U	243,851
110	0604804A	Logistics and Engineer Equipment - Eng Dev	05	U	37,420
111	0604805A	Command, Control, Communications Systems - Eng Dev	05	U	34,214
112	0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	U	6,496
113	0604808A	Landmine Warfare/Barrier - Eng Dev	05	U	13,581
114	0604818A	Army Tactical Command & Control Hardware & Software	05	U	168,574
115	0604820A	Radar Development	05	U	94,944

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116	0604822A	General Fund Enterprise Business System (GFEBs)	05	U	15,395	10,402		10,402
117	0604827A	Soldier Systems - Warrior Dem/Val	05	U	6,219	19,408		19,408
118	0604852A	Suite of Survivability Enhancement Systems - EMD	05	U	93,207	100,384		100,384
119	0604854A	Artillery Systems - EMD	05	U	25,000	48,106		48,106
120	0605013A	Information Technology Development	05	U	125,109	104,134		104,134
121	0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	U	65,230	67,519		67,519
122	0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	U	34,262			
123	0605030A	Joint Tactical Network Center (JTNC)	05	U	15,752	17,936		17,936
124	0605031A	Joint Tactical Network (JTN)	05	U	27,849	30,150		30,150
125	0605035A	Common Infrared Countermeasures (CIRCM)	05	U	15,982	11,523		11,523
126	0605036A	Combating Weapons of Mass Destruction (CWMD) Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV)	05	U				
127	0605038A	Sensor Suite	05	U	7,340			
128	0605041A	Defensive CYBER Tool Development	05	U	18,811	39,029		39,029
129	0605042A	Tactical Network Radio Systems (Low-Tier)	05	U	27,688	4,426		4,426
130	0605047A	Contract Writing System	05	U	20,195	13,742		13,742
131	0605049A	Missile Warning System Modernization (MWSM)	05	U				
132	0605051A	Aircraft Survivability Development	05	U	60,127	19,123		19,123
133	0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	U	175,604	131,093		131,093
134	0605053A	Ground Robotics	05	U	15,763	26,809		26,809
135	0605054A	Emerging Technology Initiatives	05	U	219,284	244,047		244,047

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116	0604822A	General Fund Enterprise Business System (GFEBs)	05	U	2,965
117	0604827A	Soldier Systems - Warrior Dem/Val	05	U	11,333
118	0604852A	Suite of Survivability Enhancement Systems - EMD	05	U	79,250
119	0604854A	Artillery Systems - EMD	05	U	42,490
120	0605013A	Information Technology Development	05	U	104,024
121	0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	U	102,084
122	0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	U	
123	0605030A	Joint Tactical Network Center (JTNC)	05	U	18,662
124	0605031A	Joint Tactical Network (JTN)	05	U	30,328
125	0605035A	Common Infrared Countermeasures (CIRCM)	05	U	11,509
126	0605036A	Combating Weapons of Mass Destruction (CWMD) Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV)	05	U	1,050
127	0605038A	Sensor Suite	05	U	
128	0605041A	Defensive CYBER Tool Development	05	U	27,714
129	0605042A	Tactical Network Radio Systems (Low-Tier)	05	U	4,318
130	0605047A	Contract Writing System	05	U	16,355
131	0605049A	Missile Warning System Modernization (MWSM)	05	U	27,571
132	0605051A	Aircraft Survivability Development	05	U	24,900
133	0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	U	196,248
134	0605053A	Ground Robotics	05	U	35,319
135	0605054A	Emerging Technology Initiatives	05	U	201,274

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Line No	Program Element Number	Item	Act	Se c	FY 2022	FY 2023 Less	FY 2023	FY 2023 Total
					Actuals	Supplementals Enactment	Supplementals Enactment ¹	Enactment
136	0605143A	Biometrics Enabling Capability (BEC)	05	U	4,326	11,091		11,091
137	0605144A	Next Generation Load Device - Medium	05	U	14,835	22,439		22,439
138	0605145A	Medical Products and Support Systems Development	05	U	927			
139	0605148A	Tactical Intel Targeting Access Node (TITAN) EMD	05	U	54,972	108,987		108,987
140	0605203A	Army System Development & Demonstration	05	U	122,175	143,616		143,616
141	0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05	U	2,192	6,530		6,530
142	0605206A	CI and HUMINT Equipment Program-Army (CIHEP-A)	05	U				
143	0605216A	Joint Targeting Integrated Command and Coordination Suite (JTIC2S)	05	U				
144	0605224A	Multi-Domain Intelligence	05	U	9,313	6,008		6,008
145	0605225A	SIO Capability Development	05	U	22,713			
146	0605231A	Precision Strike Missile (PrSM)	05	U	181,574	259,506		259,506
147	0605232A	Hypersonics EMD	05	U	107,404	633,499		633,499
148	0605233A	Accessions Information Environment (AIE)	05	U	16,177	10,088		10,088
149	0605235A	Strategic Mid-Range Capability	05	U		5,016		5,016
150	0605236A	Integrated Tactical Communications	05	U		12,447		12,447
151	0605450A	Joint Air-to-Ground Missile (JAGM)	05	U	2,467	2,366		2,366
152	0605457A	Army Integrated Air and Missile Defense (AIAMD)	05	U	154,257	263,545		263,545
153	0605531A	Counter - Small Unmanned Aircraft Systems Sys Dev & Demonstration	05	U	49,667	14,892		14,892
154	0605625A	Manned Ground Vehicle	05	U	194,936	554,925		554,925
155	0605766A	National Capabilities Integration (MIP)	05	U	13,454	17,030		17,030

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136	0605143A	Biometrics Enabling Capability (BEC)	05	U	
137	0605144A	Next Generation Load Device - Medium	05	U	36,970
138	0605145A	Medical Products and Support Systems Development	05	U	
139	0605148A	Tactical Intel Targeting Access Node (TITAN) EMD	05	U	132,136
140	0605203A	Army System Development & Demonstration	05	U	81,657
141	0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05	U	31,284
142	0605206A	CI and HUMINT Equipment Program-Army (CIHEP-A)	05	U	2,170
143	0605216A	Joint Targeting Integrated Command and Coordination Suite (JTIC2S)	05	U	9,290
144	0605224A	Multi-Domain Intelligence	05	U	41,003
145	0605225A	SIO Capability Development	05	U	
146	0605231A	Precision Strike Missile (PrSM)	05	U	272,786
147	0605232A	Hypersonics EMD	05	U	900,920
148	0605233A	Accessions Information Environment (AIE)	05	U	27,361
149	0605235A	Strategic Mid-Range Capability	05	U	348,855
150	0605236A	Integrated Tactical Communications	05	U	22,901
151	0605450A	Joint Air-to-Ground Missile (JAGM)	05	U	3,014
152	0605457A	Army Integrated Air and Missile Defense (AIAMD) Counter - Small Unmanned Aircraft Systems Sys Dev & Demonstration	05	U	284,095
153	0605531A		05	U	36,016
154	0605625A	Manned Ground Vehicle	05	U	996,653
155	0605766A	National Capabilities Integration (MIP)	05	U	15,129

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					Actuals	Supplementals Enactment	Supplementals Enactment	Enactment
156	0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	U	05	2,470	9,376		9,376
157	0605830A	Aviation Ground Support Equipment	U	05	1,158	2,959		2,959
158	0303032A	TROJAN - RH12	U	05	3,362	3,761		3,761
159	0304270A	Electronic Warfare Development	U	05	75,520	99,938		99,938
System Development & Demonstration					3,178,005	4,317,752	600	4,318,352
160	0604256A	Threat Simulator Development	U	06	60,749	138,937		138,937
161	0604258A	Target Systems Development	U	06	41,769	64,132		64,132
162	0604759A	Major T&E Investment	U	06	91,130	142,031		142,031
163	0605103A	Rand Arroyo Center	U	06	31,087	33,631		33,631
164	0605301A	Army Kwajalein Atoll	U	06	242,279	309,005		309,005
165	0605326A	Concepts Experimentation Program	U	06	80,386	86,824		86,824
166	0605502A	Small Business Innovative Research	U	06	374,118			
167	0605601A	Army Test Ranges and Facilities	U	06	362,223	417,567		417,567
168	0605602A	Army Technical Test Instrumentation and Targets	U	06	57,584	67,962		67,962
169	0605604A	Survivability/Lethality Analysis	U	06	35,042	36,500		36,500
170	0605606A	Aircraft Certification	U	06	2,398	4,777		4,777
171	0605702A	Meteorological Support to RDT&E Activities	U	06	6,389	6,958		6,958
172	0605706A	Materiel Systems Analysis	U	06	20,771	22,004		22,004
173	0605709A	Exploitation of Foreign Items	U	06	13,631	6,186		6,186
174	0605712A	Support of Operational Testing	U	06	54,797	70,718		70,718

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Line No	Program Element Number	Item	Act	Se c	FY 2024 Request
156	0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	05	U	27,243
157	0605830A	Aviation Ground Support Equipment	05	U	1,167
158	0303032A	TROJAN - RH12	05	U	3,879
159	0304270A	Electronic Warfare Development	05	U	137,186
System Development & Demonstration					5,639,364
160	0604256A	Threat Simulator Development	06	U	38,492
161	0604258A	Target Systems Development	06	U	11,873
162	0604759A	Major T&E Investment	06	U	76,167
163	0605103A	Rand Arroyo Center	06	U	37,078
164	0605301A	Army Kwajalein Atoll	06	U	314,872
165	0605326A	Concepts Experimentation Program	06	U	95,551
166	0605502A	Small Business Innovative Research	06	U	
167	0605601A	Army Test Ranges and Facilities	06	U	439,118
168	0605602A	Army Technical Test Instrumentation and Targets	06	U	42,220
169	0605604A	Survivability/Lethality Analysis	06	U	37,518
170	0605606A	Aircraft Certification	06	U	2,718
171	0605702A	Meteorological Support to RDT&E Activities	06	U	
172	0605706A	Materiel Systems Analysis	06	U	26,902
173	0605709A	Exploitation of Foreign Items	06	U	7,805
174	0605712A	Support of Operational Testing	06	U	75,133

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Appropriation: 2040A Research, Development, Test and Evaluation, Army

Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
175	0605716A	Army Evaluation Center	06	U	65,693	67,058		67,058
176	0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	U	2,537	6,097		6,097
177	0605801A	Programwide Activities	06	U	90,443	89,793		89,793
178	0605803A	Technical Information Activities	06	U	31,174	37,652		37,652
179	0605805A	Munitions Standardization, Effectiveness and Safety	06	U	54,922	60,645		60,645
180	0605857A	Environmental Quality Technology Mgmt Support	06	U	1,724	1,912		1,912
181	0605898A	Army Direct Report Headquarters - R&D - MHA	06	U	48,798	53,271		53,271
182	0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	U	78,187	89,602		89,602
183	0606003A	CounterIntel and Human Intel Modernization	06	U	10,641	1,424		1,424
184	0606105A	Medical Program-Wide Activities	06	U	37,616			
185	0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	U	5,466	5,816		5,816
186	0909999A	Financing for Cancelled Account Adjustments	06	U	101			
		Management Support			1,901,655	1,820,502		1,820,502
187	0603778A	MLRS Product Improvement Program	07	U	11,865	18,463		18,463
188	0605024A	Anti-Tamper Technology Support	07	U	8,544	9,284		9,284
189	0607131A	Weapons and Munitions Product Improvement Programs	07	U	39,994	54,674	2,500	57,174
190	0607136A	Blackhawk Product Improvement Program	07	U	14,599			
191	0607137A	Chinook Product Improvement Program	07	U	65,960	67,513		67,513
192	0607139A	Improved Turbine Engine Program	07	U	250,533	228,036		228,036
193	0607142A	Aviation Rocket System Product Improvement and Development	07	U	8,831	11,312		11,312

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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175	0605716A	Army Evaluation Center	06	U	71,118
176	0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	U	11,204
177	0605801A	Programwide Activities	06	U	93,895
178	0605803A	Technical Information Activities	06	U	31,327
179	0605805A	Munitions Standardization, Effectiveness and Safety	06	U	50,409
180	0605857A	Environmental Quality Technology Mgmt Support	06	U	1,629
181	0605898A	Army Direct Report Headquarters - R&D - MHA	06	U	55,843
182	0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	U	91,340
183	0606003A	CounterIntel and Human Intel Modernization	06	U	6,348
184	0606105A	Medical Program-Wide Activities	06	U	
185	0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	U	6,025
186	0909999A	Financing for Cancelled Account Adjustments	06	U	
	Management Support				1,624,585
187	0603778A	MLRS Product Improvement Program	07	U	14,465
188	0605024A	Anti-Tamper Technology Support	07	U	7,472
189	0607131A	Weapons and Munitions Product Improvement Programs	07	U	8,425
190	0607136A	Blackhawk Product Improvement Program	07	U	1,507
191	0607137A	Chinook Product Improvement Program	07	U	9,265
192	0607139A	Improved Turbine Engine Program	07	U	201,247
193	0607142A	Aviation Rocket System Product Improvement and Development	07	U	3,014

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Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment*	FY 2023 Total Enactment
194	0607143A	Unmanned Aircraft System Universal Products	07	U	4,426	10,512		10,512
195	0607145A	Apache Future Development	07	U	9,700	25,074		25,074
196	0607148A	AN/TPQ-53 Counterfire Target Acquisition Radar System	07	U	46,009	61,559		61,559
197	0607150A	Intel Cyber Development	07	U	3,611	13,343		13,343
198	0607312A	Army Operational Systems Development	07	U	28,029	26,131		26,131
199	0607313A	Electronic Warfare Development	07	U	5,673	6,432		6,432
200	0607315A	Enduring Turbine Engines and Power Systems	07	U				
201	0607665A	Family of Biometrics	07	U	1,101	1,114		1,114
202	0607865A	Patriot Product Improvement	07	U	125,851	152,312		152,312
203	0203728A	Joint Automated Deep Operation Coordination System (JADOCs)	07	U	24,556	19,311		19,311
204	0203735A	Combat Vehicle Improvement Programs	07	U	272,438	194,229		194,229
205	0203743A	155mm Self-Propelled Howitzer Improvements	07	U	168,683	116,510		116,510
206	0203744A	Aircraft Modifications/Product Improvement Programs	07	U	10,000			
207	0203752A	Aircraft Engine Component Improvement Program	07	U	127	148		148
208	0203758A	Digitization	07	U	3,759			
209	0203801A	Missile/Air Defense Product Improvement Program	07	U	122	3,109		3,109
210	0203802A	Other Missile Product Improvement Programs	07	U	9,956	9,027		9,027
211	0205412A	Environmental Quality Technology - Operational System Dev	07	U	253	793		793
212	0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	U	58,516	20,180		20,180
213	0208053A	Joint Tactical Ground System	07	U	11,379	8,813		8,813

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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194	0607143A	Unmanned Aircraft System Universal Products	07	U	25,393
195	0607145A	Apache Future Development	07	U	10,547
196	0607148A	AN/TPQ-53 Counterfire Target Acquisition Radar System	07	U	54,167
197	0607150A	Intel Cyber Development	07	U	4,345
198	0607312A	Army Operational Systems Development	07	U	19,000
199	0607313A	Electronic Warfare Development	07	U	6,389
200	0607315A	Enduring Turbine Engines and Power Systems	07	U	2,411
201	0607665A	Family of Biometrics	07	U	797
202	0607865A	Patriot Product Improvement	07	U	177,197
203	0203728A	Joint Automated Deep Operation Coordination System (JADOCS)	07	U	42,177
204	0203735A	Combat Vehicle Improvement Programs	07	U	146,635
205	0203743A	155mm Self-Propelled Howitzer Improvements	07	U	122,902
206	0203744A	Aircraft Modifications/Product Improvement Programs	07	U	
207	0203752A	Aircraft Engine Component Improvement Program	07	U	146
208	0203758A	Digitization	07	U	1,515
209	0203801A	Missile/Air Defense Product Improvement Program	07	U	4,520
210	0203802A	Other Missile Product Improvement Programs	07	U	10,044
211	0205412A	Environmental Quality Technology - Operational System Dev	07	U	281
212	0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	U	75,952
213	0208053A	Joint Tactical Ground System	07	U	203

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Line No	Program Element Number	Item	Act	Se c	FY 2022 Actuals	FY 2023 Less Supplementals Enactment	FY 2023 Supplementals Enactment	FY 2023 Total Enactment
216	0303028A	Security and Intelligence Activities	07	U	24,506			
217	0303140A	Information Systems Security Program	07	U	15,680	17,209		17,209
218	0303141A	Global Combat Support System	07	U	43,643	22,600		22,600
219	0303142A	SATCOM Ground Environment (SPACE)	07	U	16,186	18,297		18,297
222	0305179A	Integrated Broadcast Service (IBS)	07	U	5,430	9,926		9,926
223	0305204A	Tactical Unmanned Aerial Vehicles	07	U	8,410	4,500		4,500
224	0305206A	Airborne Reconnaissance Systems	07	U	11,782	17,165		17,165
225	0305219A	MQ-1C Gray Eagle UAS	07	U				
226	0307665A	Biometrics Enabled Intelligence	07	U	2,066			
227	0708045A	End Item Industrial Preparedness Activities	07	U	101,466	132,270		132,270
999	999999999	Classified Programs	07	U	2,993	6,664		6,664
	Operational Systems Development				1,416,677	1,286,510	2,500	1,289,010
228	0608041A	Defensive CYBER - Software Prototype Development	08	U	108,041	94,831		94,831
	Software And Digital Technology Pilot Programs				108,041	94,831		94,831
Total Research, Development, Test and Evaluation, Army					14,660,654	17,142,121	9,100	17,151,221

*Includes enacted funding in the Ukraine Supplemental Appropriation Act, 2023 (Division B of Public Law 117-180) and Additional Ukraine Supplemental Appropriation Act, 2023 (Division M of Public Law 117-328).

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216	0303028A	Security and Intelligence Activities	07	U	301
217	0303140A	Information Systems Security Program	07	U	15,323
218	0303141A	Global Combat Support System	07	U	13,082
219	0303142A	SATCOM Ground Environment (SPACE)	07	U	26,838
222	0305179A	Integrated Broadcast Service (IBS)	07	U	9,456
223	0305204A	Tactical Unmanned Aerial Vehicles	07	U	
224	0305206A	Airborne Reconnaissance Systems	07	U	
225	0305219A	MQ-1C Gray Eagle UAS	07	U	6,629
226	0307665A	Biometrics Enabled Intelligence	07	U	
227	0708045A	End Item Industrial Preparedness Activities	07	U	75,317
999	999999999	Classified Programs	07	U	8,786
	Operational Systems Development				1,105,748
228	0608041A	Defensive CYBER - Software Prototype Development	08	U	83,570
	Software And Digital Technology Pilot Programs				83,570
Total Research, Development, Test and Evaluation, Army					15,775,381

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8	02	0602134A	Counter Improvised-Threat Advanced Studies.....	Volume 1b - 12
9	02	0602141A	Lethality Technology.....	Volume 1b - 15
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14	02	0602146A	Network C3I Technology.....	Volume 1b - 218
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24	02	0602386A	Biotechnology for Materials - Applied Research.....	Volume 1b - 486
25	02	0602785A	Manpower/Personnel/Training Technology.....	Volume 1b - 490
26	02	0602787A	Medical Technology.....	Volume 1b - 494

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Army Applied Research	0602142A	10	02.....	Volume 1b - 57
Artificial Intelligence and Machine Learning Technologies	0602180A	18	02.....	Volume 1b - 368
Biomedical Technology	0602115A	7	02.....	Volume 1b - 9
Biotechnology for Materials - Applied Research	0602386A	24	02.....	Volume 1b - 486
C3I Applied Cyber	0602213A	23	02.....	Volume 1b - 473
C3I Applied Research	0602182A	20	02.....	Volume 1b - 394
Counter Improvised-Threat Advanced Studies	0602134A	8	02.....	Volume 1b - 12
Future Verticle Lift Technology	0602148A	16	02.....	Volume 1b - 307
Ground Technology	0602144A	12	02.....	Volume 1b - 112
Lethality Technology	0602141A	9	02.....	Volume 1b - 15
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Soldier Applied Research	0602184A	22	02.....	Volume 1b - 455
Soldier Lethality Technology	0602143A	11	02.....	Volume 1b - 58

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602002A / <i>Army Agile Innovation and Development-Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	-	1.000	5.613	-	5.613	18.845	19.218	18.128	18.357	0.000	81.161
DC4: <i>Army Applied Innovation</i>	-	-	0.500	3.135	-	3.135	3.657	4.306	4.752	4.814	0.000	21.164
DC5: <i>Team Ignite</i>	-	-	0.500	0.345	-	0.345	8.919	8.947	8.979	9.097	0.000	36.787
DC6: <i>Sci & Analysis for Autonomous Sys & Counter-Auton</i>	-	-	-	2.133	-	2.133	6.269	5.965	4.397	4.446	0.000	23.210

A. Mission Description and Budget Item Justification

This Program Element (PE) funds the Army's goal of assessing and researching innovative solutions to achieve future force modernization. The Army is developing new ways of doing business to include strategic and "non-traditional" partnerships and working with traditional vendors in novel ways to allow for agile integration of leading-edge technology. Critical technologies that allow for technological superiority are increasingly dual-use or developed in academia-led partnerships that leverage cutting edge innovation. In an era of global competition, technological superiority requires agile and rapid innovation. Cross-cutting modernization initiatives leverage strategic partnerships foster an environment to bring knowledge and expertise to demonstrate breakthrough and innovative technologies that will benefit the warfighter. These collaborations bring new ways of doing business to assess and evaluate emerging technologies with high payoff potential to address current technology shortfalls. Leveraging other innovative mechanisms, to include accelerators, incubators, and other technology accelerants, to enhance innovation is part of the overall innovation strategy. Innovation includes not only hardware and physical products but also software, software development, artificial intelligence (AI) and machine learning, all as stand-alone initiatives and as part of broader innovation to programs and technology development. Oversight includes a joint Innovation governance which requires joint evaluation of programs that will meet the basis of Army Priorities and Army Modernization needs to inform an optimal technology investment strategy.

Work in this program element is closely coordinated with program element 0603025A (Army Agile Innovation and Demonstration).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering Priority focus areas and the Army Modernization Strategy.

Work is performed by the United States Army Futures Command.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602002A / <i>Army Agile Innovation and Development-Applied Research</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	0.000	9.534	14.088	-	14.088
Current President's Budget	0.000	1.000	5.613	-	5.613
Total Adjustments	0.000	-8.534	-8.475	-	-8.475
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-8.534			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-8.475	-	-8.475

Change Summary Explanation

Funding realigned to PE 0603464A Project AF2 Long Range Maneuverable Fires (LRMF) Advanced Tech for acceleration of PrSM Inc IV extended range capability to reach TRL 6 in FY26.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research				Project (Number/Name) DC4 / Army Applied Innovation			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC4: Army Applied Innovation	-	-	0.500	3.135	-	3.135	3.657	4.306	4.752	4.814	0.000	21.164

A. Mission Description and Budget Item Justification

This project funds the Applied Research portion of the Army Innovation Plan, the Army's investment strategy to rapidly accelerate innovative solutions to challenging Warfighter problems. This project will provide the Army with the most advanced and cutting-edge solutions, and the ability to adapt and integrate multi-disciplinary innovative technologies. This project accelerates ideation & system-level integration at the initial phase of scientific concepts and technology development, to generate a holistic entry into the acquisition pipeline at the most appropriate milestone. This effort seeks to research, evaluate, and validate these technologies in support of cross-domain operations and accelerating solutions that will meet Army Priorities and provide a pathway for entry into the acquisition process.

This project is coordinated with Program Element 0603025A (Army Agile Innovation and Demonstration), Project DA3 (Army Advanced Innovation).

Army Senior Leadership approves Army innovation projects during the budget year and year of execution based on priority, opportunity, and return on investment for the American taxpayer - ensuring that innovations have a high potential for filling capability gaps and transitioning.

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

Work in this effort is performed by the United States (US) Army Futures Command.

Work in this Project supports any need for acceleration of a solution to address Army Priorities.

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

	FY 2022	FY 2023	FY 2024
Title: Army Applied Innovation	-	0.482	3.135
Description: The Army seeks to research, evaluate, and validate cross-domain technology that display unique and innovative potential to rapidly produce disruptive and groundbreaking capabilities that fall outside of the normal acquisition pipeline.			
FY 2023 Plans: Initiate a competitive process that selects technologies with a high promise of advancing and accelerating capabilities to be investigated in open systems and digital engineering architectures, prior to be transitioned to further Science and Technology efforts. The Army Innovation Program will accept multiple new efforts that support Army Modernization, to include cyber, Electronic Warfare, Sensors, Power and Energy, Artificial Intelligence and Autonomy, Communications, Position, Navigation and Timing, advancing Synthetic Training Environments; and Air and Ground Platform integration.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research	Project (Number/Name) DC4 / Army Applied Innovation

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Identify breakthrough and disruptive technologies, engage novel ideation & system-level integration at the initial phase of the scientific concepts and technology development. Merge synergistic cross-cutting innovations that will lead to advance disruptive technological solutions to Army priorities that require an accelerated solution. Also Identify and initiate development of emergent technologies, for integration in the science and technology program, to address challenges in future operating concepts, operational needs and Army identified priorities. FY 2023 to FY 2024 Increase/Decrease Statement: The applied innovation portfolio is part of a multi-tiered, holistic strategy to accelerate integration of technologies. The increase will allow for continuation of projects in year 1, along with newly identify needs that will accelerate transition development to a programmed advanced technology budget activity 3 approved program.			
Title: SBIR/STTR Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.018	-
Accomplishments/Planned Programs Subtotals	-	0.500	3.135

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research	Project (Number/Name) DC5 / Team Ignite
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC5: <i>Team Ignite</i>	-	-	0.500	0.345	-	0.345	8.919	8.947	8.979	9.097	0.000	36.787

Note

In FY 2024 realigned to PE 0603464A Project AF2 Long Range Maneuverable Fires (LRMF) Advanced Tech

A. Mission Description and Budget Item Justification

IGNITE is part of the multi-tiered Army Innovation Plan to investigate non-traditional and innovative technologies to rapidly develop the technology, delivering quick solutions for Army identified problems. IGNITE empowers individuals to create new approaches to ensure competitive advantage, identifies future warfighting concepts from recent scientific discoveries, ensures capability requirements are grounded in feasible technological advancements and uses data and analytics to build a common language across communities. The primary end state of IGNITE is an Army Modernization Enterprise that has institutionalized a new way of business where modernization processes are inherently collaborative across our diverse expertise, including S&T, conceptual, analytical, operational, experimental, requirements, and threat communities. This will allow decisive capabilities to be developed at a faster pace than our adversaries.

Work in this Project is performed by the United States Army Futures Command (AFC).

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

Title: Team IGNITE

Description: The IGNITE philosophy emphasizes integration through numerous pathways and mechanisms. These include, but are not limited to, cross-organizational events, organizational offices, enduring cohorts, enabling processes, and Ignite innovators.

FY 2023 Plans:

Investigates Innovation, Collaboration, and Integration among multiple communities (S&T, conceptual, analytical, operational, experimental, requirements, and threat communities) with diverse expertise to support the Ignite Strategy. Design and develops plans to accelerate the development of an integrated technology capability with explicit plans for the operational metrics to guide and refine technical development. Develops (and educates workforce) on systematic processes to track risk against metrics and integrate these processes into DEVCOM led reviews. Develops and leads collaborative workshops to identify future concepts about "what could be" for how the future Army fights, organizes, and equips. Conducts experiments to assess operational impact and identify innovative solutions for dynamic near peer threats. Validates modeling tools, simulation capabilities, and analytic models to determine the operational value at early levels of idea maturity and directly link operational metrics and capabilities to technical metrics.

FY 2024 Plans:

	FY 2022	FY 2023	FY 2024
	-	0.482	0.345

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research	Project (Number/Name) DC5 / Team Ignite

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will support limited engagements between multiple communities to wrap up FY23 efforts and document collaborative learning outcomes/best practices. FY 2023 to FY 2024 Increase/Decrease Statement: Decreased funding reflects planned lifecycle of the effort.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.018	-
Accomplishments/Planned Programs Subtotals	-	0.500	0.345

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research	Project (Number/Name) DC6 / Sci & Analysis for Autonomous Sys & Counter-Auton
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC6: <i>Sci & Analysis for Autonomous Sys & Counter-Auton</i>	-	-	-	2.133	-	2.133	6.269	5.965	4.397	4.446	0.000	23.210

Note

Sci & Analysis for Autonomous Sys & Counter-Auton is a new start within the Army Agile Innovation and Development-Applied Research program in FY 2024.

In Fiscal Year (FY) 2024 this Project is a New Start.

A. Mission Description and Budget Item Justification

This Project investigates and develops capabilities to understand and characterize emerging Science and Technology (S&T) technical pursuits and impacts through collaborative analytics that enable the assessment of autonomous systems-of-systems, their implications to the future threat environment, and analyzes their contributions to the Multi-Domain Operation (MDO) concept in relevant operational scenarios. This is a cross-cutting effort that supports S&T, analysis and modeling and simulation (M&S) efforts associated with the development of autonomous systems and their application in military operations.

Work in this Project also funds research to investigate, develop, and validate tools, methodologies, and analytical techniques to extend experimental results, assure early consideration of technology and system vulnerabilities, reduce developmental risk, provide mission context, and improve the robustness of technology readiness assessments.

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Threat and Operations Based Intelligent Autonomy Science (TOBIAS)	-	-	1.257
Description: This effort develops and implements models that will be used to assess the vulnerability and lethality (kinetic and non-kinetic) of U.S. and threat autonomous systems. This work will also incorporate the software-based behavioral capabilities of these systems including interfacing with humans. Technology forecasting will be used to enable the development of optimal investment strategies for autonomy science on the basis of operational merit.			
FY 2024 Plans: Will characterize the elements of vulnerability of autonomy science for unmanned ground and air platforms; define taxonomy and metrics and the representation of these effects in tools that will be developed by the DEVCOM Data and Analysis Center (DAC);			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602002A / Army Agile Innovation and Development-Applied Research	Project (Number/Name) DC6 / Sci & Analysis for Autonomous Sys & Counter-Auton		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
investigate the fragility of Artificial Intelligence/Machine Learning (AI/ML) for autonomous mobility of unmanned ground and air vehicles operating in a contested environment; perform baseline studies on vulnerability of software-based behaviors to non-kinetic effects; investigate approaches for modeling the vulnerabilities; explore forecasting science for autonomous warfare and its effective operational use during the period of 2030-2050, scope includes U.S. and allies versus near-peer threats. FY 2023 to FY 2024 Increase/Decrease Statement: This project is a new start in Fiscal Year (FY) 2024				
Title: Vulnerability and Lethality Analysis Tools for Early Science and Technology Description: Investigates, develops, and validates analytical tools, techniques, and methodologies to extend experimental and research results, ensuring early investigation of technology, system vulnerabilities, human systems integration, system performance, and mission effectiveness. Task objectives reduce developmental risk, provide validation of methodologies and tools in realistic mission contexts, and improve the robustness of technology readiness assessments. FY 2024 Plans: Will develop analytical capabilities for high priority autonomous technologies to enhance discovery and motivate early and comprehensive consideration of vulnerabilities; determine tactically critical technology metrics through scientific research and promote transition of science into systems at reduced risk with greater maturity and enhanced trust in functional autonomy; optimize analytical capabilities and assess system performance and effectiveness in an operational mission context. FY 2023 to FY 2024 Increase/Decrease Statement: This project is a new start in Fiscal Year (FY) 2024		-	-	0.876
Accomplishments/Planned Programs Subtotals		-	-	2.133
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602115A / <i>Biomedical Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	0.000	11.489	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	11.489
EB2: <i>HIV Biomedical Technology</i>	-	11.489	-	-	-	-	-	-	-	-	0.000	11.489

A. Mission Description and Budget Item Justification

This Program Element (PE) funds the Military Human Immunodeficiency Virus (HIV) Research Program and the Combatting Antimicrobial Resistant Bacteria (CARB) projects. The goal of the Military HIV Research Program is to refine identification methods for determining genetic diversity of the virus, to conduct preclinical work in laboratory animals including non-human primates to identify candidates for global HIV-1 vaccine, and to evaluate and prepare overseas sites for clinical trials with these vaccine candidates. For the CARB program, funding provides for the development of strategies to prevent, mitigate, and treat antibiotic resistant bacteria in wounds through the CARB - Walter Reed Army Institute of Research (WRAIR) Discovery and Wound Program.

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	11.925	0.000	0.000	-	0.000
Current President's Budget	11.489	0.000	0.000	-	0.000
Total Adjustments	-0.436	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.436	-			
• SBIR/STTR Transfer	-	-			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602115A / <i>Biomedical Technology</i>				Project (Number/Name) EB2 / <i>HIV Biomedical Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
EB2: <i>HIV Biomedical Technology</i>	-	11.489	-	-	-	-	-	-	-	-	0.000	11.489

A. Mission Description and Budget Item Justification

The Military Human Immunodeficiency Virus (HIV) Research Program conducts research on HIV, which causes acquired immunodeficiency syndrome (AIDS). Work in this area includes refining improved identification methods to determine genetic diversity of the virus and evaluating and preparing overseas sites for clinical trials with global vaccine candidates. Additional activities include refining candidate vaccines for preventing HIV and undertaking preclinical studies (studies required before testing in humans) to assess vaccine for potential to protect and/or manage the disease in infected individuals. This project is jointly managed through an Interagency Agreement between United States Army Medical Research and Development Command (USAMRDC) and the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health.

The Combatting Antimicrobial Resistant Bacteria (CARB) research program was established in response to Presidential direction in late 2013 to create a National Strategy to address the critical issue of antimicrobial resistance. This effort's focus is on the development of new/novel antibiotics, especially those targeting the most resistant and worrisome Gram negative bacterial pathogens, using existing expertise at the Walter Reed Army Institute of Research (WRAIR), and leveraging other WRAIR capabilities to evaluate viable candidate targets for advanced discovery. This project supports (both directly and indirectly) Global Health Security Agenda priorities to respond rapidly and effectively to biological threats of international concern.

The cited work is also consistent with the Under Secretary of Defense, Research and Engineering Science and Technology focus areas, and supports the principal area of Military Relevant Infectious Diseases to include HIV.

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

	FY 2022	FY 2023	FY 2024
<p>Title: HIV Biomedical Technology</p> <p>Description: The Military HIV Research Program (MHRP) conducts research on HIV, which causes AIDS. Work in this area includes refining improved identification methods to determine genetic diversity of the virus and evaluating and preparing overseas sites for future vaccine trials. Additional activities include refining candidate vaccines for preventing HIV and undertaking preclinical studies (studies required before testing in humans) to assess vaccine for potential to protect and/or manage the disease in infected individuals.</p>	9.536	-	-
<p>Title: Combatting Antimicrobial Resistant Bacteria</p> <p>Description: The CARB research program focus is to establish in-house capabilities for an antibacterial drug discovery program directed toward military relevant drug-resistant bacteria that a) encompasses assessment of external products/candidates/leads that may meet Department of Defense (DoD) requirements, b) opens active intramural based discovery efforts of new potential products/candidates/leads for development, and c) fosters partnerships with external collaborators to develop/co-develop new potential antibacterial treatment therapeutics.</p>	1.953	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602115A / <i>Biomedical Technology</i>	Project (Number/Name) EB2 / <i>HIV Biomedical Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Accomplishments/Planned Programs Subtotals	11.489	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army											Date: March 2023	
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602134A / <i>Counter Improvised-Threat Advanced Studies</i>							
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	1.904	6.192	6.242	-	6.242	6.245	6.273	6.276	6.344	0.000	39.476
CD2: <i>Counter Improvised-Threat Advanced Studies</i>	-	1.904	6.192	6.242	-	6.242	6.245	6.273	6.276	6.344	0.000	39.476

A. Mission Description and Budget Item Justification

This Program Element (PE) executes applied research into novel methods for detecting and defeating Improvised Explosive Devices (IED) through the application of emerging technologies as well as research into emerging IED threats to evaluate potential methods of defeat. The goal of this research is to increase the ability of deployed forces to positively identify IEDs with minimal false alarms and positively neutralize or mitigate the effects of IEDs with minimal collateral damage through the systematic identification and maturation of technologies capable of defeating IEDs.

This PE is executed by the Army Futures Command (AFC) in coordination with the Under Secretary of Defense for Research and Engineering (USD/R&E) and the Defense Threat Reduction Agency (DTRA).

Work in this PE was previously conducted under PE 0602134BR, Improvised Threat Reduction Applied Research.

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	1.976	6.192	6.215	-	6.215
Current President's Budget	1.904	6.192	6.242	-	6.242
Total Adjustments	-0.072	0.000	0.027	-	0.027
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.072	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.027	-	0.027

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602134A / <i>Counter Improvised-Threat Advanced Studies</i>				Project (Number/Name) CD2 / <i>Counter Improvised-Threat Advanced Studies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CD2: <i>Counter Improvised-Threat Advanced Studies</i>	-	1.904	6.192	6.242	-	6.242	6.245	6.273	6.276	6.344	0.000	39.476

A. Mission Description and Budget Item Justification

This Project investigates novel methods for detecting and defeating improvised explosive devices (IED) as well as research into emerging IED threats to evaluate potential methods of defeat of the same.

This Project is executed by the Army Futures Command (AFC) in coordination with the Under Secretary of Defense for Research and Engineering (USD/R&E) and the Defense Threat Reduction Agency (DTRA).

Work in this Project was previously conducted under PE 0602134, Improvised Threat Reduction Applied Research.

Work in this Project is related to, and fully coordinated with, PE 0603134A Counter Improvised-Threat Simulation.

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

	FY 2022	FY 2023	FY 2024
Title: Counter IED Emerging Technologies	1.904	5.966	6.242
Description: This effort investigates emerging technologies to include physics, chemistry, biology and computer science to identify applications to detect current and emerging IED threats and defeat their critical components. This effort investigates novel methods and technology solutions for the detection and defeat of IEDs through the systematic identification and maturation of technologies capable of defeating these threats. The goals include increasing the distance for standoff detection, improving the probability of positive identification and reducing the rate of false indications. This effort is informed by technology trends across the Department of Defense and by analysis of IED threats encountered in operational scenarios.			
FY 2023 Plans: Investigate, research and validate emerging RF, EM, EO/IR and other novel IED detection technologies and technology components. Investigate advanced neutralization techniques and components that can be applied to predicting threat emplacements. Evaluate multiple technologies in a laboratory environment for their ability to counter IED threats.			
FY 2024 Plans: Will investigate and mature optical and RF components and techniques to mitigate electromagnetic interference and increase detectability of physically obscured targets. Will reduce time needed for neutralization and expand effectiveness against various			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602134A / <i>Counter Improvised-Threat Advanced Studies</i>	Project (Number/Name) CD2 / <i>Counter Improvised-Threat Advanced Studies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
IED trigger types. Will continue to investigate and develop emerging technologies to assess their ability to counter IED threats. Will investigate sensor effectiveness in multiple locations and in varied environments. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.226	-
Accomplishments/Planned Programs Subtotals	1.904	6.192	6.242

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602141A / Lethality Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	89.285	194.717	85.578	-	85.578	86.406	95.443	96.819	95.751	Continuing	Continuing
AH6: Disruptive Energetics and Propulsion Technologies	-	8.106	8.682	8.752	-	8.752	8.805	8.816	8.822	8.919	0.000	60.902
AH7: Lethal and Scalable Effects Technologies	-	1.841	1.346	1.574	-	1.574	1.574	1.576	1.577	1.594	Continuing	Continuing
AH8: Lethality Materials and Processes Technology	-	3.872	1.868	1.906	-	1.906	1.906	1.907	1.909	1.930	0.000	15.298
AH9: Advanced Warheads Technology	-	24.118	26.780	24.326	-	24.326	27.237	29.256	31.958	32.306	0.000	195.981
BS6: Lethality Technology (CA)	-	27.500	107.000	-	-	-	-	-	-	-	0.000	134.500
CF7: Solid-state Laser Concepts and Architectures	-	7.271	8.567	9.892	-	9.892	9.892	9.904	9.911	10.019	0.000	65.456
CF8: Terminal Effects Against Critical Targets Tech	-	3.893	3.938	2.180	-	2.180	1.032	5.174	4.331	3.729	0.000	24.277
CG4: Advanced Radar Concepts and Technologies	-	4.516	5.891	6.008	-	6.008	6.030	8.990	8.995	9.093	0.000	49.523
CI1: Advanced Armaments Lethality Technology	-	-	1.544	1.684	-	1.684	8.694	7.460	6.732	5.329	0.000	31.443
CIA: Applied Armaments Tech for Distributed Lethality	-	-	-	3.445	-	3.445	-	-	-	-	0.000	3.445
CIB: Sensor to Shooter (STS) Applied Research	-	-	-	6.468	-	6.468	-	-	-	-	0.000	6.468
CIC: Fire Control Lethality Technology	-	-	-	1.462	-	1.462	-	-	-	-	0.000	1.462
CJ1: Lethality Enabling University Applied Research	-	5.583	6.570	7.197	-	7.197	7.858	8.338	8.344	8.435	0.000	52.325
CJ6: Advanced Energetics for Missile Technologies	-	1.142	-	-	-	-	-	-	-	-	0.000	1.142

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602141A / <i>Lethality Technology</i>											
<i>CJ7: Future Air Defense Missile Enabling Tech</i>	-	1.443	14.655	2.324	-	2.324	4.599	4.604	4.607	4.658	0.000	36.890
<i>CZ9: Foundational Hypersonic Weapons Research</i>	-	-	7.876	8.360	-	8.360	8.779	9.418	9.633	9.739	0.000	53.805

Note

Project CI1 (Advanced Armaments Lethality Technology) and Project CZ9 (Foundational Hypersonic Weapons Research) are New Starts for Fiscal Year 2023 (FY23). Project CJ6 (Advanced Energetics for Missile Technologies) is Terminated starting in FY23.

A. Mission Description and Budget Item Justification

Work done in this Program Element (PE) researches technologies, methodologies, and models required to enable next generation lethality. The effort focuses on: lethal mechanism technologies for projectiles and warheads that provide revolutionary capability to defeat Tier 1 adversary vehicle and body armors; selection of propulsion and energetic materials and technology to validate novel energetic materials concepts to exploit controllable energy release for future gun/missile systems; scalable effects for mixed target defeat while simultaneously decreasing warhead mass; development of materials solutions for improvement of weight and volume efficiency, lethal effects and sustainability for the warfighter in the Army of today and beyond; and multiple pathways to enhance lethal effects by investigating synergistic effects of novel micro warheads using advanced materials. Funding in this PE is a continuation of work done in PEs 0602105A (Materials Technology), 0602618A (Ballistics Technology), and 0602624A (Weapons and Munitions Technology).

Work in this PE complements PEs 0602147A (Long Range Precision Fires Technology), 0602150A (Air and Missile Defense Technology), 0602143A (Soldier Lethality Technology), 0602144A (Ground Technology), 0602145A (Next Generation Combat Vehicle Technology), and 0603116A (Lethality Advanced Technology).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	91.626	87.717	77.976	-	77.976
Current President's Budget	89.285	194.717	85.578	-	85.578
Total Adjustments	-2.341	107.000	7.602	-	7.602
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	107.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.341	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	7.602	-	7.602

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BS6: *Lethality Technology (CA)*

Congressional Add: *Program increase - Next Generation Remote Sensing*

Congressional Add: *Program Increase- Hybrid Additive Manufacturing*

Congressional Add: *Program Increase - Hypersonic Wind Tunnel Development*

Congressional Add: *Program Increase - Materials Processing Manufacturing Technology*

Congressional Add: *Program Increase - Universal Nanocrystalline Alloys*

Congressional Add: *Program Increase - ADVANCED MATERIALS AND MANUFACTURING FOR MODERNIZATION*

Congressional Add: *Program Increase - CERAMIC PROTECTION MATERIALS*

Congressional Add: *Program Increase - COLLABORATIVE NETWORKED ARMAMENT LETHALITY TECHNOLOGY*

Congressional Add: *Program Increase - ENHANCED ARMAMENT FIRE CONTROL*

Congressional Add: *Program Increase - HIGH TEMPERATURE POLYMER COMPOSITES*

Congressional Add: *Program Increase - INTELLIGENT NEXT-GENERATION ADDITIVE MANUFACTURING HUB*

Congressional Add: *Program Increase - NOVEL ARMAMENT SYSTEMS*

Congressional Add: *Program Increase - QUANTUM TECHNOLOGIES FOR ARMAMENT SYSTEMS*

Congressional Add: *Program Increase - TURRET GUNNER SURVIVABILITY AND SIMULATION ENVIRONMENT*

Congressional Add Subtotals for Project: BS6

	FY 2022	FY 2023
	3.000	-
	5.000	-
	6.500	-
	10.000	12.000
	3.000	5.000
	-	20.000
	-	3.000
	-	15.000
	-	10.000
	-	10.000
	-	2.000
	-	15.000
	-	10.000
	-	5.000
Congressional Add Subtotals for Project: BS6	27.500	107.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2022	FY 2023
Congressional Add Totals for all Projects	27.500	107.000

Change Summary Explanation

Increase in funding to support sensor to shooter design and development efforts.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) AH6 / <i>Disruptive Energetics and Propulsion Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AH6: <i>Disruptive Energetics and Propulsion Technologies</i>	-	8.106	8.682	8.752	-	8.752	8.805	8.816	8.822	8.919	0.000	60.902

A. Mission Description and Budget Item Justification

This Project investigates, models, and assesses energetic material and propulsion technologies to validate novel concepts such as maximizing total energy density and power delivered on target. This Project also optimizes propellant grains for increased range, and altering gun configurations to increase energy on target in order to exploit the controllable/scalable energy release required for improving effectiveness and reducing vulnerability of future gun/missile systems. This Project builds upon disruptive energetic materials discovery efforts to synthesize new materials with energy content from 50% to up to two times that of Research Department Explosive (RDX) in PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics). This Project also leverages the advanced additive manufacture efforts of PE 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research Technology).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Synthesis, Formulation and Diagnostics of Energetic Materials	4.838	-	-
Description: This effort pursues novel approaches to synthesize and scale up disruptive and traditional energetic materials with increased performance as well as design new formulation avenues in order to discover new materials and formulations to extend range and increase effect on target. This effort also investigates and develops revolutionary ways to release energy and characterize energetic behavior at early time and small length scales for rapid determination of detonation and propellant performance parameters to enable a "fail early, fail often" strategy.			
Title: Modeling and Simulation of Energetics and Munitions	1.738	-	-
Description: This effort develops, codes, and subsequently employs advanced models to predict multiscale response of energetic materials for both propellant and explosive purposes. Develops new simulation methods for understanding and design of advanced concepts and energetic formulations to rapidly iterate and optimize towards increased range and enhanced lethality.			
Title: Advanced Weapon Concepts	1.530	-	-
Description: This effort investigates new propellants and grain designs, burn rate/combustion modifier ingredients, as well as new gun and munition designs for extended range.			
Title: Synthesis, Formulation, Modeling, and Diagnostics of Energetic Materials for Explosive and Propellant Applications	-	8.576	8.752

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH6 / <i>Disruptive Energetics and Propulsion Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
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Description: This effort pursues novel approaches to synthesize and scale up disruptive and traditional energetic materials with increased performance as well as design new formulation avenues in order to discover new materials and formulations to extend range and increase effect on target. This effort develops, codes, and subsequently employs advanced models to predict multiscale response of energetic materials for both propellant and explosive purposes. This effort develops new simulation and small scale experimental methods and techniques for understanding and design of advanced concepts and energetic formulations to rapidly iterate and optimize parameters to enable a "fail early, fail often" strategy towards increased range and enhanced lethality. This effort also investigates new propellants and grain designs, burn rate/combustion modifier ingredients, as well as new gun and munition designs for extended range.

FY 2023 Plans:
Synthesize, scale up, and formulate high temperature resistant energetic materials, energetic polymers, and novel high energy density metallic fuels into new higher performing explosives and propellants; develop rapid laboratory scale diagnostic techniques to rapidly screen candidate materials and formulations, mitigating need for mass production for evaluation and therefore achieve faster time-to-solution for extended range and enhanced lethality; develop and experimentally validate mesoscale models an order of magnitude larger than FY21 state of the art and link with engineering scale software for explosive modeling; develop chemical kinetics for solid fuel ramjet continuum modeling for enhanced ranges; develop machine learning models of performance and material sensitivity to reduce phase space for synthetic chemists to explore; develop and transition novel propellant grain designs and initiation schemes to enable increased range for very large caliber cannon systems; develop capability to design solid fuel ramjets for increased rocket ranges; develop lightweight, increased muzzle velocity Soldier weapon systems.

FY 2024 Plans:
Will scale up, formulate, and assess novel energetic materials, energetic polymers, and novel metallic fuels for use in explosive and propellant applications; further development of machine learning models for predicting performance and physical metrics in order to guide synthesis; miniaturize diagnostic techniques in order to "fail early, fail fast" in assessing novel materials, models, and concepts; develop and validate mesoscale models for use in explosive applications and apply said models to Army relevant notional formulations and materials; develop novel chemical kinetics for rocket motors and initiation trains; develop validated models of wear and erosion to determine mitigation routes for increased flame temperature, as well as enhanced pressure propellants and charge designs; model alternative initiation schemes for improved weapon performances; develop and validate post-launch propulsion concepts; develop and validate advanced grain and pressure chamber designs in order to enhance range without requiring propellant formation engineering; continue to develop lightweight, increased muzzle velocity Soldier weapon systems.

FY 2023 to FY 2024 Increase/Decrease Statement:

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH6 / <i>Disruptive Energetics and Propulsion Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase supports planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.106	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	8.106	8.682	8.752

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) AH7 / <i>Lethal and Scalable Effects Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AH7: <i>Lethal and Scalable Effects Technologies</i>	-	1.841	1.346	1.574	-	1.574	1.574	1.576	1.577	1.594	Continuing	Continuing

A. Mission Description and Budget Item Justification

Work in this Project designs, determines and assesses technology options for scaling warhead lethality and providing extreme efficiency for highly effective, simultaneous mixed/multi target defeat and collateral damage. This Project will also design and assess scalable structure defeat to mitigate collateral damage for disruptive urban Warfighting. This research is coordinated with Project AH5 (Projectile and Multi-Function Warhead Technologies) and Project AH6 (Disruptive Energetics and Propulsion Technologies) within this PE and builds upon disruptive energetic and ballistic sciences research in PE 06011102A Defense Research Sciences / Project AA7 (Mechanics and Ballistics).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Munition Efficiency and Scalability	1.841	1.297	1.574
Description: This effort investigates, designs, determines, and assesses technologies to produce blast-fragment warheads with tailored fragment geometries to optimize target defeat. This effort identifies and develops warhead impact patterns to optimize target defeat with reduced collateral damage. This effort also designs, models, and assesses technologies for the cost effective, preprogrammed delivery of multiple scalable warheads capable of simultaneously engaging multiple targets. This effort leverages guidance technologies from PE 0602147A (Long Range Precision Fires) / Project AH4 (Precision and Coop Weapons in a Denied Env Tech), and metal additive manufacturing from PE 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research Technology).			
FY 2023 Plans: Conduct experiments to quantify the performance of the devices designed and built in FY2022; provide model updates and revised lethality analyses based on the outcome of terminal ballistic experiments conducted in Fiscal Year 2022 (FY22); continue design studies to examine performance gains provided by improved manufacturing techniques, novel energetics, and metals designed for warhead applications.			
FY 2024 Plans: Will investigate energy-efficient warhead concepts to increase fragment velocity to include improved explosive-to-metal coupling using two-phase flow computational modeling complemented by terminal ballistic experiments; mature distributed, collaborative,			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH7 / <i>Lethal and Scalable Effects Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
and synergistic effects by improving understanding of multiple lethal mechanisms (e.g., blast-fragmentation and penetration) and multiple high-speed weapons on single, simple, and complex targets; model lethality of energy-efficient warheads and distributed, collaborative, and synergistic effects for analytical campaign on Diverse, Disruptive Effects for Artillery with partners. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.049	-
Accomplishments/Planned Programs Subtotals	1.841	1.346	1.574

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) AH8 / <i>Lethality Materials and Processes Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AH8: <i>Lethality Materials and Processes Technology</i>	-	3.872	1.868	1.906	-	1.906	1.906	1.907	1.909	1.930	0.000	15.298

A. Mission Description and Budget Item Justification

Work in this Project designs, determines, and assesses innovative materials solutions aimed at achieving leap ahead increases in lethality and weapons effectiveness through improvements in weight and volume efficiency, lethal effects, and sustainability of military systems. This research is coordinated with Project AH6 (Disruptive Energetics and Propulsion Technology) and Project AH7 (Lethal and Scalable Effects Technologies) within this PE, and PE 0602147A (Long Range Precision Fires Technology) / AH4 (Precision and Cooperative Weapons in a Denied Environment) and builds upon and ballistic sciences research in PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Materials for Advanced Lethality	3.872	1.863	1.906
Description: This effort researches innovative materials aimed at achieving leap-ahead increases in lethality and weapons effectiveness through improvements in weight and volume efficiency, lethal effects, and sustainability of military systems that can only be achieved through advances in materials technology.			
FY 2023 Plans: Print and validate various energetic systems, including three-dimensional (3D) printed rocket motor, topology-optimized gun propellant, and shaped-charge explosive; develop energetic polymer feedstocks for additive manufacturing; develop additive manufacturing capable high-strength energetics binder for gun-launch applications; perform thermal drawing of nanocrystalline-based energetic materials and solid filled energetic materials.			
FY 2024 Plans: Will print and validate topology optimized additively-manufactured (AM) rocket motor; print and assess solids loading energetic polymers; assess energetic Orzo material; use Orzo on topology-optimized propellants; print high-strength energetic binder for gun-launch application; develop multi-material-capable print head and develop g-code.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.005	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH8 / <i>Lethality Materials and Processes Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	3.872	1.868	1.906

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) AH9 / <i>Advanced Warheads Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AH9: <i>Advanced Warheads Technology</i>	-	24.118	26.780	24.326	-	24.326	27.237	29.256	31.958	32.306	0.000	195.981

A. Mission Description and Budget Item Justification

This Project explores multiple pathways to enhance lethal efforts for future warheads against emerging peer/near peer target sets. Investigates synergistic effects of novel micro warheads using advance materials. This Project investigates innovative energetic materials and novel processing techniques for the next generation of explosives and propulsion applications to enable an increase in range, lethality, and utility of munitions. It also directly supports Army Modernization Priorities through researching and developing energetic (propellant) technologies and processes for increased performance, expanded operation temperature bounds, and improved safety and environmental compliance of missile systems.

Work in this Project complements PE 0602147A (Long Range Precision Fires Technology) / AG6 (Energetic Materials and Advanced Processing Techno), PE 0603464A (Long Range Precision Fires Advanced Technology / AG7 (Energetic Materials and Adv Processing Adv Tech), PE 0602150A (Air and Missile Defense Technology), PE 0602148A (Future Vertical Lift Technology), and 0602145A (Next Generation Combat Vehicle Technology).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Warheads	10.370	11.506	7.665
Description: This effort explores multiple pathways to enhance lethal effects for future warheads against emerging peer/near peer target sets; Investigates synergistic effects of novel warheads using advanced concepts of operations, materials, geometries, and manufacturing processes.			
FY 2023 Plans: Design reactive and novel materials, including advanced fragmentation, and alternate disruptive effects to enhance lethal effects on target operating in a high-g environment. Investigate potential lethal mechanism technologies for potential unmanned, multi-mission, ground & aerial target engagements. Investigate technology advances to mature warhead designs that are effective across multiple domains. Continue to develop advanced Modeling and Simulation capabilities using available technologies, including advanced algorithms to optimize Shape Charge, Fragmentation and EFP Designs. Conduct experiments to validate materials and advanced warheads designs In a high-G environment.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH9 / <i>Advanced Warheads Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will investigate novel designs, advanced materials, and manufacturing enablers to develop innovative lethal defeat mechanisms. Will develop advanced algorithms to optimize shape charge, fragmentation, and explosively formed penetrators through state of the art modeling and simulation. Will research munition warhead technologies for providing disruptive effects and/or defeating ground and aerial manned and unmanned targets. Will design and develop novel warheads for enhanced armor penetration and defeat that are survivable in high-g environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The funding for this effort was decreased in FY24 to accelerate the Army's Precision Strike Missile Inc IV under PE 0603464/AF2, Long Range Maneuverable Fires Advanced Tech.</p>				
<p>Title: Advanced Energetics</p> <p>Description: This effort develops advanced energetic materials and novel processing techniques for future explosives and propulsion applications that enable an increase in range, lethality, and utility of ammunitions.</p> <p>FY 2023 Plans: Continue to investigate novel energetic materials; design enhanced lethality explosive formulations; conduct experiments of enhanced novel propellant formulations for use in representative munitions. Develop advanced initiation concepts and advanced ignition concepts. Conduct experiments to: prepare energetic components via additive manufacturing processing technologies; validate modeling and simulation tools required to accurately predict energetic materials performance in novel and unique geometries; embed ignition for additively manufactured gun propulsion charges. Design analytical and experimental capabilities to characterize advanced energetic materials.</p> <p>FY 2024 Plans: Will design and develop novel energetic materials utilizing advanced processing methodologies. Will investigate new propellant and explosive materials and formulations for increased energy and performance. Will develop advanced manufacturing methods for additively manufactured explosive and propellant components. Will investigate novel propellant grain geometries in concert with new propellant formulations as well as investigate embedded ignition that extend lethal munition system capabilities. Will utilize experimental outputs to refine modeling and simulation algorithms to predict performance of future propellant, explosive formulations, and geometries.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		12.342	12.833	13.815
<p>Title: Advanced Pyrotechnics</p> <p>Description: This effort investigates compositions, components, and technologies to provide novel pyrotechnic formulations and devices to increase overall system performance and survivability. Coordinates research, strategic assessments and development</p>		1.406	1.506	2.846

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) AH9 / <i>Advanced Warheads Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
of novel pyrotechnic technologies that will enable disruptive capabilities for Multidomain Operations. This effort supports the Army Modernization Priorities.			
<i>FY 2023 Plans:</i> Design novel pyrotechnic materials, components, and configurations. Design advanced pyrotechnic concepts and assess the performance and effectiveness for military utility through modeling and experimental validation. Continue to conduct experiments on pyrotechnic components and formulations supporting Army Modernization and Multi-Domain Operations.			
<i>FY 2024 Plans:</i> Will develop novel pyrotechnic materials, components, and configurations to extend shelf life, operate in extreme temperatures, and provide advanced capabilities for future fuze and munition performance. Will investigate the automation of pyrotechnic processes and procedures to improve safety and performance. Will investigate pyrotechnic materials for multi-point igniters and precision self-destruct pyrotechnic components.			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Increase due to investigation and development of critical pyrotechnic, mixtures, and components.			
<i>Title:</i> SBIR/STTR Transfer	-	0.935	-
<i>Description:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	24.118	26.780	24.326

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) BS6 / <i>Lethality Technology (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BS6: <i>Lethality Technology (CA)</i>	-	27.500	107.000	-	-	-	-	-	-	-	0.000	134.500

Note

Congressional Interest Item funding provided for Lethality Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Lethality Technology.

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

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

	FY 2022	FY 2023
Congressional Add: Program increase - Next Generation Remote Sensing	3.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Next Generation Remote Sensing		
Congressional Add: Program Increase- Hybrid Additive Manufacturing	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Hybrid Additive Manufacturing for Advanced Lethality		
Congressional Add: Program Increase - Hypersonic Wind Tunnel Development	6.500	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Hypersonic Wind Tunnel Development		
Congressional Add: Program Increase - Materials Processing Manufacturing Technology	10.000	12.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Materials Processing Manufacturing Technology		
FY 2023 Plans: Congressional Interest Item funding provided for Lethality Technology.		
Congressional Add: Program Increase - Universal Nanocrystalline Alloys	3.000	5.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Universal Nanocrystalline Alloys		
FY 2023 Plans: Congressional Interest Item funding provided for Lethality Technology.		
Congressional Add: Program Increase - ADVANCED MATERIALS AND MANUFACTURING FOR MODERNIZATION	-	20.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) BS6 / <i>Lethality Technology (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - CERAMIC PROTECTION MATERIALS	-	3.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - COLLABORATIVE NETWORKED ARMAMENT LETHALITY TECHNOLOGY	-	15.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - ENHANCED ARMAMENT FIRE CONTROL	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - HIGH TEMPERATURE POLYMER COMPOSITES	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - INTELLIGENT NEXT-GENERATION ADDITIVE MANUFACTURING HUB	-	2.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - NOVEL ARMAMENT SYSTEMS	-	15.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - QUANTUM TECHNOLOGIES FOR ARMAMENT SYSTEMS	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
<i>Congressional Add:</i> Program Increase - TURRET GUNNER SURVIVABILITY AND SIMULATION ENVIRONMENT	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lethality Technology.		
Congressional Adds Subtotals	27.500	107.000

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CF7 / <i>Solid-state Laser Concepts and Architectures</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CF7: Solid-state Laser Concepts and Architectures</i>	-	7.271	8.567	9.892	-	9.892	9.892	9.904	9.911	10.019	0.000	65.456

A. Mission Description and Budget Item Justification

This Project provides the research and development of advanced solid-state laser materials and architectures to support the Army Directed Energy Strategy for laser-based directed energy (DE) weapons. This Project investigates advanced laser technologies based on unconventional solid-state laser concepts and designs, scalable and intelligent power modules, and advanced thermal management systems for the development of less complex, low size, weight, and power (SWaP) Army DE weapons and tactical lasers with much improved capabilities.

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser (HEL) Enabling Technologies for Tactical Directed Energy Weapons	7.271	8.556	2.250
Description: Investigate novel solid-state laser concepts, architectures, and components in support of the Army's HEL weapons strategy.; develop innovative laser gain materials with much improved spectral, thermal, thermo-mechanical, and thermo-optical properties; and develops increased power while reducing size and weight, and complexity of all HEL components			
FY 2023 Plans: Investigate potential of fiber laser power scaling out of a single fiber aperture by a factor of upwards 10X based on state-of-the-art glass laser fibers with modified glass composition aimed at: significantly reducing losses and instabilities from optical and thermal non-linearities; improve C4 fiber designs by adding a splicing capability of C4 fibers with silica-based pump couplers and pump-signal combiners; improve designs and further power scale directly-diode-pumped fiber lasers; assess new thermal storage materials and thermal management techniques; funds research of new compact and efficient DE specific power conversion topology concepts.			
FY 2024 Plans: Will determine critical pathways to both crystalline core/crystalline cladding (C4) and Raman fiber fabrication with the lowest achievable loss figure; mature components enabling directly-diode-cladding-pumped Raman fiber laser and C4 fiber laser power scaling to 5kW out of a single fiber; design and develop thermal material integration concepts, conduct experiments, and validate device and system-level numerical modeling optimization approaches.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CF7 / <i>Solid-state Laser Concepts and Architectures</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding decrease in this effort supports the planned lifecycle shift from primarily materials development to materials and power scaling which will be supported in the Advanced High Energy Laser Technology effort within this Project.				
Title: SBIR/STTR Transfer		-	0.011	-
Description: Funding transferred in accordance with Title 15 USC §638				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Title: Advanced High Energy Laser Technology		-	-	7.642
Description: Investigate power scaling strategies for advanced solid-state lasers through the exploitation of the unique properties of advanced materials to develop higher power lasers with lower size, weight, and power requirements. This effort funds research to maximize output power towards theoretical limits, design and develop scalable power conversion with intelligent control for improved efficiency and resiliency, and designs and develops an optimized preliminary design fiber laser to best serve the purpose of power scaling analysis toward 5 kW and 50 kW of output power; assess scaled 50 kW power and thermal concepts.				
FY 2024 Plans: Will validate major clusters of fiber laser modeling for both crystalline core/crystalline cladding (C4) and Raman fiber laser power scaling out of a single fiber aperture; identify the most promising C4 fiber fabrication technique as it pertains specifically to fiber length scaling required to achieve 5 kW power level. Will mature C4 fiber laser components to enable power scaling to 5 kW out of a single fiber. Will mature thermal management and damage resistance related concepts for achieving objective output power.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding realigned from PE 0602146A Project AR1 Robust, Resilient and Intelligent C3I Technology and PE 0602145A Project BH5 Platform Electrification and Mobility Tech to support research in Advanced High Energy Laser Technology.				
Accomplishments/Planned Programs Subtotals		7.271	8.567	9.892
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CF7 / <i>Solid-state Laser Concepts and Architectures</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CF8 / <i>Terminal Effects Against Critical Targets Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CF8: <i>Terminal Effects Against Critical Targets Tech</i>	-	3.893	3.938	2.180	-	2.180	1.032	5.174	4.331	3.729	0.000	24.277

A. Mission Description and Budget Item Justification

This Project designs and develops engineering tools and high-fidelity modeling and simulation capabilities for materials and structural response to predict and enhance weapons performance to ensure lethality against structures and critical assets. Through dynamic impact experiments for a broad range of velocities against conventional and advanced structural materials, this project develops engineering tools and technologies to rapidly evaluate and predict weapon performance.

Work in this Project complements PE 0603116A (Lethality Advanced Technology) / Project CH5 (Terminal Effects Against Critical Targets Adv Tech).

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

Work in this Project is performed by the United States Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Advanced Terminal Weapons Effects Technology</p> <p>Description: This effort develops and validates terminal weapons effects prediction capabilities for Long Range Precision Fires (LRPF) weapons against geomaterials, structures, and other critical assets.</p> <p>FY 2023 Plans: Investigate low velocity and low aspect ratio impact conditions for penetration code prediction capabilities of army warheads, develop models for shock propagation to expand predictive capabilities for enhanced blast effects, will implement single-degree-of-freedom (SDOF) models into BlastX tool for coupled blast/frag interactions with structures, and will develop two-dimensional (2D) to three-dimensional (3D) rapid conversion capabilities for NLOS BDA methods.</p> <p>FY 2024 Plans: Will mature Virtual Material Library (VML) which provides additional weapon/target pairing for predictive models; will develop high-fidelity predictive capabilities for blast and penetration of higher velocity warheads for key weaponing tools; will validate semi-automated 3D change detection tool for rapid BDA capabilities.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the transition technologies to PE 0603116A (Lethality Advanced Technology) / Project CH5 (Terminal Effects Against Critical Targets Adv Tech) for maturation and demonstration.</p>	3.893	3.851	2.180
<p>Title: SBIR/STTR Transfer</p>	-	0.087	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CF8 / <i>Terminal Effects Against Critical Targets Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	3.893	3.938	2.180

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

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CG4 / <i>Advanced Radar Concepts and Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CG4: Advanced Radar Concepts and Technologies</i>	-	4.516	5.891	6.008	-	6.008	6.030	8.990	8.995	9.093	0.000	49.523

A. Mission Description and Budget Item Justification

This Project conducts experiments on single crystal diamond and diamond hetero-structure semiconductor materials, layered structures, and novel devices for Diamond Electronics and integrated photonics structures and devices for Radar, Communications, and improved Size, Weight, and Power (SWaP) Department of Defense systems. Efforts include multiscale modeling, material and structure growth and characterization, and novel device design and fabrication as well as two-dimensional (2-D) electronics for bio-inspired neuromorphic sensors, processors, and memory. This research has application to radars, communication systems, electronic warfare, directed energy, electronics for hypersonic systems, radiation hard systems, quantum sensing, and others. This Project directly supports Air and Missile Defense modernization priority capabilities by investigating essential component technologies for insertion into Multi-Mission Army Radar systems. This Project addresses the challenges of integrating new materials into Silicon Complementary Metal Oxide Semiconductor (CMOS) processing flows, and electronics reliability including protection against unintended adversarial use of state-of-the-art semiconductor materials, devices, and systems for Air and Missile Defense in contested environments.

Work in this Project complements PE 0603466A (Air and Missile Defense Advanced Technology) Project AD6 (Next Generation Fires Radar Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Antennas and Radio Frequency (RF) Device Components for Advanced Electronic Systems	4.516	4.930	5.054
Description: Conduct experiments into novel diamond material and silicon photonic device structures operable in the RF electromagnetic spectrum with high radiated power density for increased radar range and better target detection, improved efficiency of communications systems, smaller SWaP for electronics/cooling of autonomous systems, high temperature electronics for hypersonics, and radiation hardened electronics.			
FY 2023 Plans: Conduct assessment of RF phased array beam steering embodiments and down select to optimal design in terms of SWaP and manufacturability; assess techniques for high polarization isolation and minimizing grating lobes from wideband and distributed antennas; fabricate and characterize diamond and boron nitride substrates and device test structures for correlation between the fundamental properties and the measured electrical performance.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CG4 / <i>Advanced Radar Concepts and Technologies</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will conduct research of ultra-wide bandgap (diamond based) RF power amplifier test articles for improvements in RF power density, embodied by circuits that will be aligned with requirements for phased array antenna systems and low SWaP applications; conduct preliminary assessment of a phased array antenna with chip-scale beamformer photonic circuitry; investigate novel multi-function and reconfigurable antenna solutions across distributed assets for data collection and dissemination based on additive manufacturing technology; investigate methodologies for integrating materials that naturally exhibit neuromorphic function into Silicon Complementary Metal Oxide Semiconductor (CMOS) process flows; integrate and assess novel multi-frequency antenna designs and algorithms for future Army systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>				
<p>Title: Distributed Radar Architectures</p> <p>Description: This research seeks to validate critical functions and perform proof-of-concept laboratory experimentation to develop phase synchronous, coordinated radar and multi-function effects that enable distributed, global positioning system (GPS)-independent, autonomous capabilities. This effort validates critical synchronized distributed networked sensor functions and novel signal processing methods. This effort validates advanced antenna designs for low size, weight, power and cost (SWAP-C), multi-function systems.</p> <p>FY 2023 Plans: Design spatially distributed radar nodes experiments to validate wireless time synchronization and frequency synchronization for coherent microwave beamforming; determine antenna requirements for individual nodes and develop SWaP-efficient approaches to optimize radar network performance; design and validate algorithms for node synchronization to establish time, phase, and frequency lock and to reduce antenna beam sidelobes created by the distributed, sparse apertures.</p> <p>FY 2024 Plans: Will conduct experiments for coherent radar beamforming using a 2-node distributed transceiver. Will design and develop a model of a 5-node sensing network and a method for establishing relative position without GPS.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>		-	0.939	0.954
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans:</p>		-	0.022	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CG4 / <i>Advanced Radar Concepts and Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i>			
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	4.516	5.891	6.008

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) C11 / <i>Advanced Armaments Lethality Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>C11: Advanced Armaments Lethality Technology</i>	-	-	1.544	1.684	-	1.684	8.694	7.460	6.732	5.329	0.000	31.443

A. Mission Description and Budget Item Justification

This Project designs and develops novel armament systems concepts and enabling technologies in weapons, munitions, and fire control, in order to advance range and accuracy capabilities.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Advanced Armaments Lethality Technology</p> <p>Description: This project designs and develops novel armament systems concepts and enabling technologies in weapons, munitions, and fire control required to enable and dominate Multi Domain Operations (MDO). This includes advancing state of the art armament system technologies to provide overmatch against current and future threats.</p> <p>FY 2023 Plans: Investigate novel multi-role and multi-mission armament concepts, increasing lethal effectiveness across calibers and platforms; investigate novel payloads, effects, and deployment schemes across current and future platforms to defeat and/or disrupt: material, personnel, and broad spectrum targets.</p> <p>FY 2024 Plans: Will conduct?threat based?analysis to defeat evolving and forecasted?threats, assess technological trends,?and develop enabling technologies in weapons, munitions, and fire control?to support exploration of new concepts for Multi Domain Operations; investigate complex trade space consisting of multi-role/multi-mission, kinetic/non-kinetic, and dynamic targeting.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>	-	1.493	1.684
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.051	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) C11 / <i>Advanced Armaments Lethality Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.544	1.684

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CIA / <i>Applied Armaments Tech for Distributed Lethality</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CIA: Applied Armaments Tech for Distributed Lethality</i>	-	-	-	3.445	-	3.445	-	-	-	-	0.000	3.445

Note

In FY 2024 this effort is administratively realigned from PE 0602145 CU5 / Platform Agnostic Armaments Applied Technology.

A. Mission Description and Budget Item Justification

Platform Agnostic Armaments Applied Tech investigates technologies that holistically maximize armament performance, minimize target engagement timelines, reduce crew workloads, enhance responsiveness and enable collaborative lethal effectiveness on target across distributed platforms & missions. This project researches cross caliber weapon, munition & fire-control technologies to enhance Remote Weapon Systems (RWS) responsiveness and single or combined platform lethality in Multi-Domain Operations (MDO) environments.

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

Work in this Project supports the Next Generation Combat Vehicle Army Modernization Priority.

Work in this Project is performed by the United States Army Futures Command.

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

Title: Platform Agnostic Armaments Applied Tech	FY 2022	FY 2023	FY 2024
Description: This effort designs and develops technologies that enables platform performance by increasing range without degrading accuracy, reducing size, weight, and power and impact to lighter platforms, enhancing weapon, munitions, fire control, & agnostic remote weapon automation tech to reduce the kill chain timeline. This effort enables Army Modernization and Multi-Domain Operations (MDOs) in support of the Army's future and planned vehicles.	-	-	3.445
FY 2024 Plans: Will develop concepts and supporting?critical enabling technologies that include?communication mechanisms and electrically-powered weapon technologies; focus on?decreased size, weight, and power usage while increasing performance and safety of remote weapon systems; investigate reduction of remote armament system target engagement time through novel fire control techniques.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CIA / <i>Applied Armaments Tech for Distributed Lethality</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
In FY 2024 this effort is administratively realigned from PE 0602145 Project CU5 Platform Agnostic Armaments Applied Technology			
Accomplishments/Planned Programs Subtotals	-	-	3.445

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CIB / <i>Sensor to Shooter (STS) Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CIB: <i>Sensor to Shooter (STS) Applied Research</i>	-	-	-	6.468	-	6.468	-	-	-	-	0.000	6.468

Note

In FY24, funding is realigned from PE 0602181A / CM7 Collaborative Convergence Applied Research.

A. Mission Description and Budget Item Justification

This Project designs and develops advanced algorithms for sensor to shooter decision aids and incorporates predictive tools and permissive airspace capabilities to reduce the sensor to shooter timeline and effects execution. Investigate technologies for enabling multi-sensor fusion for collaborative tracking of multi-theater threat tracks to enable tactical target engagement and counter fires across threat flight timeline.

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

Work in this Project supports Next Generation Combat Vehicle, Tactical Network, Future Vertical Lift, and Long-Range Precision Fires Army Modernization Priorities.

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Lethal Effects Architecture for Decision Synchronization Technology	-	-	6.468
Description: This effort designs and develops advanced adaptive algorithms and architectures to improve threat prediction, reduce the sensor to shooter timeline, and enhance airspace deconfliction in support of Large-Scale Combat Operations in a dynamic multi-domain environment.			
FY 2024 Plans: Will investigate advanced algorithm concepts to support decision aid recommendations across dynamic conditions. Will research advanced decentralized algorithms for networked lethality collaboration across manned and unmanned systems. Will investigate predictive and adaptive algorithm concepts and design algorithms to align with Decision Point methodologies. Will explore algorithms to predict threat behavior to improve current sensor to shooter decision aid systems for large scale combat operations. Will investigate advanced predictive tools to synchronize and de-conflict airspace.			
FY 2023 to FY 2024 Increase/Decrease Statement: This effort begins in FY24 with funding realigned from PE 0602181A / Project CM7 Collaborative Convergence Applied Research.			
Accomplishments/Planned Programs Subtotals	-	-	6.468

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) <i>CIB / Sensor to Shooter (STS) Applied Research</i>

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / Lethality Technology				Project (Number/Name) CIC / Fire Control Lethality Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CIC: Fire Control Lethality Technology	-	-	-	1.462	-	1.462	-	-	-	-	0.000	1.462

Note
Fire Control Lethality Technology is a new start within the Lethality Technology program in FY 2024.

This Project is a new start within the Lethality Technology program in FY 2024.

A. Mission Description and Budget Item Justification

Work in this Project researches, investigates and develops concepts for common open architecture fire control systems to maximize distributed armament systems performance. Researches fire control architecture framework and protocols utilizing artificial intelligence and machine learning to minimize target engagement timelines, reduce cognitive processes, and enable collaborative lethal effectiveness on target across weapon platforms. Develops modular fire control concepts enabling safe, lethal, and agile integration of current systems to engage emerging threats and decrease system vulnerabilities for maximize performance and combined arms effects.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Future Fire Control Tech (F2CT)	-	-	1.462
Description: This effort designs and develops fire control technologies to increase interoperability and improve performance across future distributed armament systems. This effort designs and develops novel components, algorithms, and architectures necessary for future fire control systems.			
FY 2024 Plans: Will investigate open and common fire control architectures to improve combined arms engagement effects from future distributed manned/unmanned armament systems; investigate novel algorithms and components for reduced fire control decision time, interoperability, and insertion into future fire control open architecture designs.			
FY 2023 to FY 2024 Increase/Decrease Statement: In FY2024 this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	1.462

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CIC / <i>Fire Control Lethality Technology</i>

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CJ1 / <i>Lethality Enabling University Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CJ1: Lethality Enabling University Applied Research</i>	-	5.583	6.570	7.197	-	7.197	7.858	8.338	8.344	8.435	0.000	52.325

A. Mission Description and Budget Item Justification

The Project leverages research and technological innovations from academia, of lethal directed energy, laser diagnostics and accelerated design of future hypersonics and their scramjet engine combustion, deep learning (DL) guidance tools and novel materials of importance to the Army, by accelerating research and conducting experiments focused on getting technology to the warfighter more quickly. This Project performs discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies critical to the Long Range Precision Fires and Air and Missile Defense. This Project focuses on employment of research technologies originating from extramural applied research in academia pertaining to lethal directed energy, laser diagnostics, future hypersonic glide body and scramjet propulsor design, DL guidance tools, novel materials, and expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range applied to lethality. This effort conducts applied research and development leading to potential emerging technologies in areas of strategic importance to the Army in directed energy, future hypersonic glide body design, DL and novel materials, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances.

Work in this Project complements Program Element 0602147A (Long Range Precision Fires) and Program Element 0602150A (Air and Missile Defense Technologies)

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Laser Diagnostics for Hypersonics and Directed Energy	1.925	1.609	1.842
Description: This effort researched systematic expansion in laser diagnostics technologies to assess hypersonic turbulence and boundary layer transition. Work is conducted in collaboration with university partners to advance the effects of atmospheric turbulence on laser propagation and gain applied knowledge in directed energy systems effectiveness and range.			
FY 2023 Plans: Will continue to investigate methods to expand laser diagnostics and the flight envelope of the existing glide body, accelerate design of future hypersonic glide bodies; reduce flight test risks. Will investigate methods to improve directed energy system lethality. Will investigate methods to improve correction for atmospheric distortion. Will conduct experiments to inform the development of the B.A.M. range for testing and evaluation of hypersonic and directed energy systems.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CJ1 / <i>Lethality Enabling University Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Will continue to investigate methods for measuring hypersonic air flow, impacts of atmospheric and environmental conditions both close to the source, near field, and close to the target, far field. Will validate models that predict impacts those conditions have on directed energy systems. Will investigate methods of sensing for hypersonic ground test and flight applications and for the measurement of turbulent aero-optical environments. Will investigate directed energy applications and effectiveness of various types of laser systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
<p>Title: Turbulence and Transition Modeling and Validation for Hypersonic Vehicles</p> <p>Description: This effort is conducted in collaboration with university partners to develop modeling tools to help inform the flight envelope of existing hypersonic vehicles to accelerate design of future hypersonic glide bodies.</p> <p>FY 2023 Plans: Will continue to design and develop modeling techniques to expand the flight envelop and control of the existing glide body. Will investigate methods to accelerate design of future hypersonic glide bodies and systems. Investigate methods to reduce flight test risk through modeling and sub-scale wind tunnel testing of effects of new design features. Will conduct experiments to inform the development of the B.A.M. range for testing and evaluation of aerothermodynamic performance at hypersonic speeds.</p> <p>FY 2024 Plans: Continues to mature modeling techniques and methods to improve the design and control of future hypersonic glide bodies. Investigate commercial methods to improve the implementation of models into relevant government tools in a high performance computing environment.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>	1.800	1.703	1.976
<p>Title: Novel Materials for Extreme Environments</p> <p>Description: This effort produces a test environment for thermal and ablation evaluation of novel materials relevant to hypersonic vehicles. Work is conducted in collaboration with university partners to assess material characteristics and develop computational models of high strain rate materials to mitigate the effects of high kinetic energy impacts.</p> <p>FY 2023 Plans: Will continue to develop critical high temperature materials and characterize for the design of thermal protection systems to overmatch from high temperatures and high kinetic energy impacts. Will investigate material ablation models and the effect of material layering on ballistics and hypervelocity impact energy absorption, damage mitigation, and penetration resistance. Will</p>	1.047	1.200	1.309

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CJ1 / <i>Lethality Enabling University Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
investigate models that account for high strain rate materials performance. Will conduct experiments to inform the development of the B.A.M. range for materials testing at hypersonic speeds. FY 2024 Plans: Will continue to develop critical high temperature materials and characterize for the design of thermal protection systems and investigate material ablation modeling. Will investigate high temperature thermal management systems for hypersonic leading edges. Will investigate thermal resistance between dissimilar hypersonic materials. Will investigate material oxidation and determine deployable solutions, advanced materials and composites to protect the hypersonic vehicles in extreme heat. Will continue to use the Ballistic Aero-Optics and Materials (BAM) range to validate data and improve test techniques. Investigate methods to discover high entropy materials for extreme environments. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.				
Title: Intelligent Hypersonics and Other Vehicle Systems Description: This effort develops and designs geometrically relevant testing hardware required to study aerothermodynamic performance, increase impact velocity and extend range of precision strike munitions. Work is conducted in collaboration with university partners to collect experimental data and insights required to train deep learning neural networks used for the development of hypersonic vehicle flight systems with adaptability and increased lethality. FY 2023 Plans: Will continue to develop intelligent defense vehicle systems using DL algorithms for improved surveillance, detection, and tracking and overcoming line-of-sight constraints. Will develop axisymmetric scramjet propulsor with transpiration fuel delivery system for high-speed projectiles. FY 2024 Plans: Will continue to develop intelligent defense vehicle systems and their self health-monitoring sensors to survive and optimize path planning. Will develop dynamic adversarial machine learning (ML) and training for rapid response automated tracking, and disguised flying objects. Will recommend sensor deployment to maximize information gain for swift decision making and suggest vulnerability scores to all locations, in complex terrains, overcoming line-of-sight constraints. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.		0.811	1.818	2.070
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638		-	0.240	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CJ1 / <i>Lethality Enabling University Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	5.583	6.570	7.197

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CJ6 / <i>Advanced Energetics for Missile Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CJ6: Advanced Energetics for Missile Technologies</i>	-	1.142	-	-	-	-	-	-	-	-	0.000	1.142

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priorities through funding research and developing energetic (propellant) technologies and processes for increased performance, expanded operation temperature bounds, and improved safety and environmental compliance of missile systems.

Work in this Project complements PE 0602147A (Long Range Precision Fires Technology), PE 0602150A (Air and Missile Defense Technology); and 0602141A (Lethality Technology) / Project AH9 (Advanced Warheads Technology).

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

Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Energetics Technology (Missiles)	1.142	-	-
Description: This effort investigates new and emerging energetic ingredients and processes for propellant formulations to enable enhanced performance and mission flexibility by extending the reach and effects of tactical and strategic missile systems.			
Accomplishments/Planned Programs Subtotals	1.142	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CJ7 / <i>Future Air Defense Missile Enabling Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CJ7: Future Air Defense Missile Enabling Tech</i>	-	1.443	14.655	2.324	-	2.324	4.599	4.604	4.607	4.658	0.000	36.890

A. Mission Description and Budget Item Justification

This Project investigates, develops, and evaluates critical missile technologies and components necessary for advanced lethal capability in support of future/mid to far term affordable short range air defense interceptor capability to defeat Cruise Missile (CM), Rotary Wing (RW), Tactical / Lethal Unmanned Aerial System (UAS), and Fixed Wing (FW) threats. This effort designs and develops technologies to provide advanced materials, seekers, guidance and control, and propulsion for reduced size weight and power and cost for Maneuver Short Range Air Defense (MSHORAD), Short Range Air Defense (SHORAD), and Lower Tier essential to maintain overmatch against mid-/far-term threats. This project supports Air and Missile Defense Modernization priority efforts.

This research is coordinated with PE 0602147A (Long Range Precision Fires Technology / Project AF3 (Extended Range Propulsion Technology) and Project AF8 (Affordable Extended Range Precision Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Future Air Defense Missile Enabling Technology	1.443	14.310	2.324
Description: Designs and develops reduced cost advanced Air Defense missile critical components essential to maintain overmatch against mid/far term M-SHORAD, SHORAD, and Lower Tier threats.			
FY 2023 Plans: Develop hardware, software, and algorithms for reduced space, weight, power and cost improved future Air Defense missile seeker, guidance and control, aerostuctures, and propulsion technologies. Design, develop and evaluate an Active Electronically Scanned Array (AESA) radar seeker capable of supporting a variety of missions, weapon sizes and threats. Develop and evaluate seeker-based fuzing; Develop and evaluate strap-down guidance techniques for maneuvering targets. Perform trade studies with industry to identify next generation concepts and emerging technology development (including resilient sensors, advanced warhead/fuzing, and propulsion) that is interoperable, scalable and affordable to reduce risk for future air and missile defense interceptor capabilities; assess and mature component designs using high-fidelity models and simulation tools against future threats.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CJ7 / <i>Future Air Defense Missile Enabling Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will investigate and develop novel missile technologies that inform future lower tier and SHORAD capabilities; investigate solid fuel ramjet (SFRJ) propulsion technology in the current Stinger form factor for increased range while maintaining current system compatibility; design and develop missile attitude control systems (MACS) for increased maneuverability and investigate reactive material warhead technologies to improve lethality for Lower Tier Future Interceptor.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects completion of advanced AESA seeker and seeker based fuzing technology development and evaluation. Funding in FY24 supports continued trade studies and missile technology development for lethal C-UAS capabilities against near and future threats.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.345	-
Accomplishments/Planned Programs Subtotals		1.443	14.655	2.324
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) CZ9 / <i>Foundational Hypersonic Weapons Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CZ9: Foundational Hypersonic Weapons Research</i>	-	-	7.876	8.360	-	8.360	8.779	9.418	9.633	9.739	0.000	53.805

A. Mission Description and Budget Item Justification

This Project investigates foundational problems associated with high-speed weapons and informs the future strategic fires echelon of Long Range Precision Fires capabilities. This Project funds the research of material science subjects such as extreme thermal loading and aero-thermodynamics and control technologies for high-speed vehicles which may encounter high mechanical loads at launch.

Work in this Project transitions foundational research obtained in Program Element (PE) 0601102A (Defense Research Sciences) / AA7 (Mechanics and Ballistics) and complements PE 0602141A (Lethality Technology) / AH4 (Precision and Cooperative Weapons in Denied Environments), AH5 (Projectile and Multi-Function Warhead Technologies), Project AH6 (Disruptive Energetics and Propulsion Technologies), AH7 (Lethal and Scalable Effects Technologies), and AH8 (Lethality Materials and Processes Technology), PE 0602144A (Ground Technology) / BL1 (Materials and Manufacturing Research Technology), and PE 0602145A (Next Generation Combat Vehicle) / BI4 (Materials Application and Integration Tech).

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

This work is consistent with the needs of the Army Research Priority of Hypersonic Flight.

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Foundational Hypersonic Weapon Materials	-	5.926	6.279
Description: This effort investigates materials synthesis and processing (including innovative approaches such as high-throughput materials-by-design using artificial intelligence and machine learning algorithms), novel experimental techniques, and fundamental theoretical modeling to decrease cost, increase availability, and model thermal and mechanical survivability on hypersonic vehicles. Specific research topics include polymer/resin synthesis for composites, novel three-dimensional composite weave architectures, composite processing (process by which the material is made), ceramic window/dome materials, high-temperature metallic alloys, and joining techniques.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CZ9 / <i>Foundational Hypersonic Weapons Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Investigate means of reducing processing costs for carbon-carbon composites; formulate initial materials-by-design workflow on high temperature metallic alloys and ceramics for leading edges (any regions of a body that encounters the free-stream flow); research manufacturing methods for ceramics and ceramic matrix composites for guidance.</p> <p>FY 2024 Plans: Will continue to reduce processing costs of carbon-carbon composites and characterize resulting materials in comparison to industrial materials; execute materials-by-design workflow on refractory alloy compositions and high temperature ceramic blends; investigate ablation and oxidation resistance through torch assessments; characterize mechanical performance of various window and dome materials of interest.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>				
<p>Title: Foundational Hypersonic Weapons Flight and Control</p> <p>Description: This effort increases understanding of hypersonic vehicle flight behavior and control approaches for more aggressive, rapid, low risk multi-disciplinary designs of future hypersonic vehicles featuring enhanced agility/stability necessary for survivable delivery to advanced threats of the future. Research includes fundamental flow physics and chemistry, guidance and flight control algorithms, vehicle maneuver control mechanisms, novel vehicle shapes, and the theoretical modeling, computational toolsets, and experimental techniques to achieve these advancements.</p> <p>FY 2023 Plans: Improved state-of-the-art toolsets and preliminary flight characterization including boundary layer transition and shock-boundary layer interactions on Army-relevant high-speed vehicle; conduct hypersonic ballistic range experimental capability improvements to refine and enhance the Army's ability to measure hypersonic vehicle behaviors; develop high-speed munition flight control algorithms to reduce cycle time and compensate for uncertainties.</p> <p>FY 2024 Plans: Will continue to explore aero-thermodynamics related to Army hypersonic vehicle concepts through advanced computational and experimental techniques; discover flight mechanisms and algorithms that overcome barriers to help enable affordable, high magazine depth, high-speed weapons.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>		-	1.663	2.081
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans:</p>		-	0.287	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>	Project (Number/Name) CZ9 / <i>Foundational Hypersonic Weapons Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i>			
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	7.876	8.360

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602142A / <i>Army Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	28.654	27.833	34.572	-	34.572	35.766	34.000	32.653	33.386	0.000	226.864
BS1: <i>Army Applied Research</i>	-	28.654	27.833	34.572	-	34.572	35.766	34.000	32.653	33.386	0.000	226.864

A. Mission Description and Budget Item Justification

The Army Applied Research budget line includes systematic application of knowledge toward the production of useful materials, devices and systems or methods including the design, development and improvement of science and technology for Army applications.

Efforts in this budget line include studies, investigations and non-system specific technology efforts leading to bread-board hardware or proof of principle analysis.

<u>B. Program Change Summary (\$ in Millions)</u>	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024 Base</u>	<u>FY 2024 OCO</u>	<u>FY 2024 Total</u>
Previous President's Budget	28.654	27.833	29.958	-	29.958
Current President's Budget	28.654	27.833	34.572	-	34.572
Total Adjustments	0.000	0.000	4.614	-	4.614
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	4.614	-	4.614

Change Summary Explanation

Funding increased for priority Army Applied Research efforts.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army											Date: March 2023	
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602143A / Soldier Lethality Technology							
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	201.221	253.539	104.470	-	104.470	108.668	108.239	103.354	104.825	0.000	984.316
AY6: Soldier Squad Small Arms Armaments Technology	-	8.503	10.897	10.143	-	10.143	10.322	10.422	10.428	10.601	0.000	71.316
AY8: Small Arms Fire Control Technology	-	4.019	2.170	-	-	-	-	-	-	-	0.000	6.189
AZ2: Body Armor & Integrated Headborne Technology	-	6.406	6.617	6.321	-	6.321	5.795	5.803	5.806	5.870	0.000	42.618
AZ5: Soldier Protection Technology - Vulnerability	-	9.016	11.141	11.370	-	11.370	11.374	11.387	11.394	11.518	0.000	77.200
AZ9: Soldier Protection Advanced Tech - Detectability	-	1.815	1.762	-	-	-	-	-	-	-	0.000	3.577
BB4: Dismounted Soldier Survivability Materials	-	2.725	3.023	4.985	-	4.985	5.256	5.345	7.852	7.890	0.000	37.076
BB5: Physical Augmentation: Tech for Human Interactions	-	1.283	0.574	-	-	-	-	-	-	-	0.000	1.857
BB9: Human Performance Tech for Mobility & Lethality	-	2.839	-	-	-	-	-	-	-	-	0.000	2.839
BC2: Next Gen Mobility & Lethality Tech for Warfighters	-	7.422	4.333	6.894	-	6.894	11.347	11.109	11.078	11.149	0.000	63.332
BC6: Human Perf - Tech for Warfighter Enhancement	-	3.212	1.377	-	-	-	-	-	-	-	0.000	4.589
BC7: Training Technology (Other than STE)	-	13.724	25.247	33.822	-	33.822	33.395	28.988	21.463	21.706	0.000	178.345
BD1: Adv Soldier Sensors/ Displays Tech for Dismounts	-	11.226	16.229	16.557	-	16.557	16.565	16.576	16.587	16.769	0.000	110.509
BD6: Soldier Sys Interfaces/ Integration- Sensor Tech	-	0.495	0.237	0.301	-	0.301	-	-	-	-	0.000	1.033
BD8: Soldier & Sm Unit Tactical Energy Tech	-	4.304	6.291	6.911	-	6.911	7.450	10.554	10.038	10.520	0.000	56.068

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>							
BE3: <i>Joint Service Combat Feeding Technology</i>	-	3.877	4.627	4.074	-	4.074	4.073	4.320	4.970	5.024	0.000	30.965
BE6: <i>Reactive/Resp Surfaces & Mats-Soldiers & Sys</i>	-	2.836	-	-	-	-	-	-	-	-	0.000	2.836
BE8: <i>Synthetic Training Environment (STE) Technology</i>	-	14.170	5.902	-	-	-	-	-	-	-	0.000	20.072
BP9: <i>Soldier Lethality Technologies (CA)</i>	-	100.000	149.700	-	-	-	-	-	-	-	0.000	249.700
BR9: <i>Personnel & Airdrop Safety Technology</i>	-	3.349	3.412	3.092	-	3.092	3.091	3.735	3.738	3.778	0.000	24.195

Note

Project BB9 (Human Performance Tech for Mobility & Lethality) is Terminated starting in Fiscal Year 2023 (FY23)

A. Mission Description and Budget Item Justification

This Program Element (PE) conducts fundamental research on Soldier Lethality technologies to develop an integrated Soldier and Squad architecture of equipment and systems that improve Soldier and Small Combat Unit survivability, sustainability, mobility, combat effectiveness, and individual cognitive and physical readiness. To address the challenges of integrating multiple technologies and sub-systems, research conducted in this PE, significant Science and Technology applied research investments in all areas of Soldier Lethality, focus on how to improve the effectiveness of the technologies a Soldier utilizes and apply systems-level practices to mitigate constraints from size and weight of the equipment. Research areas encompass individual and crew-served weapon designs and technologies as well as applied research in lightweight and transparent armor materials to mitigate effects from blast and ballistic threats, counter explosive hazard detection, counter-sensor capabilities, and signature management of weapons, equipment, personnel and high value targets. This PE investigates, develops and designs materials, technologies, methodologies and system models required to experiment and optimize Soldier lethality and survivability through investments in mobility, human-agent teaming, and improved situational awareness interfaces and display technologies as well as to provide Soldier-borne power and energy materials and components that support multiple Soldier-borne systems. This PE also investigates Warfighter training technologies and develops the underpinning technologies to establish architecture standards and interfaces necessary for creating realistic synthetic environments to create a single, interconnected synthetic training system to enable Army units and leaders to conduct realistic multi-echelon / multi-domain combined arms maneuver and mission command training, increasing proficiency through repetition. Human Factors Engineering projects conduct applied research to design weapon systems standards, guidelines, handbooks, and Soldier training curriculum and tools.

Results of these efforts are transitioned within the Army Futures Command, the Program Executive Offices, Army Training and Doctrine Command (TRADOC), Army Medical Command (MEDCOM), Human Systems Integration (HSI) Directorate (Army G1), and the Army Test and Evaluation Command (ATEC).

Work in this PE complements PE 0603118A (Soldier Lethality Advanced Technology) / Project AZ6 (Soldier Signature Management Advanced Technology).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>
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Portions of this funding line support both the Soldier Lethality and Synthetic Training Environment (STE) Army Modernization Priorities.

Work in this PE is performed by the United States Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	205.058	103.839	109.924	-	109.924
Current President's Budget	201.221	253.539	104.470	-	104.470
Total Adjustments	-3.837	149.700	-5.454	-	-5.454
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	149.700			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-3.837	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-5.454	-	-5.454

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BP9: *Soldier Lethality Technologies (CA)*

- Congressional Add: *Program increase - Pathfinder Airborne*
- Congressional Add: *Program Increase - Pathfinder Air Assault*
- Congressional Add: *Program increase - HEROES Program*
- Congressional Add: *Program increase - Academic Accelerator Pilot Program*
- Congressional Add: *Advanced Silicon Anode Material for Batteries*
- Congressional Add: *Program Increase - ADVANCED TEXTILES AND SHELTERS*
- Congressional Add: *Catalyst Traca Data Ready*
- Congressional Add: *Program Increase - Digital Night Vision Technology*
- Congressional Add: *Enhancing Soldier Ballistic Technologies*
- Congressional Add: *Materials Development for Personal Protective Systems*
- Congressional Add: *Military Footwear Research*
- Congressional Add: *Program Increase - Nanolayered Polymer Optics*
- Congressional Add: *Pathfinder Translational Research Advanced Capability Acceleration*

	FY 2022	FY 2023
	8.000	8.000
	10.000	-
	5.000	10.000
	15.000	-
	10.000	-
	6.000	6.000
	5.000	-
	5.000	9.700
	5.000	-
	10.000	-
	3.000	10.000
	10.000	10.000
	8.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2022	FY 2023
Congressional Add: <i>Program Increase - ADVANCED BALLISTIC PROTECTION TECHNOLOGY</i>	-	25.000
Congressional Add: <i>Program Increase - ARTIFICIAL INTELLIGENCE - ENHANCED EDUCATIONAL TECHNOLOGY AND LEARNING</i>	-	5.000
Congressional Add: <i>Program Increase - ENHANCED BALLISTIC PROTECTIVE EYEWEAR</i>	-	5.000
Congressional Add: <i>Program Increase - ENHANCING SOLDIER BALLISTIC TECHNOLOGIES</i>	-	5.000
Congressional Add: <i>Program Increase - FLAT PANEL TECHNOLOGY</i>	-	2.000
Congressional Add: <i>Program Increase - FUTURE FORCE REQUIREMENTS EXPERIMENTATION</i>	-	10.000
Congressional Add: <i>Program Increase - INNOVATIVE TRAINING TECHNOLOGIES</i>	-	5.000
Congressional Add: <i>Program Increase - LITHIUM-ION BATTERY CELL RESEARCH PILOT</i>	-	9.000
Congressional Add: <i>Program Increase - PATHFINDER ADAPTIVE EXPERIMENTATION FORCE</i>	-	5.000
Congressional Add: <i>Program Increase - PATHFINDER CYBER INITIATIVES</i>	-	12.000
Congressional Add: <i>Program Increase - REGIONAL WORKFORCE PILOT</i>	-	10.000
Congressional Add: <i>Program Increase - SOLDIER & SMALL UNIT TACTICAL ENERGY TECHNOLOGY</i>	-	3.000
Congressional Add Subtotals for Project: BP9	100.000	149.700
Congressional Add Totals for all Projects	100.000	149.700

Change Summary Explanation

Decreased funding to support higher priorities within the Science & Technology (S&T) portfolio.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) AY6 / <i>Soldier Squad Small Arms Armaments Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AY6: <i>Soldier Squad Small Arms Armaments Technology</i>	-	8.503	10.897	10.143	-	10.143	10.322	10.422	10.428	10.601	0.000	71.316

A. Mission Description and Budget Item Justification

This Project investigates individual and crew-served weapon designs and technologies that enhance the fighting capabilities and survivability of the dismounted Warfighter in support of all of the Services. In addition, it conceives and advances weapon concepts based on innovative ballistic and advanced incapacitation technologies that will enhance the defeat of hard and soft infantry targets at extended ranges based upon the Joint Service Small Arms Technology Development Strategy (JSATDS). The Project will continue to support technology needs from the all Services to include the Next Generation Family of Weapons. In addition, this Project will develop the technology/weapons concepts that will upgrade medium and heavy support weapons at echelons. Finally, this Project will perform research directed toward non-kinetic modalities to incapacitate combatants.

Work in this Project supports key Army needs and leverages the technical research of several Program Elements (PEs) to include PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics), PE 0603118A (Soldier Lethality Advanced Technology), and PE 0602141A (Lethality Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Soldier/Squad Lethality Technology	3.880	4.676	3.848
Description: This effort conceives and investigates advanced weapons concepts based on innovative ballistic technologies that will enhance the defeat of hard and soft infantry targets at extended ranges to ensure overmatch for Soldier Lethality. This effort will also perform research directed toward non-ballistic modalities to incapacitate combatants.			
FY 2023 Plans: Will design and develop concepts and a projectile mechanism that is compatible with precision Soldier systems to allow integration of advanced effects into the related system; develop system demonstrators for medium and heavy weapons that offer significant improvements in size and weight reductions as well as lethality performance; determine threat environment and potential growth for medium and heavy weapons along with ability to combine effects in both the mounted and unmounted roles; utilize instrumentation to characterize technology concepts to enable a reduction in dispersion of complex projectiles.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AY6 / <i>Soldier Squad Small Arms Armaments Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will develop lethal mechanisms related to the mounted machine gun roll to include defilade mission; investigate threat progression and how it relates to lethal mechanism performance in small caliber projectiles; complete development and validation of automatic jump range/approach for dispersion reduction; conduct advanced diagnostic experiments of novel propellant charges; investigate opportunities to improve performance of heavy mounted weapons in the platoon; mature weapon technologies enabling high performance, compact lightweight weapons; utilize modeling and simulation to assess the effects of standoff energy delivery and expand experimental capability.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease supports planned lifecycle of this effort.</p>				
<p>Title: Small Arms Enabling Technologies</p> <p>Description: This effort designs and develops small arms weapon systems, enablers, and ammunition technologies that will maintain decisive lethal overmatch capabilities to the Joint Warfighter. This effort matures small arms weapon system designs through experimentation in support of Joint Warfighter's capability needs.</p> <p>FY 2023 Plans: Design and develop Non-line of sight, 3 dimensional battlefield target sensing and reconstruction technologies; Augmentation technologies for increased weapon system/man-in-the loop performance; Future ballistics and weapon operation for advanced targets; Next Generation small arms barrel technologies and analysis tools; future Soldier weapon concepts; and intelligent, autonomous, and remote small arms weapon technologies. Will conduct component technology research on future small arms concepts to enable a more efficient, effective, and lethal Joint Warfighter.</p> <p>FY 2024 Plans: Will investigate future small arms concepts to enable a more efficient and lethal Joint Warfighter; design concepts to explore new small arms characterization techniques and metrics; investigate machine gun component technology for increased volume fire effectiveness from small units; validate algorithms and models used for advanced ballistics and holistic weapon signature system analysis; investigate fire control components and methodologies to improve future small arms system precision; develop technologies supporting future remote small arms systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		4.623	6.067	6.295
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 Plans:</p>		-	0.154	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AY6 / <i>Soldier Squad Small Arms Armaments Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC §638.				
Accomplishments/Planned Programs Subtotals		8.503	10.897	10.143
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) AY8 / <i>Small Arms Fire Control Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AY8: <i>Small Arms Fire Control Technology</i>	-	4.019	2.170	-	-	-	-	-	-	-	0.000	6.189

A. Mission Description and Budget Item Justification

This Project designs and develops technology for advanced small arms fire control in order to achieve lethality overmatch by supporting target prioritization, enhancing processing of information from multiple sources, and investigating aim assistance tools which remove Soldier aim error. This Project specifically supports the Army Science and Technology Soldier Lethality modernization priority.

Work in this Project complements work done in Program Element (PE) 0603118A (Soldier Lethality Advanced Technology) / AY7 (Small Arms Fire Control Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and the Soldier Lethality Cross Functional Team (CFT) efforts.

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
<p>Title: Adv. Fire Control Tech</p> <p>Description: This Project investigates software and hardware mechanisms to enable enhanced kill chain processes on small arms platforms. This includes investigating artificial intelligence and neural network hardware, conducting experiments on both Commercial and Government Off-The-Shelf (COTS and GOTS) artificial intelligence and machine learning algorithms, and validating Soldier accuracy performance models. It also includes investigation of lightweight optical components and determines viability of weight reduction and balancing approaches.</p> <p>FY 2023 Plans: Conduct experiments on target prioritization concepts in multiple scenarios, including both virtual modeling and simulation and real world environments; validate the technical performance parameters derived from experiments for applicability to system design; complete design approach for further component and system development.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease represents planned lifecycle conclusion for this effort</p>	4.019	2.091	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p>	-	0.079	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AY8 / <i>Small Arms Fire Control Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638.			
Accomplishments/Planned Programs Subtotals	4.019	2.170	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) AZ2 / <i>Body Armor & Integrated Headborne Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AZ2: Body Armor & Integrated Headborne Technology</i>	-	6.406	6.617	6.321	-	6.321	5.795	5.803	5.806	5.870	0.000	42.618

A. Mission Description and Budget Item Justification

This Project investigates and develops materials for Soldier-borne protective equipment, such as body armor and combat helmets, to increase protection from ballistic, blast, and blunt impact threats. This Project also investigates and executes systematic studies to design and develop materials, devices, systems and methods that enable the identification of protective solutions against ballistic, blast and directed energy threats. Included are investigations of emerging technologies, novel materials, and test methods and integration of personal armor, combat helmets, hearing protection, eyewear, and other personal protective equipment items.

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Body Armor & Integrated Headborne Technology	6.406	6.617	6.321
Description: This research effort supports the investigation of novel materials, component designs, and material modeling to design and develop technologies that protect Soldiers against ballistic, blast, and directed energy threats. This effort utilizes a cross-disciplinary, human-focused approach to develop technologies which optimize tradeoffs in ballistic and blast protective component design. This effort addresses the Army challenge of easing overburdened Soldiers in small units and aligns to Soldier protection modernization priorities.			
FY 2023 Plans: Conduct experiments using novel anti-fog test method to assess efficacy of active and passive anti-fog coatings for military eyewear and helmet-mounted displays; investigate film insert molding processing approaches that will enable the combination of multiple material layers to impart multiple protection capabilities (anti-scratch, laser protection, active anti-fog) into a single eyewear system of spherical geometry for the Warfighter, while maintaining optical clarity and ballistic integrity; investigate novel fabric constructs by integrating high strength ballistic fibers to produce lightweight fabric designs that provide increased protection from fragmentary blast debris; funds research of ultrasonic lamination of high performance materials and associated processing conditions to increase armor protection against small arms threats; investigate rigid fiber reinforcement composite architectures for improving ballistic performance against small arms threats.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AZ2 / <i>Body Armor & Integrated Headborne Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will mature film- insert molding- processing approaches that will enable integration of multi-layered lenses for eyewear and head mounted displays; optimize anti-scratch coatings to produce extreme high hardness durable lens surfaces to protect sophisticated head mounted displays and eyewear; optimize active and passive anti-fog technology; design and develop active cooling technology for integration into combat helmet systems; optimize the ability to highly control and engineer the structure of high performance composite armor subsystems via ultrasonic lamination techniques to produce increased protection against small arms threats; investigate threat- specific failure mechanisms and their relationship to microstructural parameters. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	6.406	6.617	6.321

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) AZ5 / <i>Soldier Protection Technology - Vulnerability</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AZ5: Soldier Protection Technology - Vulnerability</i>	-	9.016	11.141	11.370	-	11.370	11.374	11.387	11.394	11.518	0.000	77.200

A. Mission Description and Budget Item Justification

This Project investigates and develops Soldier protection methodologies, which includes the materials, methods, and models that enable design and integration of emerging material technologies into lightweight, flexible and modular Soldier equipment to protect against the range of existing and emerging battlefield threats for head, torso, and extremity protection. Specific research thrusts include the development of materials and mechanisms to enhance ballistic protection; computational models and associated experiments to provide a fundamental understanding of material properties and failure mechanisms, as well as correlation to ballistic/blast/blunt impact performance of Soldier personal protective equipment (PPE) and improved fibers, composite, and ceramic materials. Specific technologies support experimental helmets that reduce impact and blast loading to the head, Soldier torso protection systems to increase protection from ballistic and blunt impacts, and novel fibers and fabrics that provide additional survivability mechanisms.

Work in this Project supports key Army needs and is fully coordinated with several PEs to include PE 0602143A (Soldier Lethality Technology) and 0603118A (Soldier Lethality Advanced Technology); and leverages the technical research of several PEs to include PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics) and 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Soldier Protection Technologies	3.507	3.836	4.047
Description: This effort develops integrated lightweight, flexible, and modular protection equipment that is tailored to support the 'Soldier as a system' approach for defeat of emerging threats. Research areas encompass high fidelity ballistic impact injury models for hard and soft tissues, novel ceramic architectures to include graded and hierarchically structured ceramics, and novel fiber solutions for backing materials to deliver Soldier protection systems to meet emerging ballistic and signature management threats. This effort supports small caliber lethal mechanisms research in PE 0602143A (Soldier Lethality Technology) / Project AY6 (Soldier Squad Small Arms Armaments Technology).			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AZ5 / <i>Soldier Protection Technology - Vulnerability</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Develop terminal ballistic mechanisms for improved performance, additively manufactured ceramics for lightweight and high performance armors, and advanced composites materials for enhanced flexibility; investigate armor technology to defeat increment 2 ballistic threats; design armor concepts to enhance Soldier effectiveness.</p> <p>FY 2024 Plans: Will mature and transition armor design to defeat advanced threats; document ballistic performance and manufacturing requirements for the advanced armor technology; develop and analyze conformal armor concepts to improve Soldier effectiveness; validate improved computational tools for ceramic-composite armor technology.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned life cycle of this effort.</p>				
<p>Title: Soldier-Borne Composite Materials</p> <p>Description: Utilizing understanding of fibers, fabrics, and composite materials, conduct applied research of emerging lightweight materials and structures to enable affordable designs for head, torso, and extremity protection systems. Provide quantitative scientific basis for modeling and simulation that result in materials that utilize new schemes to enhance Warfighter survivability. This effort supports Soldier Protection Technologies bullet.</p> <p>FY 2023 Plans: Quantify the effects of processing conditions and constituent material properties on composite performance; develop and validate modeling tools that quantitatively predict the mechanical response of complex thermoplastic composite armors subject to high deformation impact, including the effects of multi-material and multi-orientation laminates; apply optimization tools that exploit these models to recommend favorable designs for improved ballistic and backface performance of body armor systems; initiate materials design and modeling efforts to enable lightweight polymer and polymer composite cartridges for small arms, including studies on the thermomechanical properties of thermoplastics during all stages of the firing process, physical aging of polymers, simulation of thermoplastic processing, and computer-aided design of reinforced composite cartridges.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, funding for this effort is realigned to the Novel Camouflage and Concealment Materials effort within this Project.</p>		2.626	2.776	-
<p>Title: Soldier-Borne Advanced Protection Materials</p> <p>Description: Utilizing understanding of protection materials such as armor ceramics and associated failure mechanisms, conduct applied research of emerging armor materials to enable affordable design of lightweight ballistic protective systems for the future Soldier. Provide quantitative scientific basis for modeling and simulation that result in materials that utilize new lethal mechanisms/ protection schemes for the individual Warfighter. This effort supports Soldier Protection Technologies bullet and small caliber</p>		2.883	4.123	4.398

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AZ5 / <i>Soldier Protection Technology - Vulnerability</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
lethal mechanisms research in PE 0602143A (Soldier Lethality Technology) / Project AY6 (Soldier Squad Small Arms Armaments Technology),				
<p>FY 2023 Plans: Investigate additively manufactured and diamond-composite ceramics to improve armor performance; minimize void content while maximizing high diamond content via strategic sizing of diamond phases and novel matrix infiltration and densification processes; characterize materials mechanically and with sub-scale and full-scale ballistic experiments, demonstrating high hardness and effective projectile dwell to increase armor integrity and performance; transition advanced ceramic materials and processing methodologies to Army and industrial partners for maturation; document key processing and performance parameters to enable robust manufacturing capability; develop lightweight, dynamic, and robust materials for camo and concealment; utilize advanced modeling and manufacturing tools to enable new coatings, films, and fibers that can be designed to provide tailored and adjustable reflective spectral response.</p> <p>FY 2024 Plans: Will further investigate highly diamond-loaded composite ceramics for advanced ceramic plates; refine and innovate novel manufacturing approaches for achieving improved diamond packing and bulk density; perform residual stress characterization, analysis, and optimization from micro-scale to meso-scale to achieve ideal pre-stresses at material interfaces; integrate diamond composites into heterogenous ceramic assemblies via strike face, layering, and inclusion strategies; develop improved processing, ply orientation, and consolidation strategies for high performance, fiber-reinforced composites to achieve optimal system-level mechanical performance; engineer bonding and integration strategies for composites and ceramics to create armor packages that incorporate improved ballistic response relative to state-of-the-art.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.406	-
Title: Novel Camouflage and Concealment Materials		-	-	2.925

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AZ5 / <i>Soldier Protection Technology - Vulnerability</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: The modern battlefield presents a new generation of detection threats across a wide range of wavelengths and host platforms, coupled with increasingly sophisticated computational analysis tools for identification and targeting. This effort will develop new materials and manufacturing concepts that enable a new generation of lightweight, efficient camouflage and concealment systems for the dismounted Soldier.</p> <p>FY 2024 Plans: Will develop material synthesis pathways for creating fillers with tailored or dynamic spectral properties for future integration into coatings, fibers, and composites; characterize materials via directional spectroscopy, and utilize machine learning strategies for identifying optimized material designs; generate structurally robust, first-generation materials with engineered thermal conductivity, and characterize and report properties and pathways for further material development; identify opportunities for materials to influence decoy and deception systems, particularly for autonomous assets in support of small dismounted Soldier Teams.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding Increase for this effort is from the Soldier-Borne Composite Materials effort within this Project in FY 2024.</p>			
Accomplishments/Planned Programs Subtotals	9.016	11.141	11.370

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) AZ9 / <i>Soldier Protection Advanced Tech - Detectability</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AZ9: Soldier Protection Advanced Tech - Detectability</i>	-	1.815	1.762	-	-	-	-	-	-	-	0.000	3.577

Note

In FY 2024, funding in this effort is realigned to PE 0602143A Project BB4 Dismounted Soldier Survivability Materials

A. Mission Description and Budget Item Justification

This Project investigates and designs novel materials, technologies, techniques and applications increasing the capabilities of camouflage and concealment against known and emerging sensor threats. The results of this Project enable effective deception capabilities, combinations of physical and electronic signature decoy components, and determination of analytical processes for modeling signature management technologies during multi-domain operations. These technologies will provide subsystems and concepts that shall decrease the probability of detection and targeting by peer and near-peer adversaries, enabling freedom of movement of semi-independent and dispersed formations and increased protection of dismounted soldiers. Components designed under this Project will transition to Advanced Technology Development efforts in Soldier Lethality protection/survivability Projects to provide disruptive Camouflage, Concealment and Deception technologies to the Operational Army to support expeditionary maneuver in the Multi-Domain Battle Environment and retain windows of advantage.

Work in this Project supports key Army needs and leverages/complements the technical research of several Program Elements (PEs) to include PE 0601102A (Defense Research Sciences) and PE 0603118A (Soldier Lethality Advanced Technology) / Project AZ8 (Soldier - Small Unit Detectability Adv Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Camouflage, Concealment and Decoys Technologies for Soldier and High-Value Assets	1.815	1.747	-
Description: This effort investigates and designs materials, processes, and concepts for innovative camouflage, concealment and deception technologies for Soldier to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats and to reduce the probability of detection in multi-domain operations. Investigates analytical processes to model material and system performance and predict probability of detection in the multi-domain operational environment, assisting in closing the capability gap between current camouflage, concealment, and deception technologies and defeating enemy sensorial capabilities in future operating environments.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) AZ9 / <i>Soldier Protection Advanced Tech - Detectability</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Expand on systematic studies of fiber processing, the incorporation of polymer film processing, and the incorporation of additives and coatings with optical properties to assess thermal transfer properties to potentially camouflage Soldier thermal signatures against adversary thermal-imager sensors; down select and investigate electrochromic polymer synthesis and processing techniques and their application for active color-changing materials in Soldier clothing and individual equipment. FY 2023 to FY 2024 Increase/Decrease Statement: The funding for this program (\$1.411K) is realigned to PE 0602143A Project BB4 Dismounted Soldier Survivability Materials to integrate material research activities for Soldier protection.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.015	-
Accomplishments/Planned Programs Subtotals	1.815	1.762	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BB4 / <i>Dismounted Soldier Survivability Materials</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BB4: <i>Dismounted Soldier Survivability Materials</i>	-	2.725	3.023	4.985	-	4.985	5.256	5.345	7.852	7.890	0.000	37.076

Note

In FY 2024, Funding realigned from PE 0602143A AZ9 Soldier Protection Advanced Tech - Detectability

A. Mission Description and Budget Item Justification

This Project investigates fibers, textiles, components, and materials focused on enhancing Soldier survivability from combat threats (flame and thermal, blast and ballistic, multispectral sensor, and laser threats) and environmental threats (e.g., cold, heat, wet, vector, antimicrobial, etc.) to increase operational effectiveness while decreasing the Soldier's physical and cognitive burden. The results from this Project will transition knowledge, materials, subcomponents and methods to Advanced Technology Development efforts in support of enhancing Soldier Lethality by providing protective material solutions focused on the aspects of dismounted movement and maneuver operations of the Army. This Project develops and applies validation methods that enable systematic studies of human systems integration principles and practices to protective equipment materials and designs to advance the understanding of trade-offs between protection, lethality, and mobility.

Work in this Project supports key Army needs and leverages/complements the technical research of several Program Elements (PEs) to include PE 0601102A (Defense Research Sciences), PE 0602143A (Soldier Lethality Technology) / Project AZ5 (Soldier Protection Technology - Vulnerability), and PE 0603118A Soldier Lethality Advanced Technology / Project BB3 (Dismounted Soldier Survivability Equip/Tech Integ).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

Title: Dismounted Soldier Survivability Materials	FY 2022	FY 2023	FY 2024
Description: This effort investigates materials, devices and methods that aid in the design and development of multifunctional materials for Soldier protective clothing and individual equipment. This effort conducts research to investigate and identify multi-functional material properties at the micron and sub-micron level to mitigate Soldiers susceptibility and vulnerability to operational threat, i.e., flame, thermal, environmental, and multispectral sensors. Efforts also investigate and develop devices and systems that enable extended dismounted mission duration by reducing the demand for water resupply and enabling Squad organic water filtration systems	2.725	2.948	4.985
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023			
Appropriation/Budget Activity 2040 / 2		R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BB4 / <i>Dismounted Soldier Survivability Materials</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024	
<p>Research procedures and techniques using additives and thread coating approaches investigated in prior years for tailoring multi-functionality of textiles at very small length scales and impart capabilities at the fiber level to produce textiles with inherent vector protection, blast debris protection, and moisture wicking performance with the aim of reducing the weight and cost while increasing the performance of Soldier clothing and individual equipment; investigate the effects of machine parameters, textile design, and material compositions on fabric properties to tailor a fabric design that exhibits non-conventional fabric behavior and determine improved base layer fabric constructions to increase durability and environmental protection performance parameters of the Soldiers combat ensemble; expand investigation of and down select technical approaches capable of separating salt and other contaminants from brackish and salt water sources to produce emergency water purification capability at the individual Soldier and squad level; develop and validate handheld sensing concepts to provide instantaneous monitoring of water quality at the individual Soldier and squad level.</p> <p>FY 2024 Plans: Will validate the performance of four classes of engineered fibers and yarns (ballistic protection, vector protection, flame resistance, moisture wicking) at the textile and fabric level prior to multi-functional textile integration; integrate engineered fibers and yarns from the four classes of functionality into a single fabric to conduct investigations to assess baseline performance; investigate the effect of weave construction and machine processing parameters on the performance of multi-functional textiles to establish sub-system functionality and performance against target metrics; conduct a study on polymer compounding to design conductive fibers for e-textile applications; validate the electrical and data carrying capability of thread coated conductive yarns in breadboard e-textile designs; research the mechanical properties and durability of baseline e-textile materials; design and develop e-textiles interfaces between Soldier uniform and power and data platforms; research in collaboration with DEVCOM C5ISR partners the functional components of aided target recognition algorithms and their ability to detect, recognize and identify dismounted Soldiers in support of investigating novel camouflage material approaches to reduce the effectiveness of these emerging threat sensor capabilities.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase due to realignment from PE 0602143A AZ9 Soldier Protection Advanced Tech - Detectability to integrate material research activities for Soldier protection.</p>					
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.075	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BB4 / <i>Dismounted Soldier Survivability Materials</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	2.725	3.023	4.985

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BB5 / <i>Physical Augmentation: Tech for Human Interactions</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BB5: <i>Physical Augmentation: Tech for Human Interactions</i>	-	1.283	0.574	-	-	-	-	-	-	-	0.000	1.857

Note

Beginning in FY24 all PE 0602143A / Soldier Lethality Technology Project BB5 / Physical Augmentation: Tech for Human Interactions funding will transition to PE 0602143A / Soldier Lethality Technology BC2 / Next Gen Mobility & Lethality Tech for Warfighters.

A. Mission Description and Budget Item Justification

This Project advances the understanding of human augmentation and interaction for enhanced operational performance with a focus on adaptation, training, human variability, metrics/methodologies for assessment, and task quantification. Research encompasses conducting applied research to develop metrics, measures, tools, and techniques to quantify and understand the relationships that enable maximum effectiveness of integrated Soldier-augmentation technologies. The resulting data are the basis for physical augmentation systems and equipment design standards, guidelines, and intelligent agent requirements to improve equipment operation and Soldier-system synergy. Application of this research will yield reduced workload, reduced Soldier training requirements, enhanced Soldier lethality/survivability, user acceptance, and allow Soldiers to achieve maximum performance. Major efforts explore novel techniques for Soldier assessment, characterization of individual variability effects on performance, development of evidence-based design guidance for the application of augmentation technologies, exploration of the relationship of exoskeleton and physical-assist device adaptation and baseline Soldier parameters such as gait, neuromuscular motor control and proprioception. This Project will also explore novel training paradigms for reduced Soldier-augmentation technology adaptation times to address current and future warrior performance issues. Individual efforts exploit wearable sensor technologies, translate surrogate task performance to operational outcomes, develop approaches to distinguish tasks and individual state and intent of movement, establish database of human movement variability to inform intelligent system design, and identify high impact applications of augmentation.

Work in this Project supports key Army needs and leverages the technical research of several Program Elements (PEs) to include PE 0602143A (Soldier Lethality Technology) / Project BC2 (Next Gen Mobility & Lethality Tech for Warfighters) and Project BC6 (Human Perf - Tech for Warfighter Enhancement); and supports PE 0603118A (Soldier Lethality Advanced Technology) / Project BC1 (Human Performance AdvTech for Mobility & Lethality). Additionally, work in this Project complements and is fully coordinated with the Medical Research and Development Command under the Military Operational Medicine Research Program within PE 0602787A (Medical Technology) / Project MK4 (Warfighter Health Applied Research Technology), and the Veteran Administration's exoskeleton research area. This Project also complements and is fully coordinated with work performed across Army, Navy, and Air Force under the Reliance 21 Human Systems Community of Interest: Protection, Sustainment, and Warfighter Performance and with our international partners through The Technical Cooperation Program / Human Resources and Performance Group / Panel JP1 (TTCP HUM JP1).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BB5 / <i>Physical Augmentation: Tech for Human Interactions</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Title: Training Adaptation and Movement Science</p> <p>Description: This effort investigates the science behind movement for physical augmentation to maximize mobility capacity and training adaptation to decrease learning curve with physical augmentation systems (e.g., physical-assist devices, exoskeletons). This work will enable the Army to make informed decisions on the ultimate effectiveness of human augmentation technologies before significant resources are expended.</p> <p>FY 2023 Plans: Implement classification and prediction algorithms into smart controllers capable of anticipating changes in movement states (e.g., run to walk, walk to stair climb, etc) into and actuated device to optimize human-system synergy and performance outcomes; investigate feasibility of using such devices on common activities and Soldiering tasks to assess relevance; identify differences between actuated device with and without smart controllers and assess the impact of the algorithms on human-system performance in order to inform system design.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects realignment of funding (\$1.142K) to PE 0602143 Project BC2 (Next Gen Mobility & Lethality Tech for Warfighters) to consolidate enhancement work.</p>	1.283	0.567	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.007	-
Accomplishments/Planned Programs Subtotals	1.283	0.574	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BB9 / <i>Human Performance Tech for Mobility & Lethality</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BB9: Human Performance Tech for Mobility & Lethality</i>	-	2.839	-	-	-	-	-	-	-	-	0.000	2.839

Note

Project BB9 (Human Performance Tech for Mobility & Lethality) planned completion in Fiscal Year 2022.

A. Mission Description and Budget Item Justification

This Project investigates human performance based information portrayal system design parameters that integrate mobility & lethality considerations (such as cognitive workload, target discrimination and engagement, and fatigue) into training/education tools, mission command platforms, and technologies that help Soldiers more rapidly and efficiently acquire complex skills and make decisions quickly from training through mission planning and execution.

This Project supports key Army needs and leverages the technical research of several Projects in Program Element (PE) 0603118A (Soldier Lethality Advanced Technology) / Project BD7 (Soldier Sys Interfaces/ Integration-Sensor Adv Tech), Project AY9 (Body Armor & Integrated Headborne Advanced Tech), and Project BC9 (Adv Soldier Sensors/Displays AdvTech for Dismounts).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy and the Soldier Lethality Cross Functional Team (CFT).

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Human Interaction for Situational Understanding	2.839	-	-
Description: This effort investigates, designs, and develops design guidance for information portrayal systems and sub-systems in augmented/virtual reality that enable Soldiers to make better, faster decisions for close combat operations at the small unit level. This effort also conducts experiments to populate performance models that have application across materiel and non-materiel solutions.			
Accomplishments/Planned Programs Subtotals	2.839	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BB9 / <i>Human Performance Tech for Mobility & Lethality</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC2 / <i>Next Gen Mobility & Lethality Tech for Warfighters</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BC2: Next Gen Mobility & Lethality Tech for Warfighters</i>	-	7.422	4.333	6.894	-	6.894	11.347	11.109	11.078	11.149	0.000	63.332

Note

Beginning in FY24 all PE 0602143A / Soldier Lethality Technology Project BB5 / Physical Augmentation: Tech for Human Interactions and BC6 / Human Perf - Tech for Warfighter Enhancement funding will realign to PE 0602143A / Soldier Lethality Technology BC2 / Next Gen Mobility & Lethality Tech for Warfighters.

A. Mission Description and Budget Item Justification

This Project investigates the means to monitor, assess, predict and optimize/enhance Soldier and squad decision-making and shoot and move performance. In addition, it will provide design guidance for individual and mission specific equipment (e.g., individual protection, small arms, load carriage, information portrayal etc.) and quantitative impacts of mission and associated clothing and individual equipment (CIE) on individual and small unit performance. Research conducted focuses on translating mission tasks to measures of human performance. These measures of human performance will inform predictive algorithms, human based modeling and simulation, and assessment tools that enable Soldier performance trade space analysis for acquisition, training, and operations. These data and algorithms will allow us to determine the impact of new capabilities on Soldier and Squad performance and effectiveness, understand deficiencies in performance and investigate novel strategies to optimize and enhance performance.

This Project supports key Army needs and leverages the technical research of several Program Elements (PEs) to include the following: PE 0602143A (Soldier Lethality Technology) / Projects BC6 (Human Perf-Tech for Warfighter Enhancement), and PE 0603118A (Soldier Lethality Advanced Technology)/ Projects BC1 (Human Performance AdvTech for Mobility & Lethality). This Project also supports and leverages PE 0603118A (Soldier Lethality Advanced Technology) / Project AY9 (Body Armor & Integrated Headborne Advanced Tech), and , Project BD7 (Soldier Sys Interfaces/Integration- Sensor AdvTech).

Work in this Project complements and is fully coordinated with the Medical Research and Development Command under the Military Operational Medicine Research Program as well as Defense Medical Research and Development Program under Military Operational Medicine (JPC-5) to include Projects in PE 0602787A (Medical Technology). This Project also complements and is fully coordinated with work performed across Army, Navy, and Air Force under the Reliance 21 Human Systems Community of Interest: Protection, Sustainment, and Warfighter Performance.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and the Soldier Lethality Cross Functional Team (CFT).

Work in this Project is performed by the United States Army Futures Command (AFC).

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

Title: Human Interaction for Mobility & Lethality	FY 2022	FY 2023	FY 2024
	7.422	4.259	6.894

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC2 / <i>Next Gen Mobility & Lethality Tech for Warfighters</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort investigates and develops human performance based design guidance for protection and weapon systems and sub systems to improve the mobility and lethality of individuals and small units. The applied research translates traditional means for measuring and understanding human performance to the means to conduct assessment for Warfighter and small unit readiness and/or new capabilities.</p> <p>FY 2023 Plans: Conduct targeted laboratory and field experiments to populate research gaps identified in previous year's predictive modeling work, emphasizing the ability for Soldiers to shoot, move, communicate, navigate and decide during conditions of physical and cognitive stress elicited by operational scenarios; conduct experiments on the effects of head-support load and distribution configurations on Soldier task performance to refine head supported mass guidelines and modeling and simulation tools to understand the headborne trade space; develop ear and female & male head models for headborne system design guidance; conduct experiments to understand and develop optimal augmented reality (AR) design elements, interactions, applications, and performance metrics to enhance situation awareness (SA) and provide design guidance for heads-up display (HUD) systems.</p> <p>FY 2024 Plans: Will investigate stressor interactions on Soldier, small unit, and leader tactical outcomes to advance predictive modeling; conduct experiments on the effects of head-support load and distribution configurations on female and male Soldier task performance to refine head supported mass guidelines and modeling and simulation tools; develop female & male neck models (or other anatomical models as needed) for headborne system design guidance; conduct experiments to address gaps in the optimization of augmented reality (AR) design elements, interactions, applications, and performance metrics to inform heads-up display (HUD) systems; begin the development of novel HSI test methodologies to inform lethality trade space impacts of Soldier clothing and individual equipment (CIE) and technologies; investigate novel cognitive and physical enhancement strategies on Soldier task performance and recovery.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the realignment of funds from BB5 / Physical Augmentation: Tech for Human Interactions (\$1.142K) and BC6 / Human Perf - Tech for Warfighter Enhancement (\$1.290K) to consolidate enhancement work.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.074	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC2 / <i>Next Gen Mobility & Lethality Tech for Warfighters</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	7.422	4.333	6.894

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC6 / <i>Human Perf - Tech for Warfighter Enhancement</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BC6: Human Perf - Tech for Warfighter Enhancement</i>	-	3.212	1.377	-	-	-	-	-	-	-	0.000	4.589

Note

Beginning in FY24 all PE 0602143A / Soldier Lethality Technology Project BC6 / Human Perf - Tech for Warfighter Enhancement funding will realign to PE 0602143A / Soldier Lethality Technology BC2 / Next Gen Mobility & Lethality Tech for Warfighters.

A. Mission Description and Budget Item Justification

This Project investigates and develops mechanisms for safely and effectively optimizing and enhancing Warfighter ability to shoot, move, communicate, and decide. These mechanisms have the potential to exploit the Soldier and Squad as the capability platform beyond materiel solutions provided to the individual and small unit. This project also conducts experiments to populate human performance models that enable trade space analysis for portions of doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) analysis.

This Project supports key Army needs and leverages the technical research of several Program Elements (PEs) / Projects to include: PE 0602143A (Soldier Lethality Technology) / BE3 (Joint Service Combat Feeding Technology) and BE2 (Joint Service Combat Feeding Advanced Technology).

Work in this Project complements and is fully coordinated with the Medical Research and Development Command under the Military Operational Medicine Research Program as well as Defense Medical Research and Development Program under Military Operational Medicine (JPC-5) to include Projects in PE 0602787A (Medical Technology). This Project also complements and is fully coordinated with work performed across Army, Navy, and Air Force under the Reliance 21 Human Systems Community of Interest: Protection, Sustainment, and Warfighter Performance. Work in this Project complements and is fully coordinated with research at the US Army Combat Capabilities Development Command Army Research Laboratory (ARL).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and the Soldier Lethality Cross Functional Team (CFT).

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Human Performance Technology for Warfighter Enhancement	3.212	1.348	-
Description: This effort investigates mechanisms for exploiting human physiology to develop safe and effective interventions that create smarter, faster, more lethal Close Combat Warfighters. This work will result in a Soldier's ability to shoot, move,			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC6 / <i>Human Perf - Tech for Warfighter Enhancement</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
communicate, and decide faster than an adversary. Findings from these investigations will leverage existing systems and platforms to get the greatest human performance return in training and operations.			
<p><i>FY 2023 Plans:</i> Develop meta-regression model and software tool to predict neurostimulation effects on cognitive and physical performance; limited iterative testing and validation of the model with Commercial Off-The-Shelf (COTS) devices will occur. Exercise the Gastro-Intestinal Joint Automated Army Colon on a Bench (GI-jA2COB) in vitro lower GI tract model to down-select the highest impact, most mature performance enhancement intervention from those currently being studied (muscle recovery performance probiotics, prebiotics for high altitude performance resiliency and engineered probiotics for sleep fatigue mitigation).</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding decrease reflects administrative realignment of funding (\$1.290K) to PE 0602143 Project BC2 (Next Gen Mobility & Lethality Tech for Warfighters).</p>			
<p><i>Title:</i> SBIR/STTR Transfer</p> <p><i>Description:</i> Funding transferred in accordance with Title 15 USC §638</p> <p><i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638</p>	-	0.029	-
Accomplishments/Planned Programs Subtotals	3.212	1.377	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BC7 / <i>Training Technology (Other than STE)</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BC7: <i>Training Technology (Other than STE)</i>	-	13.724	25.247	33.822	-	33.822	33.395	28.988	21.463	21.706	0.000	178.345

A. Mission Description and Budget Item Justification

This Project funds research into technologies and their applications that can inform and/or enhance the Army's live, virtual, and constructive training systems. This Project conducts research in immersive virtual, mixed, and augmented reality (AR) environments that stimulate human senses (e.g. sight, sound, and touch) and also conducts experiments to understand how users interface with the technology in order to improve the realism of simulation environments and therefore create enhanced immersion and more effective training systems. Models and simulations are designed and developed to allow realistic, fair fight engagements across all training environments and training devices, to include the cyberspace domain. Included in the investigations of this Project are also medical training systems (e.g., part-task trainers and physiological modeling).

Work in this Project supports key Army needs and complements efforts in Program Element (PE) 0603118A (Soldier Lethality Advanced Technology) / Project BC8 (Training Advanced Technology (Other than STE)).

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

Work in this Project is performed by the United States Army Futures Command (AFC) and at the Institute for Creative Technologies (ICT) University Affiliated Research Center (UARC) at the University of Southern California.

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

	FY 2022	FY 2023	FY 2024
Title: Medical Training Technology	3.511	3.111	3.599
Description: Included in this effort will be the development of new medical training simulations to train medical personnel across all levels of care. Improvements in haptic capabilities will ensure hyper bio-fidelity for all levels of care. Automated measures of student performance will support Army medical Individual Critical Task Lists (ICTLs). Research areas will also include more realistic tissue properties supporting part-task trainers and modular patient simulator systems. Initial exploration of Army ICTLs will result in early proof-of-concept development of proof-of concept training systems to support non-traditional medical areas, such as dental training simulations.			
FY 2023 Plans: Investigate the usability and training effectiveness of an integrated collective live, virtual, constructive medical training capability; determine optimum physiology engine(s) and haptic configuration leveraging modular manikin and haptic capabilities for emerging scenarios, such as extended care in an austere environment, gender care differences, and patient hand-off.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC7 / <i>Training Technology (Other than STE)</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will mature the usability and training effectiveness of an integrated collective live, virtual, constructive medical training capability; design and develop optimum physiology engine(s) and haptic configuration leveraging modular manikin and haptic capabilities for defined scenarios that support Army medical training, such as extended care in an austere environment, gender care differences, and patient hand-off.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the design and development of physiology engine(s).</p>				
<p>Title: Warfighting M/S Concepts and Design (ICT)</p> <p>Description: This Project designs and develops photorealistic synthetic environments, multi-sensory interfaces, artificially intelligent agents, and human performance assessment technologies to create virtual, augmented, and mixed reality simulation environments for training. This Project uses advanced modeling, simulation, and leadership development techniques to leverage the emerging immersive technologies of industry and the research and development community to advance the Army's capabilities.</p> <p>FY 2023 Plans: Investigate automation techniques to develop individual agent and aggregate unit behaviors to represent friendly forces, hostile forces, and civilian groups in virtual training exercises; investigate and develop a rapid capture technology to generate three-dimensional (3D), fully body personalized avatars that replicate a trainee's non-verbal behavior styles allowing for increased realism in virtual training environments; evaluate methods for various sensor-based reconstructions of real-world terrain and environments to represent live battlespaces effectively in simulations that provide highly accurate and feature-rich 3D geospatial data.</p> <p>FY 2024 Plans: Will mature automation techniques to develop individual agent and aggregate unit behaviors to represent friendly forces, hostile forces, and civilian groups in virtual training exercises; investigate methods for the realistic physical and mental representation of individual Soldiers; fund research to determine how to improve Soldier cognitive and experiential learning; investigate adaptive, multi-modal interfaces for Army-specific applications of augmented reality technologies; validate methods to synchronize light detection and ranging (LIDAR) and photogrammetry data collected in the real world to enhance the realism of simulation-based training.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort</p>		3.731	6.995	7.360
<p>Title: Cyberspace Electromagnetic Activities (CEMA) Effects Modeling and Simulation</p>		1.418	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC7 / <i>Training Technology (Other than STE)</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Description: This effort investigates and develops capabilities to more accurately model and simulate CEMA necessary to support training events for Corps and below.				
Title: Innovative Synthetic Training Technology		2.885	-	-
Description: This effort investigates and designs methods of applying AI into the STE to simulate a fully immersive environment in large urban settings with a population of adaptable, noncombatant virtual human agents for increasing the realism and complexity of training scenarios. In addition, it develops tools, techniques and technologies for improving the immersion of human senses within simulation environments with the goal of creating enhanced realism within the simulated environment.				
Title: STE Live Training		2.179	-	-
Description: This effort investigates technology to enhance the fidelity of live training systems and investigates future live training capabilities for conducting force-on-force, combined arms exercises to enhance readiness at Army home stations and Combat Training Centers.				
Title: Digital Terrain for Live Training		-	5.478	6.970
Description: This effort investigates technologies to enhance the fidelity and visual effects of digital terrain for live training systems, with an objective metric of reducing overall training time to gain proficiency in the live environment. It addresses live training needs for conducting force-on-force, combined arms exercises to enhance readiness at Army home stations and Combat Training Centers by enhancing vertical terrain resolution, physics-based blast effects on terrain, and data compression technologies.				
FY 2023 Plans: Investigate existing physics-based algorithms, new wireless data compression methods, and feature attribution for live-synthetic training environments; fund research on terrain accuracy metrics and digital terrain level of detail needs for live training.				
FY 2024 Plans: Will mature existing physics-based algorithms for munitions effects; design novel wireless data compression methods for feature attribution in live- synthetic training environments; design data model extensions for terrain accuracy metrics and digital terrain level of detail needs for live training; and design a layered and scalable terrain architecture to support dynamic Live training interactions.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the start of component and architecture design.				
Title: Simulation Management Technologies		-	3.378	8.081

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC7 / <i>Training Technology (Other than STE)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort aims to automate management of resources and equipment associated with the planning, preparation, execution, and assessment of individual through collective training exercises. This effort will inform requirements and research capabilities to enable a self-healing simulation architecture that can automatically architect, configure, detect, deploy, and manage resources to support individual and collective training use-cases. The design and development of fully autonomous constructive models will be leveraged within this architecture to further automate exercise execution and greatly increase time and effectiveness of training and readiness opportunities within the distributed training environment.</p> <p>FY 2023 Plans: Investigate required simulation components for enhanced architecture and decompose/derive minimum training requirements for each specified MDO Use Case; begin Cognitive Behavior Use Case development and Front End Analysis to inform minimum technical requirements in support of defined readiness objectives; identify applicable artificial intelligence (AI) algorithms and begin development to meet initial use-case prototyping objectives.</p> <p>FY 2024 Plans: Will investigate hardware acceleration and common platform components; design and develop dynamic behavior algorithms and fitness functions based on training use-cases; design and develop configuration and authoring components to support simulation execution; and conduct experiments aligned to training use-cases to validate architecture.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the start of design and development activities, as well as the beginning of architecture validation experiments.</p>			
<p>Title: Multi-Domain Environments for Training</p> <p>Description: This effort will define a new, common MDO competency framework to drive machine-supported training performance data collection, tracking and readiness projections for current and new MDO use-cases. This effort also investigates emerging operational/training paradigms, including a detailed focus on modeling non-combat factors of operational environments and developing models necessary to train for Information Advantage.</p> <p>FY 2023 Plans: Investigate knowledge, skills, abilities, and behaviors (KSABs) across major MDO task structures; start development of re-usable Measures of Performance/Effectiveness (MOPs/MOEs) that apply to synthetic data sources; investigate first, second, and third order effects for the information warfare domain.</p> <p>FY 2024 Plans:</p>	-	5.392	7.812

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC7 / <i>Training Technology (Other than STE)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will continue development of reusable Measures of Performance/Effectiveness (MOPs/MOEs); design MDO profiles and authoring tools/user interfaces aligned to knowledge, skills, abilities, and behaviors (KSABs) across identified MDO task structures; conduct experiments to validate first order effects in information warfare domain. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects beginning of authoring tool design and first experiments to validate first order effects in information warfare domain.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.893	-
Accomplishments/Planned Programs Subtotals	13.724	25.247	33.822

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BD1 / <i>Adv Soldier Sensors/Displays Tech for Dismounts</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BD1: <i>Adv Soldier Sensors/Displays Tech for Dismounts</i>	-	11.226	16.229	16.557	-	16.557	16.565	16.576	16.587	16.769	0.000	110.509

A. Mission Description and Budget Item Justification

This Project designs and develops low power, next generation modular sensor and display components for detection and identification of both threats and friendlies in all environments to increase situational awareness, decrease fratricide, and enable Soldiers to respond more quickly for greater lethality.

This effort supports work done in Program Element (PE) 0603118A (Soldier Lethality Advanced Technology) / BC9 (Adv Soldier Sensors/Displays AdvTech for Dismounts).

Work in this Project supports the Army Science and Technology Soldier Lethality, Next Generation Combat Vehicle, and Future Vertical Lift Army Modernization Priorities.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Soldier Lethality Cross Functional Team (CFT).

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Soldier Sensors/Displays Technology for Dismounts	11.226	15.939	16.557
Description: This effort models, simulates, investigates, designs, and develops novel low power, modular electro-optic / infrared (EO/IR), displays, augmented reality approaches and integrates aided/automatic target detection and recognition techniques to enable improved Soldier maneuver and lethality through greater information fidelity to increase Soldier probability of recognition/identification and tracking of all threats.			
FY 2023 Plans: Investigate new mixed and augmented reality (MR/AR) component technologies to enhance multi sensor and multi system simulation capabilities; improve algorithm evaluation capabilities to validate performance of Electro Optic/Infrared (EO/IR) sensor systems; develop tools and techniques to advance synthetic image generation for augmenting existing data and creation of new training data; develop improved low light level sensors capable of adjusting to a dynamic imaging environment in order to provide actionable information and situational awareness no matter the illumination conditions; design lower SWAP, high definition			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BD1 / <i>Adv Soldier Sensors/Displays Tech for Dismounts</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>longwave infrared (LWIR) bolometer sensors with enhanced sensitivity to provide full awareness to Soldiers in every illumination environment; validate improved performance of AR systems when paired with higher dynamic range low light imaging sensors.</p> <p>FY 2024 Plans: Will investigate mixed and augmented reality (MR/AR) content to Heads Up Displays (HUDs) for representation of threats via automated threat cueing from UAV sources; develop modular virtual prototype environments for expedited User feedback; develop image fusion optimization processes to improve target acquisition of sensor systems with multiple camera sources; conduct experiments to determine performance of Electro Optic/Infrared (EO/IR) sensor performance prediction models; investigate advanced materials and processing methods for improvement in operations within lowest lighting conditions with digital low light sensors; develop material and processing methods to design advanced, high definition longwave infrared (LWIR) sensors for tailorable SWaP and/or target acquisition performance.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.290	-
Accomplishments/Planned Programs Subtotals	11.226	16.229	16.557

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BD6 / <i>Soldier Sys Interfaces/Integration-Sensor Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BD6: <i>Soldier Sys Interfaces/Integration- Sensor Tech</i>	-	0.495	0.237	0.301	-	0.301	-	-	-	-	0.000	1.033

A. Mission Description and Budget Item Justification

This Project investigates, designs, and validates advanced technologies and algorithms for enhancing dismounted Soldier deployed robotics and autonomous systems used to improve the Small Unit's situational awareness, survivability, and lethality. Technologies to be investigated may include: algorithms for dismounted robotic systems to enable autonomous navigation, automated object recognition, persistent surveillance, launch and recovery from vehicles, networked lethality, manned-unmanned teaming, and collaborative behaviors; and advanced user interfaces to optimize human-robotic interaction during dismounted operations. These advanced technologies will enable Squad and Platoon level autonomous reconnaissance using robotic systems to minimize the operator's dedicated control of the systems and reduce their cognitive burden, thus allowing Soldiers to be more lethal and survivable.

Work in this Project supports key Army needs and leverages the technical research of several Program Elements (PEs) / Projects to include PE 0603118A (Soldier Lethality Advanced Technology) / Project BD7 (Soldier Sys Interfaces/Integration-Sensor AdvTech) and Project BC9 (Adv Soldier Sensors/Displays AdvTech for Dismounts).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Soldier System Interfaces & Integration (Sensor Technology)	0.495	0.237	0.301
Description: This effort will investigate, design, and validate advanced dismounted Soldier robotic and autonomous systems technologies to enable autonomous navigation, manned-unmanned teaming, and networked reconnaissance to improve Soldier lethality, situational awareness, and survivability during tactical operations.			
FY 2023 Plans: Investigate, design, and develop advanced motion planning and precision landing algorithms to enable extended operations and autonomous search capability for resource constrained Small Unmanned Aerial Systems (SUAS); verify functionality of these algorithms on open architecture SUAS platforms in laboratory and simulated environment to reduce risk and improve system design.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BD6 / <i>Soldier Sys Interfaces/Integration-Sensor Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will conduct experiments on autonomy and teaming technologies for resource constrained Small Unmanned Aerial Systems (SUAS) operating in complex environments to enhance navigation, search capabilities, and extend operations. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding realigned (\$300K) from PE 0603118A (Soldier Lethality Advanced Technology) / Project BD7 (Soldier Sys Interfaces/Integration-Sensor AdvTech)			
Accomplishments/Planned Programs Subtotals	0.495	0.237	0.301

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BD8 / <i>Soldier & Sm Unit Tactical Energy Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BD8: <i>Soldier & Sm Unit Tactical Energy Tech</i>	-	4.304	6.291	6.911	-	6.911	7.450	10.554	10.038	10.520	0.000	56.068

A. Mission Description and Budget Item Justification

This Project conducts applied research and development on materials and component level power and energy technologies in the areas of energy storage, power generation, alternative energy, and intelligent power distribution and thermal management designs that support Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and Soldier power needs to include next generation squad weapons and advanced optical devices and sensors. Enables future Soldier lethality and mobility for longer mission durations at lighter weights to provide enhanced lethality and tactical overmatch of adversaries, and to reduce the burden on the Soldier.

This Project support key Army needs and complements the technical research of Program Element 0602184 (Soldier Applied Research) / Project CO1 (Soldier Power and Energy Concepts) and Program Element 0603118A (Soldier Lethality Advanced Technology) / BD9 (Soldier & Sm Unit Tactical Energy AdvTech).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Tactical Power for Soldier Lethality	3.427	5.341	5.946
Description: This effort investigates, designs, and develops innovative materials and component level power generation and energy storage technologies that support next generation weapons, sensors, radios, and human augmentation devices enabling Soldiers and Small Units to maximize probability of target hits, improve collective situational awareness, ensure multiple communication streams, and assist with tactical tasks in order to decrease Soldier load and power burden, and increase power capabilities by providing more energy to prolong mission run-time.			
FY 2023 Plans:			
Down-select, design, and develop safe, high voltage electrolyte materials and investigate pairing these materials against improved Si anode and Li-metal technologies to verify and validate performance of the Technology Readiness Level (TRL) 5 components. These safe, lightweight power and energy technologies with energy densities from 400-600Wh/kg will enable substantially longer runtimes in multiple soldier-worn portable electronic devices identified by the Soldier Lethality CFT. Investigate and design Soldier and Squad power generation technologies to provide recharging and power scavenging capability from available resources to sustain energy storage technologies while on-the-move in order to limit battery swaps and enable longer mission durations for			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BD8 / <i>Soldier & Sm Unit Tactical Energy Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Soldier Tactical Power, Robotics, and other critical Soldier Lethality applications for 7 day semi-autonomous operations with limited resupply.</p> <p>FY 2024 Plans: Will mature safe, high voltage electrolyte materials paired with improved Si anode technologies to verify and validate performance of 2x increase for the Conformal Wearable Battery (CWB); design and develop Li-metal components that will enable a 2-3x increase in energy and pair it with safer, high voltage electrolyte materials; design and develop breadboard components for Soldier and Squad power generation technologies, such as fuel cells and solar, to provide battery recharge capability to sustain on-the-move operations and limit battery swaps to enable longer mission durations; investigate scaling 2x power density fuel cell stacks to platoon power generation requirement; develop and validate family of Si-Anode based Small Tactical Universal Batteries (STUB) to support enabler and small handheld devices for the Soldier.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Increase represents investments in promising power generation technologies that can be implemented across multiple platforms for Soldier and Squad.</p>				
<p>Title: Materials & Component Technologies for Energy Independence</p> <p>Description: The effort develops technologies to substantially reduce the number of batteries required to accomplish dismounted Soldier/Squad mission objectives by developing more efficient power and thermal management for small systems and harvesting energy and alternative energy technologies thereby significantly reducing Soldier-borne load and logistics requirements for Soldier/Squad power and energy.</p> <p>FY 2023 Plans: Explore and determine conversion efficiency and power density limits for a thermal conversion approach comprised of a gray-body radiant emitter and back surface reflector-based thermophotovoltaic cell coupled with heat recirculating meso-scale reactors under relevant size constraints for portable power generation; investigate multiplexed microreactors including models, designs, and fabrication of conceptual reactors with increasing multiplexing to investigate performance at different scales for wearable or portable multi-fuel fired power generator heat sources.</p> <p>FY 2024 Plans: Will investigate compact heat recirculating burners, including models, designs, and fabrication of burners to increase heat transfer rates that increase power density and efficiency; explore thermophotovoltaic and thermionic designs and improvements that increase power density and efficiency of the thermal-to-electric conversion, and improve coupling efficiency with novel heat sources.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		0.877	0.950	0.965

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BD8 / <i>Soldier & Sm Unit Tactical Energy Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	4.304	6.291	6.911

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BE3 / <i>Joint Service Combat Feeding Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BE3: <i>Joint Service Combat Feeding Technology</i>	-	3.877	4.627	4.074	-	4.074	4.073	4.320	4.970	5.024	0.000	30.965

A. Mission Description and Budget Item Justification

This Project investigates and develops nutrient compositions and stabilization techniques to maximize the Warfighter's physical and cognitive performance on the battlefield, investigates technologies to enhance detection and identification capabilities of chemical and biological threats in foods, and develops innovative ration and field feeding technologies to reduce resupply requirements for the multi-domain battlefield. The Army serves as the Executive Agent for this Department of Defense (DoD) program, with oversight and coordination provided by the DoD Combat Feeding Research and Engineering Board.

Work in this Program Element (PE) is related to and fully coordinated with PE 0602787A (Medical Technology) / Project MK4 (Warfighter Health Applied Rsch Technology) to develop technologies and concepts; Army Additive Manufacturing Community of Practice to enable customization, increase readiness, and improve sustainment due to fabrication of end-use items at point of need; Defense Threat Reduction Agency to maximize protection of rations from contamination; Defense Health Agency (DHA) to transition and develop materiel solutions in the microbiome technical areas; and DHA Joint Program Committee-5, which seeks to develop effective nutritional countermeasures against stressors and to maximize health, performance, and well-being.

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Joint Service Combat Feeding Technology	3.877	4.627	4.074
Description: This effort investigates, designs, and develops nutrient compositions and stabilization techniques to maximize the Warfighter's physical and cognitive performance on the battlefield. The effort investigates technologies to enhance detection and identification capabilities of chemical and biological threats in foods and develops innovative ration and field feeding technologies to reduce resupply requirements. Work in this area results in increased performance, less food-borne illness, and overall increased readiness of the Warfighter.			
FY 2023 Plans: Determine optimal dietary fat levels in weight reduced rations to sustain warfighter physical performance; investigate effect of physical and chemical state of food on fat stability to inform calorically dense ration component design; determine efficacy of nutritional interventions and bioactives on 3D intestinal tissue model to prevent effects of military related stressors; conduct experiments to identify potential of stress adaptation to induce probiotic cultures to survive military ration storage requirements;			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE3 / <i>Joint Service Combat Feeding Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>determine efficacy of residual sanitizers and disinfectants against bacteria and viruses on multiple surfaces; design and develop shelf stable polyphenol containing food products to reduce performance decrements.</p> <p>FY 2024 Plans: Will conduct mathematical analysis of lipid stability in nutrient dense rations; investigate compounds to promote protective potential for the probiotic strain during freeze- drying; develop nutritional intervention and placebo bars in support of human performance research in extreme environments; analyze theoretical/empirical data & characterize materials to examine responsiveness of advanced insulating materials to various stimuli - electro/magneto/thermo/solar; conduct accelerated storage study to mature packaging reduction technologies for operational rations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort to progress into PE 0603118A (Soldier Lethality Advanced Technology) / BE2 (Joint Service Combat Feeding Advanced Technology), to enable efforts which increase performance, decrease food-borne illness, and increase overall readiness of the Warfighter .</p>			
Accomplishments/Planned Programs Subtotals	3.877	4.627	4.074

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE6 / <i>Reactive/Resp Surfaces & Matls-Soldiers & Sys</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BE6: Reactive/Resp Surfaces & Matls-Soldiers & Sys</i>	-	2.836	-	-	-	-	-	-	-	-	0.000	2.836

Note

In Fiscal Year (FY) 2023, this project is administratively realigned to Program Element 0602184A (Soldier Applied Research) Project CW9 (Syn Bio for Reactive-Resp Matls-Soldiers & Sys).

A. Mission Description and Budget Item Justification

This Project designs, fabricates, and assesses a variety of bio-based materials through the application of biotechnology advances to develop material capabilities that respond and adapt to a wide range of external stimuli and biological processes for protection, situational awareness, and sustainment. Innovative materials will be sought that are capable of sensing and responding, as well as adapting response, to a broad spectrum of environmental variables. Research will develop materials that are able to self-monitor, self-heal, and self-sustain. Research will explore new biology-based methods for controlled synthesis and assembly to create materials with precise chemistries, microstructures, properties, and responsive functionalities through controlled molecular placement, spatial architectures, and interfacial structures. These materials have potential to enable more survivable, situationally aware, lighter weight Soldier systems and electronics. Research conducted focuses on unique and/or novel material properties, developing models, materials characterization techniques, non-destructive testing methods and advanced fabrication/processing methodologies.

Work in this Program Element (PE) complements PE 0601102A (Defense Research Sciences) / Project AA3 (Single Investigator Basic Research), Project AA7 (Mechanics and Ballistics), and Project AA5 (Biotechnology and Systems Biology) and informs PE 0603118A (Soldier Lethality Advanced Technology) / BB3 (Dismounted Soldier Survivability Equip/Tech Integ).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

Title: Bio-enabled Materials and Processes	FY 2022	FY 2023	FY 2024
Description: This effort conducts applied research through the application of biotechnology advances to develop materials with capabilities to respond and adapt to a wide range of external stimuli and biological processes. Investment in bio-enabled materials research allows for the design of materials that are capable of sensing and responding, as well as adapting to a broad spectrum of environmental variables with the ability to self-monitor, self-heal, and self-sustain. Investments in this area could lead to future	2.836	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE6 / <i>Reactive/Resp Surfaces & Mats-Soldiers & Sys</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
applications in Soldier performance, situational awareness, protection and sustainment. Research from this effort has potential to transition to multiple end items and applications.			
Accomplishments/Planned Programs Subtotals	2.836	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE8 / <i>Synthetic Training Environment (STE) Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BE8: <i>Synthetic Training Environment (STE) Technology</i>	-	14.170	5.902	-	-	-	-	-	-	-	0.000	20.072

Note

In FY2024 funding realigned to PE 0602184A Project CN2 Intelligent Weapons Concepts and Technology

A. Mission Description and Budget Item Justification

This Project designs and develops technologies supporting the Army's Synthetic Training Environment (STE). The STE is the next generation holistic collective training capability that will train units where they will fight, with whom they will fight, and in complex operational environments to include dense urban and sub-terrain; within the entire range of combined arms maneuver tasks in support of Multi- Domain Operations. STE Information Systems (STE-IS) delivers the Common Synthetic Environment consisting of Global Terrain/One World Terrain (OWT), Training Simulation Software (TSS), and Training Management Tools (TMT). The STE will be available where training occurs (home station, combat training centers, armories, institutions, shipboard, deployed) and will include Air and Ground Reconfigurable Virtual Collective Trainers (RVCTs), a Soldier/Squad Virtual Training (S/SVT), and a live training capability. The STE will be cloud-enabled, compatible with the Army Enterprise Network, and service-based through the Common Operating Environment, including Live and Constructive. The STE will provide the realistic repetitions necessary to fight 25 bloodless battles before the first battle.

This Project is coordinated with work done in Program Element (PE) 0603118A (Soldier Lethality Advanced Technology) / Project BE9 (STE Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy and supports the STE Cross Functional Team efforts.

Work in this Project is performed by the United States Army Futures Command (AFC) and at the Institute for Creative Technologies (ICT) University Affiliated Research Center (UARC) at the University of Southern California

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

Title: STE One World Terrain	FY 2022	FY 2023	FY 2024
Description: This effort investigates and designs tools and methods to improve the speed and fidelity of a terrain capability that provides a representation of the globe, fully accessible through the Army network and usable by all simulation trainers; develops complex representations (including megacities and subterranean) of the operational environment and the Multi-Domain battlefield in synthetic training environments.	5.339	3.744	-
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE8 / <i>Synthetic Training Environment (STE) Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Investigate tools, algorithms and communities of practice to influence terrain collection sensor design principles to include data and surfaces that portray positional information in three physical dimensions that may incorporate multiple heights at any given horizontal position directly contributing to military urban operations (e.g., single building with multiple levels); investigate the automation and convergence (fusion and decimation techniques) of geospatial sensor byproducts to support and advance the utility of 3D geospatial data across the broader force structure.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects a maturation of STE-related OWT technologies and a shift in research focus to longer- term research supporting training of multi-domain operations on complex, data-intensive battlefields. Effort ends in FY2023</p>				
<p>Title: STE Training Management Tool</p> <p>Description: This effort investigates Adaptive Training (AT) methods to facilitate authoring, distribution, management, and evaluation of tailored instruction for both individuals and teams; and evaluates the impact of training and education tools/ methods on comprehension, reasoning, learning, performance, retention, and transfer of knowledge and acquired skills to assess Training Effectiveness (TE) in Synthetic Training Environments.</p> <p>FY 2023 Plans: Investigate and validate approaches to model team competencies based on automated performance assessments from infantry squads in both live and simulated environments; develop a scenario agnostic call for fire assessment engine; conduct experiments to improve the function of dynamic, role-based assessments in teams using intelligent tutoring technologies; mature natural language processing techniques to improve near real-time assessment of teamwork using verbal communications; expand and mature the design of competency tracking architectures to include other teams including armor crews and mission command groups; validate data and reinforcement learning-driven coaching models that apply feedback and scenario adaptations to drive team development across synthetic and mixed reality environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding realigned to PE 0602184A Project CN2 Intelligent Weapons Concepts and Technology in FY 2024 to increase research into Human-Agent Interactions for Intelligent Squad Weapons.</p>		4.805	1.999	-
<p>Title: STE Training Simulation Software</p> <p>Description: This effort designs and develops Modeling and Simulation (M&S) technologies to enable the Army's STE TSS. This includes technologies that enable the representation of the development of synthetic military forces and noncombatants leveraging emerging Artificial Intelligence (AI) methods and techniques. This application of AI to simulation use is focused on enabling more complex modeling of the Operational Environment and the representation of Multi-Domain Operations. This effort also investigates methods and means to enable a pipeline of modeling development and reuse from authoritative sources to</p>		4.026	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BE8 / <i>Synthetic Training Environment (STE) Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
simulation environments considering the complexities of simulating various echelons of warfare and their application in support of multiple collective training use cases and user interfaces to access the TSS.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.159	-
Accomplishments/Planned Programs Subtotals	14.170	5.902	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BP9 / <i>Soldier Lethality Technologies (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BP9: <i>Soldier Lethality Technologies (CA)</i>	-	100.000	149.700	-	-	-	-	-	-	-	0.000	249.700

Note

Congressional Interest Item funding provided for Soldier Lethality Technologies.

A. Mission Description and Budget Item Justification

This Project is for congressional increases that support applied research in support of Soldier Lethality, where the Soldier and Squad are treated as an integrated combat platform.

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

	FY 2022	FY 2023
Congressional Add: Program increase - Pathfinder Airborne	8.000	8.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Pathfinder Airborne		
FY 2023 Plans: Congressional Interest Item funding provided for Pathfinder Airborne		
Congressional Add: Program Increase - Pathfinder Air Assault	10.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Pathfinder Air Assault		
Congressional Add: Program increase - HEROES Program	5.000	10.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for HEROES		
FY 2023 Plans: Congressional Interest Item funding provided for HEROES		
Congressional Add: Program increase - Academic Accelerator Pilot Program	15.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Academic Accelerator Program		
Congressional Add: Advanced Silicon Anode Material for Batteries	10.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Advanced Silicon Anode Material for Batteries		
Congressional Add: Program Increase - ADVANCED TEXTILES AND SHELTERS	6.000	6.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Advanced Textiles and Shelters		
FY 2023 Plans: Congressional Interest Item funding provided for ADVANCED TEXTILES AND SHELTERS		
Congressional Add: Catalyst Traca Data Ready	5.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BP9 / <i>Soldier Lethality Technologies (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Catalyst TRACA Data Ready		
Congressional Add: Program Increase - Digital Night Vision Technology	5.000	9.700
FY 2022 Accomplishments: Congressional Interest Item funding provided for Digital Night Vision Technology		
FY 2023 Plans: Congressional Interest Item funding provided for Digital Night Vision Technology		
Congressional Add: Enhancing Soldier Ballistic Technologies	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Enhancing Soldier Ballistic Technologies		
Congressional Add: Materials Development for Personal Protective Systems	10.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Materials Development for Personal Protective Systems		
Congressional Add: Military Footwear Research	3.000	10.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Military Footwear Research		
FY 2023 Plans: Congressional Interest Item funding provided for Military Footwear Research		
Congressional Add: Program Increase - Nanolayered Polymer Optics	10.000	10.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Nanolayered Polymer Optics		
FY 2023 Plans: Congressional Interest Item funding provided for Nanolayered Polymer Optics		
Congressional Add: Pathfinder Translational Research Advanced Capability Acceleration	8.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Pathfinder Translational Research Advanced Capability Acceleration		
Congressional Add: Program Increase - ADVANCED BALLISTIC PROTECTION TECHNOLOGY	-	25.000
FY 2023 Plans: Congressional Interest Item funding provided for ADVANCED BALLISTIC PROTECTION TECHNOLOGY		
Congressional Add: Program Increase - ARTIFICIAL INTELLIGENCE - ENHANCED EDUCATIONAL TECHNOLOGY AND LEARNING	-	5.000
FY 2023 Plans: Congressional Interest Item funding provided for ARTIFICIAL INTELLIGENCE - ENHANCED EDUCATIONAL TECHNOLOGY AND LEARNING		
Congressional Add: Program Increase - ENHANCED BALLISTIC PROTECTIVE EYEWEAR	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BP9 / <i>Soldier Lethality Technologies (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for ENHANCED BALLISTIC PROTECTIVE EYEWEAR		
<i>Congressional Add:</i> Program Increase - ENHANCING SOLDIER BALLISTIC TECHNOLOGIES	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for ENHANCING SOLDIER BALLISTIC TECHNOLOGIES		
<i>Congressional Add:</i> Program Increase - FLAT PANEL TECHNOLOGY	-	2.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Flat Panel Technology		
<i>Congressional Add:</i> Program Increase - FUTURE FORCE REQUIREMENTS EXPERIMENTATION	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for FUTURE FORCE REQUIREMENTS EXPERIMENTATION		
<i>Congressional Add:</i> Program Increase - INNOVATIVE TRAINING TECHNOLOGIES	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Innovative Training Technologies		
<i>Congressional Add:</i> Program Increase - LITHIUM-ION BATTERY CELL RESEARCH PILOT	-	9.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for LITHIUM-ION BATTERY CELL RESEARCH PILOT		
<i>Congressional Add:</i> Program Increase - PATHFINDER ADAPTIVE EXPERIMENTATION FORCE	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for PATHFINDER ADAPTIVE EXPERIMENTATION FORCE		
<i>Congressional Add:</i> Program Increase - PATHFINDER CYBER INITIATIVES	-	12.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for PATHFINDER CYBER INITIATIVES		
<i>Congressional Add:</i> Program Increase - REGIONAL WORKFORCE PILOT	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Regional Workforce Pilot		
<i>Congressional Add:</i> Program Increase - SOLDIER & SMALL UNIT TACTICAL ENERGY TECHNOLOGY	-	3.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for SOLDIER & SMALL UNIT TACTICAL ENERGY TECHNOLOGY		
Congressional Adds Subtotals	100.000	149.700

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BP9 / <i>Soldier Lethality Technologies (CA)</i>

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BR9 / <i>Personnel & Airdrop Safety Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BR9: <i>Personnel & Airdrop Safety Technology</i>	-	3.349	3.412	3.092	-	3.092	3.091	3.735	3.738	3.778	0.000	24.195

A. Mission Description and Budget Item Justification

This Project funds the research and investigation of component technologies to enhance cargo and personnel airdrop capabilities for global precision delivery, rapid deployment, and insertion for force projection into hostile regions. Areas of emphasis include parachute technologies, parachutist injury reduction, precision offset aerial delivery, soft landing technologies, and airdrop simulation. Technologies support the Soldier Lethality Army Modernization Priority. New operational concepts call for increased precision of personnel and cargo in austere environments in which small units are dispersed and logistical supply is limited. The Army requires enhanced payload extraction and other increased capabilities to support the airdrop requirement for current and future vehicles exceeding aircraft payload weight capacity.

Work in this Project supports key Army needs and complements the technical research of several Program Elements (PEs) to include PE 0601102A (Defense Research Sciences), PE 0602143A (Soldier Lethality Technology) / Project BD6 (Soldier Sys Interfaces/ Integration- Sensor Tech), and PE 0603118A (Soldier Lethality Advanced Technology) / Project BE5 (Personnel & Airdrop Safety Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Personnel & Airdrop Safety Technology	3.349	3.337	3.092
Description: This effort investigates technologies that enhance payload extraction, which will allow current vehicles to be dropped with more armor and support equipment, and reduce the design constraint on future vehicles that have airdrop as an operational requirement, increase parachute gliding capabilities, and mature delivery accuracy of cargo aerial delivery systems that support varying payload weights. Research in the area of novel parachute materials will provide increased capabilities for cargo and personnel aerial delivery systems. This effort will support an investigation of new Modeling and Simulation (M&S) tools to develop validation methods for airdrop concepts. This effort also investigates technologies that advance airborne personnel insertion safety requirements to modernize the Airborne Soldier and provide the ability to effectively execute the airborne mission through reducing safety risk and increasing capabilities.			
FY 2023 Plans: Design and develop technologies to increase the level of autonomy (e.g. fully autonomous takeoff and landing) for the manned and unmanned long range aerial resupply/insertion of a vehicle(s); design and develop safe human-in-the-loop teaming with these autonomous technologies for use with the manned personnel infiltration/exfiltration system (PIES); funds research on mission			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BR9 / <i>Personnel & Airdrop Safety Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>planning interfaces and algorithms to reduce a soldier's cognitive burden when planning for and executing insertion and resupply missions in a complex, contested environment.</p> <p>FY 2024 Plans: Will investigate non-traditional delivery approaches and platforms to support resupply methods in dispersed, contested environments; design and develop personnel infiltration/exfiltration system fuselage to increase reliability with optional autonomous guidance and flight control for a soldier and their supplies; design and develop technologies to facilitate autonomous long distance precision aerial delivery of multiple effects with expanded Global Positioning System (GPS) - degraded/denied capabilities (to include inclement weather, nighttime) and enhanced mission planning algorithms; mature models/simulation in support of cargo resupply methods and atmospheric constraints by analyzing and comparing with flight test data;</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects reduction of maturation of models effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.075	-
Accomplishments/Planned Programs Subtotals	3.349	3.412	3.092

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army											Date: March 2023	
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602144A / Ground Technology							
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	214.489	264.523	60.005	-	60.005	69.110	80.531	79.954	90.043	0.000	858.655
BK7: Robotics for Engineer Operations Technology	-	1.183	1.802	6.459	-	6.459	5.725	3.748	2.089	7.211	0.000	28.217
BL1: Materials and Manufacturing Research Technology	-	9.032	4.257	4.321	-	4.321	4.319	7.081	7.085	7.162	0.000	43.257
BL2: Explosives Forensics Technology	-	1.524	1.673	1.707	-	1.707	8.314	8.365	8.353	12.391	0.000	42.327
BL5: Expedient Passive Protection Technology	-	1.836	4.348	2.957	-	2.957	3.113	4.786	4.160	3.457	0.000	24.657
BL7: Power Projection in A2AD Environments Technology	-	3.036	1.871	2.963	-	2.963	2.157	3.611	2.567	1.948	0.000	18.153
BL9: Protection from Advanced Weapon Effects Technology	-	4.185	5.037	5.211	-	5.211	5.023	4.809	5.512	7.191	0.000	36.968
BN8: Ground Technology Materials(CA)	-	160.150	211.900	-	-	-	-	-	-	-	0.000	372.050
CG5: Ground Vehicle Sensor Concepts and Technologies	-	3.994	-	-	-	-	-	-	-	-	0.000	3.994
CG6: Ground Vehicle Power and Energy Concepts and Tech	-	2.583	2.526	2.605	-	2.605	4.669	6.049	6.003	6.049	0.000	30.484
CG7: Ground Protection Concepts and Technologies	-	14.033	12.194	10.473	-	10.473	13.687	16.384	17.893	16.620	0.000	101.284
CG8: Human Autonomy Teaming	-	8.285	9.036	9.263	-	9.263	9.265	9.327	9.334	9.449	0.000	63.959
CI2: Ground Enabling University Applied Research	-	4.648	3.682	3.906	-	3.906	5.522	4.621	4.624	4.675	0.000	31.678
CV3: Engineer Enablers Maneuver, LOG, & Sustainment Apl	-	-	2.518	2.195	-	2.195	1.254	4.171	3.022	4.070	0.000	17.230

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602144A / <i>Ground Technology</i>											
DA1: <i>SAFR Alternatives for Readiness Applied Research</i>	-	-	3.679	5.171	-	5.171	6.062	7.579	9.312	9.820	0.000	41.623
DG1: <i>Development of Obscurants</i>	-	-	-	2.774	-	2.774	-	-	-	-	0.000	2.774

Note
 Project CV3 (Engineer Enablers Maneuver, LOG, & Sustainment Apl) and Project DA1 (SAFR Alternatives for Readiness Applied Research) are New Start Projects for Fiscal Year 2023 (FY23). Project CG5 (Ground Vehicle Sensor Concepts and Technologies) is Terminated starting in FY23.

A. Mission Description and Budget Item Justification
 This Program element (PE) researches efforts that support and enable the Army's modernization priority for the Next Generation of Combat Vehicles including systems for the deployment and sustainment of ground movement and maneuver. This PE designs and validates technologies that are necessary and foundational for legacy and future ground movement, maneuver and protection of Soldiers and systems.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas in support of the National Defense Strategy and the Army Modernization Strategy.

Work in this PE supports the Army Science and Technology Ground portfolio.

Work is performed by the United States (U.S.) Army Futures Command and the U.S. Army Engineer Research and Development Center.

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology), PE 0603119A (Ground Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0602143A (Soldier Lethality Technology) and PE 0603118A (Soldier Lethality Advanced Technology).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	216.550	52.848	59.131	-	59.131
Current President's Budget	214.489	264.523	60.005	-	60.005
Total Adjustments	-2.061	211.675	0.874	-	0.874
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	211.900			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-2.061	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.874	-	0.874
• FFRDC Transfer	-	-0.225	-	-	-

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BN8: *Ground Technology Materials(CA)*

Congressional Add: *Program increase: Advanced Polymers for Force Protection*

Congressional Add: *Program increase - High Performance Polymers*

Congressional Add: *Program increase - INTEGRITY OF TRANSPARENT ARMOR*

Congressional Add: *Program increase - ENVIRONMENTAL QUALITY ENHANCED COATINGS*

Congressional Add: *Program increase - Autonomous Digital Design and Manufacturing*

Congressional Add: *Program increase - MATERIALS RECOVERY TECHNOLOGIES FOR DEFENSE SUPPLY RESILIENCY*

Congressional Add: *Program increase - Additive Manufacturing Machine Learning Initiative*

Congressional Add: *Program increase - RAPID ADVANCED DEPOSITION*

Congressional Add: *Program increase - Defense Resiliency Against Extreme Cold Weather*

Congressional Add: *Program increase - Earthen Structures Soil Enhancement*

Congressional Add: *Advanced Manufacturing Materials Processes Initiative*

Congressional Add: *Advanced Materials Manufacturing*

Congressional Add: *Anti-Corrosion Materials*

Congressional Add: *Ceramic Materials for Extreme Environments*

Congressional Add: *Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research*

	FY 2022	FY 2023
	8.000	-
	5.000	-
	5.000	4.400
	5.000	5.000
	5.000	-
	10.000	10.000
	5.000	-
	5.000	10.000
	10.000	-
	4.000	-
	10.000	-
	8.000	-
	7.000	-
	8.000	-
	6.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army		Date: March 2023	
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>		R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	
<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>		FY 2022	FY 2023
Congressional Add: <i>Electrolyzer</i>		7.000	-
Congressional Add: <i>Flexible Hybrid Electronics and Environmental Sustainability</i>		12.000	-
Congressional Add: <i>PFAS Modeling</i>		5.000	-
Congressional Add: <i>Polar Proving Ground and Training Program</i>		2.000	-
Congressional Add: <i>Rapid Infrastructure Development and Engineering</i>		3.000	-
Congressional Add: <i>Program Increase - RARE EARTH INITIATIVE</i>		7.000	10.000
Congressional Add: <i>Solid Oxide Fuel Cell Development</i>		10.000	-
Congressional Add: <i>Tank Tracks</i>		3.150	-
Congressional Add: <i>Program Increase - VERIFIED INHERENT CONTROL</i>		10.000	10.000
Congressional Add: <i>Program Increase - ADVANCED CERAMIC TECHNOLOGIES</i>		-	2.000
Congressional Add: <i>Program Increase - ALTERNATIVE ENERGY RESEARCH</i>		-	20.000
Congressional Add: <i>Program Increase - AUTONOMOUS DIGITAL DESIGN</i>		-	5.000
Congressional Add: <i>Program Increase - CARBON NANOMATERIALS AS FUNCTIONAL ADDITIVES</i>		-	6.500
Congressional Add: <i>Program Increase - COLD REGION RESEARCH</i>		-	5.000
Congressional Add: <i>Program Increase - DEFENSE RESILIENCY AGAINST EXTREME COLD WEATHER</i>		-	11.000
Congressional Add: <i>Program Increase - DEFENSE RESILIENCY PLATFORM ADDRESSING EXTREME COLD WEATHER</i>		-	10.000
Congressional Add: <i>Program Increase - DETECTION AND DEFEAT OF BURIED MUNITIONS</i>		-	4.000
Congressional Add: <i>Program Increase - EARTHEN STRUCTURES SOIL ENHANCEMENT</i>		-	4.000
Congressional Add: <i>Program Increase - ELECTROLYZER</i>		-	7.000
Congressional Add: <i>Program Increase - EXTREME BATTERY TECHNOLOGIES</i>		-	10.000
Congressional Add: <i>Program Increase - FLEXIBLE HYBRID ELECTRONICS</i>		-	15.000
Congressional Add: <i>Program Increase - FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS</i>		-	5.000
Congressional Add: <i>Program Increase - GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE</i>		-	1.000
Congressional Add: <i>Program Increase - HIGH PERFORMANCE POLYMER COMPOSITES AND COATINGS</i>		-	10.000
Congressional Add: <i>Program Increase - LIGHTWEIGHT HIGH ENTROPY METALLIC ALLOY DISCOVERY COLLABORATION</i>		-	5.000
Congressional Add: <i>Program Increase - LOGISTICS OVER-THE-SHORE CAPABILITIES</i>		-	10.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2022	FY 2023
Congressional Add: <i>Program Increase - POLAR PROVING GROUND</i>	-	5.000
Congressional Add: <i>Program Increase - PROTECTIVE COATINGS</i>	-	10.000
Congressional Add: <i>Program Increase - ULTRA-HIGH DENSITY STORAGE</i>	-	10.000
Congressional Add: <i>Program Increase - AI/ML materials for sensors and electronics</i>	-	7.000
Congressional Add Subtotals for Project: BN8	160.150	211.900
Congressional Add Totals for all Projects	160.150	211.900

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) BK7 / <i>Robotics for Engineer Operations Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BK7: Robotics for Engineer Operations Technology</i>	-	1.183	1.802	6.459	-	6.459	5.725	3.748	2.089	7.211	0.000	28.217

A. Mission Description and Budget Item Justification

This research investigates and develops standoff robotic capabilities for Combat Engineers to reduce Soldier/Engineer risks and fatalities while conducting activities essential to shaping the environment. It will close the gaps between commercial construction equipment and the requirements of the future Engineer Force to support maneuver, movement, and sustainment. This research will develop the capability to generate a near real-time site model with appropriate engineering details to allow unmanned shaping of the environment through physical interaction (e.g. push, pull, lift, or dig). This effort will also develop the requisite mission planner and task execution controller that accepts input from the user and provides suggestions and feedback based on updates to the site model, reporting from hardware agents, and resource allocation logic. The end state goal is the development of beyond visual line of sight teleoperation and semiautonomous capabilities allowing Engineer robotic support to match pace in near term and future combat environments. This effort will support the development, testing, and evaluation of prototypical robotic Combat Engineer equipment. This Project develops modeling and simulation tools that represent realistic states for Engineer robotic operations and develops and assesses semi-autonomous and autonomous construction equipment technologies needed for remote control Engineer operations.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology) / Project BK8 (Robotics for Engineer Operations Adv Tech).

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

Work in this Project supports the Army Science and Technology Ground Portfolio.

Work in this Project is coordinated with Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology).

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Beyond-Visual-Line-of-Sight Teleoperated Engr Ops	1.138	-	-
Description: This effort develops site characterization technologies, equipment localization technologies, equipment tools, and controls protocols to support remote control and semi-autonomous engineering operations and develops modeling and simulation tools to support remote operations.			
Title: Semi-Autonomous Engineer Operations	-	1.802	6.459

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BK7 / <i>Robotics for Engineer Operations Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort investigates and develops machine tool behaviors to perform semi-autonomous shaping of the terrain through physical interaction with the environment (push, pull, lift, and dig). The effort develops the necessary decision-making, data fusion, localization, and inter-platform communication to allow semi-autonomy on commercial off the shelf (COTS) equipment.</p> <p>FY 2023 Plans: Investigate instrumenting individual motors and movement joints on the heavy Engineer equipment for machine feedback to planning algorithms; develop the required sensor payload, onboard processing, and path planning and control algorithms on heavy Engineer equipment to enable semiautonomous navigation.</p> <p>FY 2024 Plans: Will adapt and validate autonomous path planning and movement control algorithms, developed during previous efforts, to apply to heavy Engineer equipment. Will enhance simulation environment with the design and development of machine-learning based terrain shaping algorithms to enable autonomous execution of a simple repetitive Combat Engineer task using single type of heavy Engineer equipment.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects investments required to conduct experiments to adapt and validate movement control algorithms developed for small robotic platforms to heavy Engineer equipment as well as beginning development of terrain shaping algorithms needed for heavy Engineer equipment.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p>	0.045	-	-
Accomplishments/Planned Programs Subtotals	1.183	1.802	6.459

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks N/A</p> <p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) BL1 / <i>Materials and Manufacturing Research Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BL1: <i>Materials and Manufacturing Research Technology</i>	-	9.032	4.257	4.321	-	4.321	4.319	7.081	7.085	7.162	0.000	43.257

A. Mission Description and Budget Item Justification

This Project links materials research, manufacturing processes, and design to enable higher quality additive manufacturing products for Army applications through the development of high performance feedstock materials (polymers, metals, and ceramics), physics-based process models, and in-situ process monitoring. Integration of these tools with process models enables real-time control and manipulation of materials structure and properties to produce three-dimensional hybrid electronics packaging, power and energy sources and converters and new materials/structures for protection. The goal of this work is to develop robust physics-based models to optimize material properties, structures, and manufacturing processes for Army applications in protection, maneuver, power, sensing, and signature management necessary to rapidly respond to emerging and unknown threats in a battlefield environment.

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

Work in this Project supports the Army Science and Technology Ground, Next Generation Combat Vehicle, Long Range Protective Fires, and Soldier Lethality.

Work in this Project is performed by the United States (US) Army Futures Command.

This work is done in coordination with Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology), 0602143A (Soldier Lethality Technology) and 0603118A (Soldier Lethality Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Additive Manufacturing Research	8.162	3.348	3.382
Description: This effort Investigates new additive manufacturing (AM) capabilities that enable production of lightweight materials for protection, lethality, and maneuverability that cannot be produced through traditional manufacturing methods. Efforts include the design and development of new feedstock materials engineered specifically for low-volume additive processes to produce net-shape materials with desired properties and functionalities; integrated process models and real-time monitoring for closed-loop control and production of lightweight materials with optimal architectures, property gradients, and interfaces; and design optimization capabilities that connect materials and manufacturing to access the full design space enabled by additive manufacturing.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL1 / <i>Materials and Manufacturing Research Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Design and develop three-dimensional printed propellants, both rocket and gun charges, which yield optimized pressurization profiles to increase muzzle velocity for increased penetration in direct fire applications and/or increased range for large caliber munitions; conduct experiments of tailorable fragmentation schemes in metals AM printed parts, controlling size and size distribution of fragments as it is integrated with next generation explosive technologies (potentially integrated with AM explosives).</p> <p>FY 2024 Plans: Will validate machine learning guided process control for metal AM builds of munition components; design printed munition casings with microstructure driven fragmentation schemes using novel next generation alloys; validate modeling tools that predict the fragmentation behavior of printed metals based on process specific thermal history for precision control of lethality; validate full 3-Dimensional electronic processes, milled circuit traces, conductive traces, circuit component placement in microcontroller, and seeker circuits for Army-relevant applications; validate high accelerative loading conditions on printed electronics to determine that AM conformal electronics can withstand accelerative loading; finalize development of integrated circuits, fuze, and initiators for high g-force reliability.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>				
<p>Title: Energy Sources and Storage</p> <p>Description: This effort focuses on the design and characterization of chemistries, materials, and components for advanced batteries, fuel reformers, and fuel cells. Potential Army applications include hybrid power sources, smart munitions, hybrid electric vehicles, and soldier power applications. This effort also investigates the applicability of photosynthesis to provide fuel and electricity for soldier power applications, and investigates silicon carbide power module components that could enable compact, high-efficiency, high-temperature, and high-power density converters for motor drive and pulse power applications.</p> <p>FY 2023 Plans: Investigate ability to incorporate chemically modify and dope silicon-based Li-ion battery anodes as a means to address reactivity to improve ultrahigh energy performance of Soldier-carried batteries; explore ability to combine with advanced high voltage electrolytes to mitigate risks of fire and thermal runaway in event of damage or abuse; investigate ability to enable fast charge / high power in high capacity anodes including nanostructured Si-, composite-, metal-oxides, and structured anodes; design and develop high ionic conductivity solid-state electrolytes and integral electrode structures as means to further mitigate safety risks in high energy, high rate rechargeable Li-ion battery.</p> <p>FY 2024 Plans: Will identify most promising compositions and methods for chemical modification of silicon as high capacity Li-ion battery anode; characterize the nature, quality, and robustness of the solid electrolyte interface layer forming at the silicon anode-electrolyte interface to determine its ability to provide necessary passivation (chemical process) of the Li-ion battery anode, and its impact</p>		0.870	0.901	0.939

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL1 / <i>Materials and Manufacturing Research Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
on charge rate, temperature, and cycle life performance; explore Li-ion battery safety, through thermal, electrical short, and penetration assessments; investigate spinel, garnet, and monolithic solid electrolyte interphase (SEI), and complementary electrode integration for high energy Li-ion batteries; explore low-cobalt or cobalt-free, high-voltage, and high-capacity battery cathodes. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.008	-
Accomplishments/Planned Programs Subtotals	9.032	4.257	4.321

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) BL2 / <i>Explosives Forensics Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BL2: <i>Explosives Forensics Technology</i>	-	1.524	1.673	1.707	-	1.707	8.314	8.365	8.353	12.391	0.000	42.327

A. Mission Description and Budget Item Justification

This Project investigates and develops analytical methods for military explosives, homemade explosives (HME), HME precursors, and residue analysis for forensics attribution purposes. This project pursues research in signatures and algorithms required to provide improved residue analysis of explosives and precursor materials to enable integration into chemical and explosive hazard detection equipment for the warfighter.

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

Work in this Project supports the Army Science and Technology Ground Portfolio.

Work in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Forensic Analysis of Explosives Signatures Applied Research	1.524	1.612	1.707
Description: This effort investigates forensics analytical methods for military explosives, homemade explosives (HME), HME precursors, and residue analysis for attribution.			
FY 2023 Plans: Will mature concepts and technologies in analytical forensics methods leading to the design and development of portable tools and capabilities for the detection of explosives, drugs (synthetic opioids), and other chemical residue analysis for attribution. Further develop inkjet manufactured coupons for quantifiable threat assessments mimicking bulk and trace level hazards of contamination on surfaces to be utilized for assessment of optical and non-optical detection systems. Investigate multi-wavelength, multi-phenomenology orthogonal systems for low level surface detection characteristics.			
FY 2024 Plans: Will further mature collimated Raman system for real time detection of liquid and solid visual and non-visual contaminated surfaces; continue to examine surface-enhanced Raman spectroscopy nano-metallic substrates to augment normal Raman handheld devices for trace level detection of explosives and opioids, and continued development of chemical depositions systems for quantifiable test standards for point and standoff sensors.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.061	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL2 / <i>Explosives Forensics Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	1.524	1.673	1.707

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL5 / <i>Expedient Passive Protection Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BL5: <i>Expedient Passive Protection Technology</i>	-	1.836	4.348	2.957	-	2.957	3.113	4.786	4.160	3.457	0.000	24.657

A. Mission Description and Budget Item Justification

This Project designs and develops rapidly deployable passive protective solutions; algorithms for decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities. Through experimental and computational investigation and design, this project develops force protection technologies for complex and urban environments. This Project also develops expedient solutions and decision support applications for protection against advanced energetic threats and large caliber rockets, missiles, and other emerging weapons.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology) / Project BL6 (Expedient Passive Protection Advanced Technology).

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

Work in this Project supports the Army Science and Technology Ground Portfolio.

Work in this Project is performed by the United States (US) Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Protection Against High Trajectory Large Caliber Rocket and Missile Threats</p> <p>Description: This effort investigates high trajectory large caliber rocket and missile weapon effects on critical assets and facilities and develops expedient force protection solutions for these new weapon threats. These solutions include the application of novel protective materials and designs. This effort develops and validates deployable protection systems against these threats and develops decision support tools to aid the warfighter in selecting protective positions.</p>	1.766	-	-
<p>Title: Assessments of Solutions for Survivability from Emerging Threats (ASSET)</p> <p>Description: This effort investigates emerging weapon threat effects on critical assets, theater of operation facilities, and existing protection technologies; designs and develops rapidly deployable passive protective solutions; algorithms for decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities against emerging threats, such as high trajectory large caliber rockets and missiles as well as UAS threats. This effort integrates experimental and computational analysis.</p> <p>FY 2023 Plans:</p>	-	4.303	2.957

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL5 / <i>Expedient Passive Protection Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Develop design concepts and models of rapidly deployable protection systems to protect critical semi-fixed assets and facilities from the effects of emerging threats, and develop fast-running algorithms to estimate the effects of emerging threats on legacy protective systems and new conceptual passive protection designs.</p> <p>FY 2024 Plans: Will conduct experiments of newly designed rapidly deployable protection systems against emerging threats, such as large caliber rockets and missiles and will enhance high-fidelity models and fast-running algorithms to predict emerging threat effects.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the transition of technologies to PE 0603119A (Ground Advanced Technology) / Project BL6 (Expedient Passive Protection Advanced Technologies) / Task Assessments of Solutions for Survivability from Emerging Threats Demonstrations for maturation and demonstration.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	0.070	0.045	-
Accomplishments/Planned Programs Subtotals	1.836	4.348	2.957

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks N/A</p> <p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL7 / <i>Power Projection in A2AD Environments Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BL7: Power Projection in A2AD Environments Technology</i>	-	3.036	1.871	2.963	-	2.963	2.157	3.611	2.567	1.948	0.000	18.153

A. Mission Description and Budget Item Justification

This Project designs and develops remote assessment technologies to determine entry and maneuver corridors, develops site selection tools and decision support technologies for all climates in all season conditions including aviation site selection tools, enhanced automated route reconnaissance technologies, mobility models for extreme climates, and road capacity assessment technologies. These technologies reduce reliance on manned on-site reconnaissance for projection platform assessments and provide all season capacity predictions to ensure air and ground battlespace entry and maneuver. This Project also designs and develops material solutions to repair, rebuild and construct infrastructure required for movement and maneuver in highly contested, complex operational environments such as Anti-Access/Area Denial (A2/AD).

Work in this PE complements PE 0603119A (Ground Advanced Technology) / Project BL8 (Power Projection in A2AD Environments Adv Tech).

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

Work in this Project supports the Army Science and Technology Ground Portfolio.

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Entry and Sustainment in Complex Contested Environments	1.275	-	-
Description: This effort designs and develops strategic and tactical level planning tools for assessing engineering behavior of ground surfaces as it relates to battlefield maneuver to include factors affecting on-and-off-road vehicle mobility as well as aviation assembly areas; applies new technologies for data acquisition to engineering design factors to rapidly assess vehicle and terrain interaction.			
Title: Engineering for Battlespace Maneuver	1.646	1.844	2.963
Description: This effort develops the capability to rapidly repair and upgrade damaged infrastructure along mobility corridors and restaging areas to maintain and enhance freedom of maneuver achieving overmatch and tactical advantage in contested complex environments.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL7 / <i>Power Projection in A2AD Environments Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Determine design and selection protocol for executing rapid soil hardening; conduct experiments to quantify effectiveness of equipment attachments for executing rapid route remediation; and perform simulations to identify requirements for mechanical stabilization systems to support heavy tactical wheeled vehicle loads.</p> <p>FY 2024 Plans: Will develop a framework for automated decision support tools that will determine requirements for planning tools to task route repair and upgrades; will develop optimization routine for selecting equipment and materials to perform repair missions.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects investments required to develop a framework for automated decision support tools that implement best practices for contingency repairs.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	0.115	0.027	-
Accomplishments/Planned Programs Subtotals	3.036	1.871	2.963

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

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL9 / <i>Protection from Advanced Weapon Effects Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BL9: <i>Protection from Advanced Weapon Effects Technology</i>	-	4.185	5.037	5.211	-	5.211	5.023	4.809	5.512	7.191	0.000	36.968

A. Mission Description and Budget Item Justification

This Project designs and develops structural hardening, high-performance computing capabilities, and force protection technologies to enhance survivability of personnel and critical assets. This project investigates and develops advanced materials for protection against blast, fragmentation, and penetration through physical experiments and modeling and simulation. Additionally, this project investigates, designs, and develops passive protection technologies and protective design criteria to mitigate attack from emerging advanced threats.

Work in this Program Element (PE) complements PE 0603119A (Ground Advanced Technology) / Project BM1 (Protection from Advanced Weapon Effects Adv Tech).

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

Work in this Project supports the Army Science and Technology Ground Portfolio.

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Defeat of Complex Attack</p> <p>Description: This effort designs and develops passive protection structural hardening designs and solutions against emerging large-caliber advanced weapons; investigates and validates computational models for predicting residual protective capacity for multi-hit threat scenarios; and designs and develops micro-mechanics-based models and material solutions matured by conducting high-rate experiments.</p>	2.654	-	-
<p>Title: Advanced Materials and Modeling for Force Protection</p> <p>Description: This effort designs and develops capabilities in the use of poorly-understood and indigenous materials. This effort develops multi-scale material modeling frameworks incorporating physics of deformation and damage mechanisms; a 3D multi-physics material modeling capability to allow for weapons effects models to be informed by remote sensing; and advanced material technologies for force protection.</p> <p>FY 2023 Plans:</p>	1.531	1.548	1.595

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL9 / <i>Protection from Advanced Weapon Effects Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Expand the multi-scale materials-by-design tools for unconventional / indigenous materials for force protection, investigate dynamic material simulation capabilities, multi-functional materials development for kinetic and non-kinetic force protection, and design and develop and conduct advanced high-rate dynamic experiments.</p> <p>FY 2024 Plans: Will implement thermodynamics-based geomaterial modeling into multi-scale modeling framework; investigate advanced composite, metal, and hybrid materials developed through materials-by-design approaches; and will investigate system-level integration of advanced materials into force protection systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Protection from Advanced Penetrators</p> <p>Description: This effort designs and develops protective material solutions and enhances modeling and simulation (M&S) tools for designing, analyzing and improving these advanced protective materials to be used in large hardened protective structures; investigates and validates computational models and passive protective solutions for large hardened structures from advanced precision penetrating threat weapons.</p> <p>FY 2023 Plans: Investigate material solutions and structural component enhancements for use in hardened protective structures to mitigate weapons effects of advanced penetrators.</p> <p>FY 2024 Plans: Will design, develop and conduct sub-scale experiments to predict weapon effects from advanced penetrators on protective structures. Will update M&S based on experiments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>		-	3.489	3.616
Accomplishments/Planned Programs Subtotals		4.185	5.037	5.211
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BL9 / <i>Protection from Advanced Weapon Effects Technology</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BN8: <i>Ground Technology Materials(CA)</i>	-	160.150	211.900	-	-	-	-	-	-	-	0.000	372.050

Note

Congressional Interest Item funding provided for Ground Technology Materials.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Ground Technology Materials.

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

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

	FY 2022	FY 2023
Congressional Add: Program increase: Advanced Polymers for Force Protection	8.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Advanced Polymers for Force Protection		
Congressional Add: Program increase - High Performance Polymers	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for High Performance Polymers		
Congressional Add: Program increase - INTEGRITY OF TRANSPARENT ARMOR	5.000	4.400
FY 2022 Accomplishments: Congressional Interest Item funding provided for Integrity of Transparent Armor		
FY 2023 Plans: Congressional Interest Item funding provided for Integrity of Transparent Armor		
Congressional Add: Program increase - ENVIRONMENTAL QUALITY ENHANCED COATINGS	5.000	5.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Environmental Quality Enhanced Coatings		
FY 2023 Plans: Congressional Interest Item funding provided for Environmental Quality Enhanced Coatings		
Congressional Add: Program increase - Autonomous Digital Design and Manufacturing	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Autonomous Digital Design and Manufacturing		
Congressional Add: Program increase - MATERIALS RECOVERY TECHNOLOGIES FOR DEFENSE SUPPLY RESILIENCY	10.000	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Materials Recovery Technologies for Defense Supply Resiliency		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Materials Recovery Technologies for Defense Supply Resiliency		
<i>Congressional Add:</i> Program increase - Additive Manufacturing Machine Learning Initiative	5.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Additive Manufacturing Machine Learning Initiative (Community Project Funding)		
<i>Congressional Add:</i> Program increase - RAPID ADVANCED DEPOSITION	5.000	10.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Rapid Advanced Deposition		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Rapid Advanced Deposition		
<i>Congressional Add:</i> Program increase - Defense Resiliency Against Extreme Cold Weather	10.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Defense Resiliency Against Extreme Cold Weather		
<i>Congressional Add:</i> Program increase - Earthen Structures Soil Enhancement	4.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Earthen Structures Soil Enhancement		
<i>Congressional Add:</i> Advanced Manufacturing Materials Processes Initiative	10.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Advanced Manufacturing Materials Processes Initiative		
<i>Congressional Add:</i> Advanced Materials Manufacturing	8.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Advanced Materials Manufacturing		
<i>Congressional Add:</i> Anti-Corrosion Materials	7.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Anti-Corrosion Materials		
<i>Congressional Add:</i> Ceramic Materials for Extreme Environments	8.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023	
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Ceramic Materials for Extreme Environments			
Congressional Add: Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research	6.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research			
Congressional Add: Electrolyzer	7.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Electrolyzer			
Congressional Add: Flexible Hybrid Electronics and Environmental Sustainability	12.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Flexible Hybrid Electronics and Environmental Sustainability			
Congressional Add: PFAS Modeling	5.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for PFAS Modeling			
Congressional Add: Polar Proving Ground and Training Program	2.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Polar Proving Ground and Training Program			
Congressional Add: Rapid Infrastructure Development and Engineering	3.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Rapid Infrastructure Development and Engineering			
Congressional Add: Program Increase - RARE EARTH INITIATIVE	7.000	10.000	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Rare Earth Initiative			
FY 2023 Plans: Congressional Interest Item funding provided for Rare Earth Initiative			
Congressional Add: Solid Oxide Fuel Cell Development	10.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Solid Oxide Fuel Cell Development			
Congressional Add: Tank Tracks	3.150	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Tank Tracks		
<i>Congressional Add:</i> Program Increase - VERIFIED INHERENT CONTROL	10.000	10.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Verified Inherent Control		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Verified Inherent Control		
<i>Congressional Add:</i> Program Increase - ADVANCED CERAMIC TECHNOLOGIES	-	2.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Advanced Ceramic Technologies		
<i>Congressional Add:</i> Program Increase - ALTERNATIVE ENERGY RESEARCH	-	20.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Alternative Energy Research		
<i>Congressional Add:</i> Program Increase - AUTONOMOUS DIGITAL DESIGN	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Autonomous Digital Design		
<i>Congressional Add:</i> Program Increase - CARBON NANOMATERIALS AS FUNCTIONAL ADDITIVES	-	6.500
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Carbon nanomaterials as Functional Additives		
<i>Congressional Add:</i> Program Increase - COLD REGION RESEARCH	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Cold Region Research		
<i>Congressional Add:</i> Program Increase - DEFENSE RESILIENCY AGAINST EXTREME COLD WEATHER	-	11.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Defense Resiliency Against Extreme Cold Weather		
<i>Congressional Add:</i> Program Increase - DEFENSE RESILIENCY PLATFORM ADDRESSING EXTREME COLD WEATHER	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Defense Resiliency Platform Addressing Extreme Cold Weather		
<i>Congressional Add:</i> Program Increase - DETECTION AND DEFEAT OF BURIED MUNITIONS	-	4.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Detection and Defeat of Buried Munitions		
<i>Congressional Add:</i> Program Increase - EARTHEN STRUCTURES SOIL ENHANCEMENT	-	4.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Earthen Structures Soil Enhancement		
<i>Congressional Add:</i> Program Increase - ELECTROLYZER	-	7.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Electrolyzer		
<i>Congressional Add:</i> Program Increase - EXTREME BATTERY TECHNOLOGIES	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Extreme Battery Technologies		
<i>Congressional Add:</i> Program Increase - FLEXIBLE HYBRID ELECTRONICS	-	15.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Flexible Hybrid Electronics		
<i>Congressional Add:</i> Program Increase - FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for FUNCTIONAL POLYMERIC MATERIALS AND COMPOSITES FOR EXTREME TEMPERATURE ENVIRONMENTS		
<i>Congressional Add:</i> Program Increase - GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE	-	1.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for GROUND TECHNOLOGY FOR CHEMICAL AND BIOLOGICAL DEFENSE		
<i>Congressional Add:</i> Program Increase - HIGH PERFORMANCE POLYMER COMPOSITES AND COATINGS	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for High Performance Polymer Composites and Coatings		
<i>Congressional Add:</i> Program Increase - LIGHTWEIGHT HIGH ENTROPY METALLIC ALLOY DISCOVERY COLLABORATION	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Lightweight High Entropy Metallic Alloy Discovery Collaboration		
<i>Congressional Add:</i> Program Increase - LOGISTICS OVER-THE-SHORE CAPABILITIES	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Logistics Over-The-Shore Capabilities		
<i>Congressional Add:</i> Program Increase - POLAR PROVING GROUND	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Polar Proving Ground		
<i>Congressional Add:</i> Program Increase - PROTECTIVE COATINGS	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Protective Coatings		
<i>Congressional Add:</i> Program Increase - ULTRA-HIGH DENSITY STORAGE	-	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) BN8 / <i>Ground Technology Materials(CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Ultra-High Density Storage		
<i>Congressional Add:</i> Program Increase - AI/ML materials for sensors and electronics	-	7.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for AI/ML materials for sensors and electronics		
Congressional Adds Subtotals	160.150	211.900

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG5 / <i>Ground Vehicle Sensor Concepts and Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CG5: <i>Ground Vehicle Sensor Concepts and Technologies</i>	-	3.994	-	-	-	-	-	-	-	-	0.000	3.994

A. Mission Description and Budget Item Justification

This Project investigates, designs, fabricates, assesses, and characterizes advanced sensor protection technologies, components, and concepts that will enable the future Soldier to see and operate through a laser directed energy weapon attack. Both active and passive protection technologies will be investigated to protect Army sensors that operate in the visible, short-wave infrared, mid-wave infrared, and long-wave infrared spectra from battlefield laser threats. Areas of research include passive optical limiters such as nonlinear organic dyes, semiconductors, and meta-materials, as well as fast active switches and tunable filters. As new laser technologies are developed, effects of those threats will be studied and assessed to determine vulnerability of Army sensor systems and sensor system materials.

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

Work in this Project supports the Army Science and Technology Ground and Next Generation Combat Vehicle portfolios.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Laser Protection Technologies	3.994	-	-
Description: This effort designs and develops new materials and devices for the protection of Army sensors and eyes behind day-view optical sights from a variety of laser threats. This research utilizes a combination of technologies based on the nature of the different threats, as well as the fundamental differences in sensors operating over different frequency ranges. Passive optical limiting materials that block specific frequency bands of light will be investigated and developed for the visible and short-wave infrared (SWIR) spectrum, and active meta- material-based solutions will be investigated for uncooled sensors in the long-wave infrared. Vulnerability of sensors and optical sensor systems will be investigated against high-power and ultra-short pulsed laser threats to determine protection requirements.			
Accomplishments/Planned Programs Subtotals	3.994	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG5 / <i>Ground Vehicle Sensor Concepts and Technologies</i>

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG6 / <i>Ground Vehicle Power and Energy Concepts and Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CG6: Ground Vehicle Power and Energy Concepts and Tech</i>	-	2.583	2.526	2.605	-	2.605	4.669	6.049	6.003	6.049	0.000	30.484

A. Mission Description and Budget Item Justification

This Project investigates and develops advanced power and energy technologies for combat ground vehicles that are necessary for parallel hybrid, series hybrid, and all- electric vehicle systems. This Project investigates, designs, and develops electric conversion technologies to reduce size and weight of military vehicles while increasing performance and capabilities to support current and future mission loads and provide improved military vehicle mobility.

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

Work in this Project supports the Army Science and Technology Ground and Next Generation Combat Vehicle portfolios.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Distributed Power for Autonomous Systems	1.371	2.504	0.955
Description: This effort designs and develops technologies for electrification of both manned and unmanned Next Generation Combat Vehicle platforms. Electrification of these platforms will enable advanced lethality and protection systems, reduced battlefield fuel consumption, and provide new capabilities such as burst acceleration, extended silent mobility, and silent watch. The effort investigates, designs, and develops electric conversion technologies to reduce size and weight while increasing performance and capabilities to support current and future mission loads and provide improved military vehicle mobility. Research focuses on high power/ temperature power electronics, magnetic gears, electric drive motors, and adaptive device and component level control that optimized operation in real time. Investigation of advanced control methods at the module and conversion component levels provides an understanding of the impact real time optimization and energy tracking can have on power conversion optimization and mission effectiveness. The research enables the integration of component state and behavior into system level management algorithms that support non-autonomous and autonomous operations while providing modular and scalable electrification architectures. Efforts will also investigate non-contact magnetic gear technologies coupled with electrical motors and generators to reduce size and weight with an increase in reliability and performance through increased torque and			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG6 / <i>Ground Vehicle Power and Energy Concepts and Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>speed operational range. Results of the research inform PE 0602145A (Next Generation Combat Vehicle Technology) / BH5 (Platform Electrification and Mobility Tech).</p> <p>FY 2023 Plans: Experimentally validate high torque magnetic gear designs and optimization strategies. Investigate and analyze advanced control methods to improve fast battery charging. Investigate advanced power module concepts through the use of co-design and co-engineering methodologies to increase efficiency, power transfer, and reliability through improved device and thermal control. Investigate and analyze energy storage / battery technologies with an order of magnitude increase in energy densities. Research advanced control methodologies at the module and component levels providing higher efficiency and reliability through energy optimization. Research advanced transformer designs and fabrication to enable high frequency switching with improved thermal management in smaller more efficient packages.</p> <p>FY 2024 Plans: Will experimentally validate battery charger and characterize battery charger performance. Will validate battery management concepts and characterize effect of battery management concepts.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, a portion of this funding has been realigned to Power Conversion for Platforms within this Project.</p>				
<p>Title: Power Electronic Components and Materials</p> <p>Description: This effort investigates, designs, and develops electric conversion technologies to reduce size and weight while increasing performance and capabilities to support current and future mission loads and provide improved military vehicle mobility. Research focuses on semiconductor power switches, power switch modules/packaging, and power switch module thermal management. Investigation of high voltage/high frequency power semiconductor materials and devices is concentrated on efficient power switching under militarily relevant temperatures. Design and development of multi-disciplinary parametric design optimization software tools and multi-functional package structures provides advances in device packaging technology to fully realize device performance improvements. Results of the research inform 0602145A BH5 Platform Electrification and Mobility Tech.</p>		1.212	-	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.022	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG6 / <i>Ground Vehicle Power and Energy Concepts and Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
<p>Title: Power Conversion for Platforms</p> <p>Description: This effort investigates, designs, and assesses technologies for platform electrification that will reduce Army impact to the environment through electrified systems that more effectively utilize energy and improve resiliency. Transitioning to hybrid electric and all electric platforms provides improved energy utilization while reducing emissions providing the Warfighter increased capabilities. Reduction in impact to the environment also improves Warfighter survivability by reducing emissions that can be used for tracking and locating. Research focuses on material and design concepts for compact high-power transformers required by power conversion components, fabrication of new power semiconductor packaging, and advances in control and component power management methods.</p> <p>FY 2024 Plans: Will utilize co-design and co-engineering methodologies and laboratory experiments to validate performance of advanced power packaging concepts to increase efficiency, power transfer, and reliability. Will experimentally validate component level monitoring and control concepts and determine performance of prediction and optimization control algorithms. Will validate advanced transformer designs and thermal performance under high power.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, funding realigned from Advanced Distributed Power for Autonomous Systems within this Project.</p>	-	-	1.650
Accomplishments/Planned Programs Subtotals	2.583	2.526	2.605

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG7 / <i>Ground Protection Concepts and Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CG7: Ground Protection Concepts and Technologies</i>	-	14.033	12.194	10.473	-	10.473	13.687	16.384	17.893	16.620	0.000	101.284

Note

In FY 2024, particle funding realigned to PE 0602145A Project BK5 Advanced Direct In-Direct Armament System (ADIDAS)

A. Mission Description and Budget Item Justification

This Project investigates advanced materials and mechanisms to defeat the most common and most dangerous threats that are expected to be encountered by our ground forces in near-, mid-, and far-term. This Project also designs and develops experimental and computational tools and techniques (high resolution instrumentation to observe impact events, theories, and algorithms to explain these phenomena and numerical implementation of these algorithms) for the development of mass-efficient armor mechanisms. This project designs and develops armor mechanisms that will be integrated to create multi-threat armor technologies and form the building blocks for Adaptive and Cooperative Protection Technologies in the Advanced Concepts for Active Defense Project (Program Element (PE) 0602145A Next Generation Combat Vehicle Technology). Additionally, research will focus on subcomponent/component models to predict performance of early concepts and the means to assess effectiveness on ground platforms. The Project will balance designs and developments of active threat defeat measures with the necessary advanced passive and reactive components that will ultimately provide for full system solutions which meet the requirements of current and next generation ground tactical and combat vehicles.

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

Work in this Project supports the Army Science and Technology Ground and Next Generation Combat Vehicle.

Work in this Project is performed by the United States (US) Army Futures Command portfolios.

This Project is coordinated with and transition to Projects in PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and builds upon weapon target interaction research in PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics).

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

Title: Advanced Armor and Protection Technologies	FY 2022	FY 2023	FY 2024
Description: This effort designs and develops the next generation of lightweight protective concepts and technologies for defeat of current and future threats by utilizing real-time information, combined with threat knowledge, to provide increased protection. This effort investigates the fundamental physics of new terminal effects concepts and provides an understanding of interaction	7.868	7.136	5.241

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG7 / <i>Ground Protection Concepts and Technologies</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>between the platform's defeat mechanism and the threat . The effort also investigates the ability to analytically simulate complex threat interactions. Experiments will be conducted to validate the efficacy of the designs.</p> <p>FY 2023 Plans: Investigate armor mechanism and protection concepts for the robotic combat vehicles to survive direct-fire engagements; refine methodology to conduct small scale armor survivability experiments to reduce the number of full sized experiments required; design and develop high throughput ballistics metrics and scaling to enable terminal effects research.</p> <p>FY 2024 Plans: Will validate the predictive modeling capability of advanced armor with an emphasis on hybrid armor systems and armor efficiency; incorporate machine learning (ML) / high-throughput data directly into simulations to design new materials for specific threats; explore coupling laser shock experiments to reduce uncertainty in material behavior.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding realigned from PE 0602144A Project CG7 (\$2,151) to PE 0602145A Project BK5 Advanced Direct In-Direct Armament System (ADIDAS) to support research into Decisive Lethality.</p>				
<p>Title: Computational and Experimental Capability</p> <p>Description: This effort will design and develop computational design tools along with diagnostic and experimental capabilities that support the development of advanced protection systems. Such systems include passive, active, and hybrid solutions for defeating (multiple) anti-armor threats and exploit solid-dynamic, explosive-driven, and magneto-hydrodynamic target interactions. This work allows for predicting armor performance and understanding mechanisms, regardless of vehicle platform, with improved and quantified confidence. This effort leverages the Department of Defense and Department of Energy (DOE) Technical Coordination Group Memorandum of Agreement and directly leverages DOE investments in computational platforms for problems in solid dynamics and impact mechanics.</p> <p>FY 2023 Plans: Design and develop physically accurate and robust modeling and simulation tools for explosive effects to inform armor development; continue to mature the capabilities of the multi-physics models needed to rapidly assess threats and develop protection solutions to defeat those threats; continue to mature our ballistics and explosive effects diagnostics to better assess terminal ballistics.</p> <p>FY 2024 Plans: Will design and develop combined explosive effects mechanism software which, coupled with experimental data, will enable the rapid assessment of threats against existing and future armor designs; explore experimental diagnostics for explosive effects to improve understanding of threat loading on armor solutions; conduct computational studies of armor mechanisms to assess</p>		6.165	5.058	5.232

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG7 / <i>Ground Protection Concepts and Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
the defeat of current and future shape charge threats; develop multi-physics model enhancements to continue to improve the capability to assess threats and armor mechanisms to defeat those threats. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding increase supports planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	14.033	12.194	10.473

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) CG8 / <i>Human Autonomy Teaming</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CG8: <i>Human Autonomy Teaming</i>	-	8.285	9.036	9.263	-	9.263	9.265	9.327	9.334	9.449	0.000	63.959

A. Mission Description and Budget Item Justification

This Project performs applied research for capabilities that support teams of Soldier and Artificial Intelligence (AI)-enabled systems to execute missions in complex, dynamic, multi-domain operations environments. Centered on ground vehicle mission planning and operations, this Project is focused on core technologies to enable Soldiers and AI-enabled systems to function as a team, to perform at high levels, and to adapt to adversarial actions and new mission requirements. This Project will enable future Soldiers with AI-enabled systems to perform complex missions with increasingly sophisticated technologies, and in increasingly complex, dynamic, socio-technical environments. The applied research will provide the fundamental technologies to enable scalable Soldier-AI teams and team-centered dynamic tasking to effectively utilize the full capabilities of team and technologies. The research will include considerations to reduce data requirements for AI adaptation, increasing appropriate Soldier trust and use of technology, and ensuring ethical behaviors by teams of Soldier and AI-enabled systems. The capabilities created by this research will lead to increased overall Soldier-AI team mission performance, improved Soldier-centric situation awareness technologies, and units that can effectively integrate within a multi-domain battlefield.

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

Work in this Project supports the Army Science and Technology Ground and Next Generation Combat Vehicle portfolios.

Work in this Project is performed by the United States Army Futures Command.

Work in this Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and PE 0602143A (Soldier Lethality Technology) .

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

	FY 2022	FY 2023	FY 2024
Title: Soldier-AI Team Mission Planning for Dynamic Complex Environments	1.218	1.313	1.357
Description: Planning in multi-domain operations environments is complex and has increased temporal and spatial sensitivities for Soldiers to integrate with AI-enabled systems to plan and execute missions. This effort investigates the fundamental concepts and technologies to enable Soldier and AI to team together to plan for multidomain operations from a ground vehicle perspective. This effort determines planning enablers to maximize manned-unmanned team performance across squads and platoons and includes mid- to far-term crew station-based emerging technologies in the areas of human- interaction with AI technologies and human-guided machine intelligence. Designs and develops models of both Soldier and AI capabilities and their limitations as a function of the mission environment and mission requirements, and applying those models to form mission plans.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG8 / <i>Human Autonomy Teaming</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Design and develop capability to leverage multiple forms of Soldier feedback to enable mission-to-mission adaptation of intelligent system behaviors to meet evolving mission needs. FY 2024 Plans: Will design and develop route/mission planning tools that incorporate operator load and autonomous system interaction cost functions to improve performance from mission to mission. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.				
Title: Dynamic Soldier-AI Team Resource Allocation Description: This effort designs and develops the concepts and technologies necessary to dynamically allocate Soldiers and unmanned systems during missions to adapt mission plans to adversarial actions and other events at a squad and platoon level, including responding to degradation or loss of team capabilities, changes in mission goals or priorities, and responding to adversarial actions. The effort investigates the allocation of Soldiers, platforms, and platform sub-system capabilities with the focus to ensure that future AI and automation capabilities are focused on the circumstances and conditions where they are most likely to be successful, and to ensure that the Soldier's cognition is focused appropriately to ensure mission success. FY 2023 Plans: Mature algorithms to generate task allocations across a distributed heterogeneous team to enable flexible team reorganization to improve team performance in dynamic environments; design and develop initial methods to create algorithms that provide a Commander with suggested courses of action to coordinate actions of distributed team through a library of preset formations and crew configurations. FY 2024 Plans: Will investigate approaches to mitigate performance penalties due to task switching in a human-autonomy team to enable rapid team reconfiguration and improve team performance in dynamic environments; refine methodology and algorithms designed to provide a Commander with suggested courses of action to reconfigure the team based on changes in operator or agent state, mission requirements, and environment. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.		2.368	2.562	2.638
Title: Soldier Cognition-Centric Interface Technologies Description: This effort designs and develops cognitive-centric displays that ensure Soldiers are focused on aspects of situational awareness, mobility, target engagements, and communications that are critical to mission performance as future crew stations and displays provide vast amounts of multi-domain information that has the potential to distract, overwhelm, and mislead Soldiers. This effort ensures that our systems do not capture and misdirect Soldier attention and/or cognition, maximizing the utility of AI-		1.555	1.677	1.772

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG8 / <i>Human Autonomy Teaming</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>enabled systems to the Soldier. This effort also enables Soldiers to better understand the actions, goals, intents, and general reasoning of the AI systems to ensure they are effectively used, but not inappropriately relied upon.</p> <p>FY 2023 Plans: Conduct experiments to investigate the impact of enabling Soldiers to rapidly train autonomous systems on an individual Soldier's trust in autonomous systems; conduct experiments to investigate the ability for Soldier guided adaptation of autonomous systems to capture individual Soldier knowledge, skills, and abilities.</p> <p>FY 2024 Plans: Will conduct experiments to assess the effectiveness and impact of integrating Soldier-trained autonomous systems into reconfigurable human-autonomy teams; create and empirically validate team assessment toolkit for measuring human-autonomy team trust and cohesion from data collected during the mission.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>				
<p>Title: Enabling Soldier-AI Technology Adaptation</p> <p>Description: This effort designs and develops technologies to rapidly adapt and upgrade AI-enabled system capabilities in response to advancements in AI in the commercial and adversary environments. Focus areas include enabling rapid technology adaption during Soldier experimentation and enabling data to be collected during these events for rapid development of technology updates and modifications. This effort has four goals: 1) increasing the ability of Soldier-AI teams to rapidly adapt to adversarial actions, new technologies, environmental changes, and mission requirements; 2) decreasing the data requirements to train and adapt AI-enabled systems; 3) increasing appropriate Soldier trust and use of technology; and 4) ensuring ethical decisions by using Soldiers to guide the actions and in-field adaptations of Soldier-AI team behaviors.</p> <p>FY 2023 Plans: Mature algorithms that learn from natural interactions to allow Soldiers to communicate intent for adaptation and training of autonomous systems; mature algorithms for using interactive machine learning to enhance the robustness of algorithms for assessing effectiveness of Soldier-AI teams; conduct experiments to investigate effectiveness of leveraging initial algorithms that infer Soldier intent from natural Soldier-system interactions to enhance capability to rapidly train autonomous systems with reduced data requirements.</p> <p>FY 2024 Plans:</p>		3.144	3.400	3.496

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CG8 / <i>Human Autonomy Teaming</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will design and develop capability to use unobtrusively-sensed information from Soldier-based sensors to adapt autonomy behavior; validate autonomy adaptation methods leveraging multiple forms of Soldier interactions. Will mature and validate the effectiveness of algorithms that infer Soldier intent from natural Soldier-system interactions in order to adapt team dynamics. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding increase reflects the planned lifecycle of this effort.			
<i>Title:</i> SBIR/STTR Transfer <i>Description:</i> Funding transferred in accordance with Title 15 USC §638 <i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638 <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638	-	0.084	-
Accomplishments/Planned Programs Subtotals	8.285	9.036	9.263

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) CI2 / <i>Ground Enabling University Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CI2: <i>Ground Enabling University Applied Research</i>	-	4.648	3.682	3.906	-	3.906	5.522	4.621	4.624	4.675	0.000	31.678

A. Mission Description and Budget Item Justification

The Project leverages applied research from academia, in the focus areas of ground autonomy, Artificial Intelligence/Machine Learning (AI/ML) and robotics, occupant/vehicle survivability and other ground platform technologies of importance to the Army. This Project performs discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies critical to the next generation combat vehicles. This Project focuses on employment of research technologies originating from extramural applied research in academia pertaining to navigation/routing, autonomous robotic vehicles with the use of artificial intelligence and machine learning as applied to ground mobility and maneuver, and other innovative ground enabling applied research technologies. This effort conducts applied research and development leading to potential emerging technologies in areas of strategic importance to the Army in autonomy, robotics and AI/ML, protection of both platform and occupant, and other ground platform technologies in propulsion, survivability, powertrain, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances.

Work in this Project complements Program Element (PE) 0603119A (Ground Advanced Technology), PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Robust autonomous capabilities for ground vehicles	3.132	1.879	2.059
Description: This effort investigates AI/ML and autonomous mobility-enabled ground vehicles to conduct off-road maneuvers to transition from tele-operated to either autonomous, or semi-autonomous scenarios. Research is conducted in collaboration with university partners to advance autonomous mobility and protection of both occupant and platform in optionally manned and autonomous ground vehicles.			
FY 2023 Plans: Will mature AI/ML methods to enable robust, autonomous, and tactical behaviors for multi-agent air and ground vehicle teams beyond existing behaviors such as leader-follower (e.g., flanking, occupying); as well as increase performance through effective			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) C12 / <i>Ground Enabling University Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
navigation and route planning using techniques to extract terrain features from imagery and transfer of simulator-learned behaviors to developmental ground platforms within academia. FY 2024 Plans: Will continue to investigate and develop multi-robot long-term autonomy, ML for autonomous navigation, off-road autonomy software. Will investigate and develop multi-layered situational awareness, cooperative tactical reasoning, and communication frameworks solutions for multiple autonomous air and ground vehicles used for route and area reconnaissance. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.				
Title: Human-robot/AI interactions Description: This effort designs and develops systems involving physical and cognitive levels of interactions between humans and robots, with the use of reinforcement learning (an area of ML research) from human feedback, learning from demonstration, and safe human-aware controllers. Work is conducted in collaboration with university partners to advance autonomous mobility as well as other areas of ground platform technologies in propulsion, survivability, powertrain, etc. FY 2023 Plans: Will investigate and mature AI/ML methods to improve autonomous systems by capturing and learning from human teleoperation command gestures, human interventions, and other forms of human interaction (e.g., spoken language, augmented reality). Will mature tactics and algorithms on common software platforms which enable robots to deal with complex environments in real time while working autonomously around humans for extended periods of time. FY 2024 Plans: Will continue to investigate AI/ML research for robust autonomous capabilities, real-time basic feature extraction, multi-robot long-term autonomy, human-AI collaboration, human-in-the-loop ML for autonomous navigation. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.		1.516	1.669	1.847
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.134	-
Accomplishments/Planned Programs Subtotals		4.648	3.682	3.906

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) C12 / <i>Ground Enabling University Applied Research</i>

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) CV3 / <i>Engineer Enablers Maneuver, LOG, & Sustainment Apl</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CV3: <i>Engineer Enablers Maneuver, LOG, & Sustainment Apl</i>	-	-	2.518	2.195	-	2.195	1.254	4.171	3.022	4.070	0.000	17.230

A. Mission Description and Budget Item Justification

This effort designs and develops software tools to modernize the Army's logistics planning capability. The project researches planning of logistics resupply via distributed supply routes through complex terrain and environmental conditions within a contested environment, while also improving the efficiency of logistics planning, enabling planners to develop and compare courses of action, and simulate logistics activities using complex algorithms. This effort links the engineer applications into a geospatial framework and enables planners to better understand the dynamic scenario development providing a simple and clear critical vulnerabilities assessment, easy visual comparison of inventories available, supply needs within the battlespace, and the logistics options to mitigate potential issues.

Work in this Project complements PE 0603119A (Ground Advanced Technology) / Project CV5 (Engineer Enablers Maneuver, LOG, & Sustainment Adv).

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

Work is performed at the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Planning Logistics Analysis Network System Applied Research	-	2.426	2.195
Description: This effort will design and develop new engineering applications and methodologies that support improved logistics planning via distributed networks, investigate methods to link existing data describing complex environmental features that impact planning into the engineer applications, and design new automated algorithm technologies to improve the efficiency and effectiveness of the planning decision making.			
FY 2023 Plans: Investigate new algorithms that describe the operating environment as a series of nodes and routes that consider complex battlespace concerns and terrestrial issues such as terrain complexity or weather impacts; mature components of a multi-modal transportation network model.			
FY 2024 Plans: Will design and develop transportation throughput options for feasible nodes and routes and investigate routing options based on weather and terrain concerns, and investigate cross-country movement options within the transportation network.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) CV3 / <i>Engineer Enablers Maneuver, LOG, & Sustainment Apl</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding decrease reflects the transition of technologies to PE 0603119A (Ground Advanced Technology) / Project CV5 (Engineer Enablers Maneuver, LOG, & Sustainment Adv) for maturation and demonstration.			
Title: SBIR/STTR Transfer	-	0.092	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	2.518	2.195

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) DA1 / <i>SAFR Alternatives for Readiness Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DA1: <i>SAFR Alternatives for Readiness Applied Research</i>	-	-	3.679	5.171	-	5.171	6.062	7.579	9.312	9.820	0.000	41.623

A. Mission Description and Budget Item Justification

This Project will develop safer alternative technologies that enable Army readiness, support supply chain resilience, improve Soldier and worker safety and reduce environmental impacts, including reduction of greenhouse gas emissions. The Project investigates alternatives for cross-cutting materials, undergoing or threatened by regulatory scrutiny, found in ground vehicles and all other types of Army weapon systems. Research areas of focus include alloys, ceramics, composites, textiles, maintenance fluids, propellants, explosives, and pyrotechnics. This work addresses increasing threats to readiness associated with carcinogenic, toxic, and restricted materials such as lead, beryllium, perchlorates, volatile organic compounds and per- and polyfluoroalkyl substances (PFAS) (forever chemicals), which can diminish Soldier and community health, restrict training and interrupt critical maintenance activities. Future liabilities and risks are characterized early in the life cycle of material development to ensure truly sustainable alternatives. This Project also investigates, develops and designs technologies to allow Soldiers to rapidly prioritize risk for PFAS to enable informed, timely and cost-effective solutions.

The cited work is consistent with the Army Modernization Strategy and provides enabling technologies in support of all Cross Functional Teams.

Work in this Project is performed by the United States (U.S.) Army Combat Capabilities Development Command (DEVCOM) Army Research Laboratory, Aberdeen Proving Ground, MD; the Armaments Center, Picatinny Arsenal, NJ; the Aviation and Missile Center, Huntsville, AL; the Soldier Center, Natick, MA; the Ground Vehicle Systems Center, Warren, MI; and the U.S. Army Corps of Engineers (USACE) Engineer Research and Development Center (ERDC). It is coordinated with the U.S. Army Futures Command.

This Project complements and transitions technologies to Program Element (PE) 0603119A (Ground Advanced Technology) / Project DA2 (SAFR Alternatives for Readiness Advanced Tech).

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

	FY 2022	FY 2023	FY 2024
Title: PFAS Risk Reduction Applied Research	-	0.756	1.201
Description: This effort will design and develop a novel rapid risk characterization framework that will be validated with a rapid fate and transport screen, a break through toxicity screening, and treatment approaches.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) DA1 / <i>SAFR Alternatives for Readiness Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Design and develop a framework for case studies to detail per- and polyfluoroalkyl substance (PFAS) toxicity through outdoor experimental system studies of the natural environment under controlled conditions (mesocosms) that examine toxicity in various geophysical conditions. FY 2024 Plans: Will develop a rapid risk prioritization database tool validated with per- and polyfluoroalkyl substance (PFAS) case studies. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects investments required to develop the database design.				
Title: Safer Alternatives for Readiness (SAFR) Applied Research Description: Design and develop novel cross-cutting solutions to eliminate Soldier and worker exposure to airborne lead from energetic materials; efficiently and safely demilitarize materiel; support the next generation of enhanced and sustainable munitions; reduce the use of toxic and hazardous chemicals in cleaners, degreasers, lubricants and fluids to ensure Soldier and ground vehicle readiness; and minimize the life cycle health and safety risks associated with emerging high-performance materials. FY 2023 Plans: Research green chemistry approaches to energetic material synthesis methods; explore novel non-metallic and non-energetic initiation techniques to replace lead-based primary explosives; investigate non-chemical surface cleaning and preparation techniques for relevant substrates. FY 2024 Plans: Will research PFAS-free surface treatment for coatings and textile applications; investigate material alternatives for critical energetic materials; and explore lead-free rocket propellants. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned life cycle for this project		-	2.817	3.970
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.106	-
Accomplishments/Planned Programs Subtotals		-	3.679	5.171

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) DA1 / <i>SAFR Alternatives for Readiness Applied Research</i>

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) DG1 / <i>Development of Obscurants</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DG1: <i>Development of Obscurants</i>	-	-	-	2.774	-	2.774	-	-	-	-	0.000	2.774

Note

In Fiscal Year (FY) 2024, funding realigned from Program Element 0602145 / Project BG8 (Obscuration Technology)

A. Mission Description and Budget Item Justification

This Project investigates and evaluates obscurant technologies that degrade threat force surveillance sensors and defeat the enemy's target acquisition devices, missile guidance, and directed energy weapons. This Project focuses on advanced infra-red and multi-spectral obscurant materials that provide effective, affordable, and efficient screening of deployed forces, while being safe and environmentally acceptable.

Work in this Project is related to and fully coordinated with Program Element 0603119 (Ground Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering Priority focus areas and the Army Modernization Strategy.

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority.

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Obscuration Enabling Technologies	-	-	2.774
Description: This effort investigates new materials and compounds to enable safe, effective screening of personnel and equipment across the electromagnetic spectrum. This effort also provides vulnerability assessments against enemy threat systems.			
FY 2024 Plans: Will explore medium range obscurant systems and work towards using novel materials to maximize performance; explore the potential of medium range obscurant systems to disseminate counter unmanned aerial obscurant-based materials; provide further enhancement and support for screening and obscuration module systems.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding realigned from Program Element 0602145 / Project BG8 (Obscuration Technology)			
Accomplishments/Planned Programs Subtotals	-	-	2.774

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>	Project (Number/Name) DG1 / <i>Development of Obscurants</i>
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C. Other Program Funding Summary (\$ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	239.284	277.445	166.500	-	166.500	166.523	171.140	161.329	152.140	0.000	1,334.361
BF3: <i>Combat Vehicle Robotics Tech</i>	-	16.105	20.614	17.443	-	17.443	16.832	16.010	15.707	15.878	0.000	118.589
BF6: <i>Crew Augmentation and Optimization Tech</i>	-	8.558	10.761	11.664	-	11.664	11.668	10.101	10.108	10.217	0.000	73.077
BF8: <i>Artificial Intelligence & Machine Learning Tech</i>	-	13.261	19.906	20.329	-	20.329	17.477	17.498	17.510	17.702	0.000	123.683
BF9: <i>Sensors for Autonomous Operations and Surv Tech</i>	-	34.174	22.666	25.327	-	25.327	24.722	24.890	25.639	25.919	0.000	183.337
BG2: <i>Modeling and Simulation for MUMT Technology</i>	-	6.473	5.591	5.526	-	5.526	4.591	4.267	4.419	4.043	0.000	34.910
BG6: <i>Advanced Concepts for Active Defense Technology</i>	-	29.415	33.656	32.668	-	32.668	33.005	37.824	34.056	25.215	0.000	225.839
BG8: <i>Obscuration Technology</i>	-	2.482	2.722	-	-	-	-	-	-	-	0.000	5.204
BH5: <i>Platform Electrification and Mobility Tech</i>	-	13.278	14.226	13.763	-	13.763	17.168	19.957	15.514	14.398	0.000	108.304
BI2: <i>Sensor Protection Technology</i>	-	5.615	6.229	5.532	-	5.532	5.955	8.462	7.734	7.819	0.000	47.346
BI4: <i>Materials Application and Integration Tech</i>	-	7.369	7.722	7.505	-	7.505	7.508	7.047	7.051	7.128	0.000	51.330
BI9: <i>Vehicle System Security Technology</i>	-	2.273	-	-	-	-	-	-	-	-	0.000	2.273
BJ2: <i>Tactical and Navigation Lasers Sensors Technology</i>	-	5.168	5.673	5.790	-	5.790	5.851	5.854	5.857	5.921	0.000	40.114
BJ9: <i>Autonomous Mobility Tech</i>	-	3.671	-	-	-	-	-	-	-	-	0.000	3.671
BK2: <i>Virtual Prototyping Technology</i>	-	7.871	9.622	9.910	-	9.910	9.934	10.648	10.656	10.772	0.000	69.413

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity	R-1 Program Element (Number/Name)												
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>												
BK3: <i>Next Gen Intelligent Fire Control (NG-IFC) Tech</i>	-	0.926	-	-	-	-	-	-	-	-	-	0.000	0.926
BK5: <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>	-	8.845	13.526	11.043	-	11.043	11.812	8.582	7.078	7.128	-	0.000	68.014
BP5: <i>Ground Vehicle Technology (CA)</i>	-	73.800	103.500	-	-	-	-	-	-	-	-	0.000	177.300
CU5: <i>Platform Agnostic Armaments Applied Technology</i>	-	-	1.031	-	-	-	-	-	-	-	-	0.000	1.031

A. Mission Description and Budget Item Justification

This Program element (PE) line is directly aligned to the Next Generation Combat Vehicle (NGCV) Army Modernization Priority. This PE researches, designs, and evaluates combat vehicle technologies that enable the Army to have a smarter, faster, more lethal, more precise, more protected, and more adaptable force. The focus is on building upon the foundational vehicle architectures to support the Next Generation of Combat Vehicles, to include autonomy architecture, power architecture, vehicle electronic architecture, physical architecture, lethality architecture and vehicle protection architecture. The research conducted will provide technologies to enable leap ahead capabilities for manned, optionally manned and unmanned vehicles that deliver decisive lethality.

Work in this PE complements PE 0602141A (Lethality Technology), PE 0602144A (Ground Technology), PE 0602146A (Network C3I Technology), PE 0603116A (Lethality Advanced Technology), PE 0603119A (Ground Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), and PE 0603463A (Network C3I Advanced Technology).

Work in this PE will transition to PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering Priority focus areas and the Army Modernization Strategy.

Work is performed by the United States Army Futures Command and United States Army Engineer Research and Development Center.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	245.525	174.090	174.430	-	174.430
Current President's Budget	239.284	277.445	166.500	-	166.500
Total Adjustments	-6.241	103.355	-7.930	-	-7.930
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	103.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-6.241	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-7.930	-	-7.930
• FFRDC Transfer	-	-0.145	-	-	-

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BP5: Ground Vehicle Technology (CA)

	FY 2022	FY 2023
Congressional Add: Program Increase - Silicon Carbide Electronics	5.500	6.000
Congressional Add: Program Increase - Highly Electrified Vehicles	5.000	3.000
Congressional Add: Program Increase - Prototyping Energy Smart Autonomous Ground Systems	10.000	10.000
Congressional Add: Advanced Materials Development for Survivability	5.000	10.000
Congressional Add: Advanced Optics Program	4.300	-
Congressional Add: Program Increase - Digital Design and Simulated Testing	4.000	5.000
Congressional Add: Program Increase - Fast-Refueling Fuel Cell Engines	7.000	7.000
Congressional Add: Program Increase - Hydrogen Technologies	10.000	15.000
Congressional Add: Program Increase - Machine Learning Optimized Power Electronics	3.000	3.000
Congressional Add: Systems Engineering for Autonomous Ground Vehicles	9.000	-
Congressional Add: Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms	5.000	-
Congressional Add: Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles	3.000	-
Congressional Add: Program Increase - Zero Emission Combat Vehicles	3.000	3.000
Congressional Add: Program Increase - ADVANCED MANUFACTURING FOR COMBAT LOGISTICS SUPPORT	-	2.000
Congressional Add: Program Increase - ENTERPRISE AND CROSS-FUNCTIONAL LVC FOR ACCELERATED DEVELOPMENT	-	8.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2022	FY 2023
Congressional Add: <i>Program Increase - MOBILITY MATERIALS RESEARCH</i>	-	5.000
Congressional Add: <i>Program Increase - MODULAR ELECTRIC MOTORS</i>	-	5.500
Congressional Add: <i>Program Increase - SMALL UNIT TECHNOLOGY ADVANCEMENTS</i>	-	10.000
Congressional Add: <i>Program Increase - SOLID OXIDE FUEL CELL DEVELOPMENT</i>	-	5.000
Congressional Add: <i>Program Increase - STRUCTURAL THERMOPLASTICS</i>	-	6.000
Congressional Add Subtotals for Project: BP5	73.800	103.500
Congressional Add Totals for all Projects	73.800	103.500

Change Summary Explanation

Decreased funding to support higher priorities within the Science & Technology (S&T) portfolio.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BF3 / <i>Combat Vehicle Robotics Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BF3: <i>Combat Vehicle Robotics Tech</i>	-	16.105	20.614	17.443	-	17.443	16.832	16.010	15.707	15.878	0.000	118.589

A. Mission Description and Budget Item Justification

This Project designs, develops, and evaluates a variety of innovative technologies that enable scalable integration of multi-domain robotic and autonomous system capabilities teamed within Army formations supporting all combat warfighting functions (close combat, reconnaissance, targeting and acquisition, etc.). This Project focus areas include autonomous architecture, autonomous behaviors and perception, and soldier machine Interface. Autonomous Behaviors efforts focus on enhancing the performance of autonomy such as obstacle detection and avoidance. Soldier Machine interface efforts focus on design and development of technologies to become more efficient and effective for a robotic operator to complete missions on government owned Warfighter Machine Interface (WMI) software.

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

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority .

Work in this Project is performed by the United States (US) Army Futures Command.

This work is done in coordination with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and transitions to PE 0604017A (Robotics Development).

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

	FY 2022	FY 2023	FY 2024
Title: Autonomous Behaviors and Perception	9.018	13.034	9.827
Description: This effort contributes to the NGCV Robotic Autonomous Strategy (RAS) to advance the mobility performance of autonomous systems within complex environments/ operations to allow for the completion of mission goals in separate and teaming configurations at varying levels of autonomy.			
FY 2023 Plans:			
Develop and validate object classification and scene understanding for autonomous vehicles, enabling them to identify objects in the environment and their significance in the overall scenario within government autonomy software, Robotic Technology Kernel (RTK). Mature the basic scene understanding framework created in Fiscal Year 2022 (FY22), resulting in an improved framework enabling customized reactions to specific situations and arbitrating between existing tasks. Research a comprehensive cyber-hardened software suite to make RAS resilient to existing and emerging cyber threats. Research the use of enhanced a-priori data for advanced navigation and reconnaissance maneuvers for implementation in RTK. Investigate space, weight, and power (SWAP) reduction for RTK autonomy kit hardware on small unmanned ground vehicles (UGVs). Develop and mature additional mission subsets and task decompositions within the operational reference models for the AGVRA. Develop an experimental			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF3 / <i>Combat Vehicle Robotics Tech</i>

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

unified architecture and associated model profile, library and views realizing current technologies within a model-based systems engineering (MBSE) environment. Develop and mature the ROS-M to support the registration and distribution of developed autonomous software solutions and supporting tools.

FY 2024 Plans:

Will develop and validate complex obstacle detection and obstacle avoidance at operationally relevant speeds and over rough terrain, enabling autonomous vehicles to successfully navigate in unstructured environments. Further develop, validate, and certify the object classification and scene understanding created in FY 2023, resulting in a matured framework for customized and trusted reactions to specific situations. Will investigate teaming and tactical behaviors for multi-vehicle goal negotiation, using the enhanced scene understanding from FY 2023 with a focus on human-understandable autonomy within the Army's Robotic Technology Kernel (RTK) autonomy stack (system). Will develop methods for using map data merged with current sensor data to increase situational awareness and conduct reconnaissance maneuvers with an emphasis on autonomous implementation and tools. Will continue to mature the Autonomous Ground Vehicle Reference Architecture (AGVRA) framework by building additional large and small team mission models and task decomposition within the operational reference models. Will mature ground vehicle robotics architecture and associated model profile, library, and views, advancing current technologies within a model-based systems engineering environment. Will continue to develop interface model definition and tools to facilitate model integration. Will continue to develop and mature the Robot Operating System - Military (ROS-M) to support the ability to register and distribute concepts, specifications, requirements, standards and architectures, in addition to autonomous software solutions and supporting tools.

FY 2023 to FY 2024 Increase/Decrease Statement:

Funding is decreased in FY 2024 for Autonomous Behaviors & Perception due to the transition of technology to PE 0603462A / Next Generation Combat Vehicle Advanced Technology Project BF4: Combat Vehicle Robotics Advanced Tech - Unmanned Maneuver.

Title: Human Robotic Interaction

Description: This effort contributes to the NGCV RAS to implement a focused approach to deliver optimized unmanned system and manned-unmanned system team performance through reduced cognitive burden for the Soldier while maintaining real-time unmanned system status/activity, overall mission effectiveness, and predictive capability of the system's intended activity.

FY 2023 Plans:

Design and develop robotic soldier machine interface technologies to become more efficient and effective for a robotic operator to complete missions in a simulated combat scenario built on government owned Warfighter Machine Interface (WMI) software.

FY 2022	FY 2023	FY 2024
7.087	5.296	3.423

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF3 / <i>Combat Vehicle Robotics Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Investigate improved language control with tactical commands for a robotic operations to bring a more natural implementation of teaming within a command and control scenario to improve mission timelines and overall mission success. FY 2024 Plans: Will continue to design robotic warfighter machine interface (WMI) technologies to become more efficient and effective for a robotic operator to demonstrate the ability to complete mission in a combat scenario. Will continue to investigate improved language control with tactical commands for robotic operations to bring a more natural implementation of teaming within a command and control scenario, improving mission time and overall mission success. Will investigate improved methodologies to express autonomy systems' decision process and intent to the operator. Will investigate ways for the operator to influence autonomous decisions through the WMI tools. FY 2023 to FY 2024 Increase/Decrease Statement: Funding is decreased in FY 2024 for Human Robotic Interaction due to the transition of technology to PE 0603462A Combat Vehicle Robotics Advanced Technology Soldier Robotic Interface Integration.				
Title: M&S for Autonomy Enabled Ground Systems Description: This effort contributes to the NGCV RAS program by designing and developing modeling and simulation (M&S) tools for the development and evaluation of autonomy technologies. The effort designs and develops tools necessary to virtually evaluate autonomy algorithms developed under the Combat Vehicle Robotics (CoVeR) program. The capabilities and contents of the M&S tools will emulate the CoVeR Engineering Evaluation Test (EET) events conducted in PE 0603462A (Next Generation Ground Vehicle Advanced Technology) / Project BF4 (Combat Vehicle Robotics Adv Tech) and allowing these tools to be run at scale on other Army and Department of Defense compute platforms. FY 2023 Plans: Mature M&S capability to support CoVeR evaluations with the first Virtual EET planned for the Fall of 2024. Mature the architecture to integrate and interoperate with key CoVeR technologies to include the RTK, Robotic Vehicle Integration and Safety (RVIS) and Warfighter Machine Interface (WMI). M&S capability, focus on real-time models of CoVeR platforms and sensors operating in terrains and scenarios focused on the 2024 EET event. Initial capability, focus on run-time configurability for experimental parameters and building the fundamental capabilities within the simulation to run at scale on externally provided cloud or High Performance Computing (HPC) resources. FY 2024 Plans:		-	2.002	2.081

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF3 / <i>Combat Vehicle Robotics Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will enhance and develop Robotic Technology Kernel (RTK), Robotic Vehicle Integration and Safety (RVIS) and Warfighter Machine Interface (WMI) M&S started in FY 2023. Will use M&S to ensure readiness of the various technologies to be incorporated in the FY 2025 EET.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p> <p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.282	-
<p>Title: Small Unmanned Ground Vehicle (UGV) as Deployable Sensor</p> <p>Description: This effort advances unmanned system teaming between autonomous small Unmanned Ground Vehicles (UGVs) and Next Generation Combat Vehicles (NGCV) to execute collaborative mission tasks in support of reconnaissance and clearing missions.</p> <p>FY 2024 Plans: Will continue to develop and further advance autonomous behaviors to enable small robot autonomy teaming with NGCV systems. Will update and expand the task-distribution architecture as well as autonomy behaviors to optimize small UGVs and NGCV teaming in support of mission tasks such as route and area reconnaissance, Listening Post/Observation Post (LP/OP), and clearing missions. In addition, the effort will advance Artificial Intelligence (AI) enabled sensing and communication Modular Mission Payloads (MMPs) to support the mission tasks. Will validate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomy teaming technology and integrated MMPs are fully evaluated for performance and safety.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This is a new effort in FY 2024.</p>		-	-	2.112
Accomplishments/Planned Programs Subtotals		16.105	20.614	17.443
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF3 / <i>Combat Vehicle Robotics Tech</i>

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology				Project (Number/Name) BF6 / Crew Augmentation and Optimization Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BF6: Crew Augmentation and Optimization Tech	-	8.558	10.761	11.664	-	11.664	11.668	10.101	10.108	10.217	0.000	73.077

A. Mission Description and Budget Item Justification

This Project designs capabilities for reduced vehicle crew sizes to successfully operate a larger number of closed-hatch manned and remote unmanned vehicles in a complex multi-domain operations environment. This Project will enable future crews to perform complex missions with increasingly sophisticated technologies, and in increasingly complex, dynamic socio-technical environments. The applied research will provide the fundamental technologies to enable integrated performance-improved Learning - Warfighter Machine Interfaces (WMIs) that are scalable to multiple crew hardware and functional configurations; reconfigurable frameworks and simulation for concept experimentation and exploration; and team-centered dynamic tasking by machine intelligence to effectively utilize full capabilities of crew and technologies. The research will generate soldier-informed data, reports, and analysis to support operational use in future vehicles through soldier experimentation and assessment of technical concepts in simulation and in-field WMIs. The capabilities created by this research will lead to increased overall crew and team performance; improved soldier safety due to fewer soldier per vehicle, closed-hatch operations, and improved standoff from effective control; and vehicles that can effectively perform across multiple domains of battle.

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

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority .

Work in this Project is performed by the United States (US) Army Futures Command.

This work is done in coordination with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and PE 0602143A (Soldier Lethality Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Crew & Robotic Mission with Agent Technology	0.468	-	-
Description: This effort focuses on the design, development and validation of hardware and software for establishing crew to robotic mission operator interactions to address full vehicle performance. Included are simulation tools and hardware for Soldier-in-the-loop testing including the Learning Warfighter Machine Interface (L-WMI), a seven-Soldier vehicle crew configuration command vehicle simulator; personalization of crew and robotic operator configurations to permit reconfiguration for role, mission requirements and Soldier monitoring; optimization of vehicle crew interactions to permit sharing, reallocation and management of tasks, as well as situational awareness and data management.			
Title: Crew Capability Enhancement	3.107	3.397	3.447

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF6 / <i>Crew Augmentation and Optimization Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort focuses on the dynamic interaction of Soldiers, responsible for both manned and unmanned ground vehicles, working together within a platoon formation. The project funds research on the simultaneous use of multiple technologies by Soldiers including transparent multi-modal user interfaces, commander's tools for maintaining and enhancing situation awareness, decision aids for enabling dynamic resource allocation and orchestration, and tools to interact with and adapt vehicle based autonomy. Products will include artificial intelligence algorithms, information display technologies, and team-centric design principles.</p> <p>FY 2023 Plans: Design and develop tools and technology aids within the Warfighter Machine Interface to ensure data sharing is customized to individual operators based on their roles in order to improve Soldier-autonomous system team function and cohesion. Augment data-driven approaches to cue Vehicle Commander of potential task sharing opportunities through the addition of learning based methodologies.</p> <p>FY 2024 Plans: Will design and implement a component-level Warfighter-Machine Interface-embedded capability allowing autonomous systems to learn from multiple forms of Soldier interaction; implement automatic team re-tasking components for dynamic task allocation based on operator workload, mission, or personalization.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
<p>Title: Characterize Soldier-Adaptive AI Interactions</p> <p>Description: This effort develops approaches for characterizing Soldier interactions and overall human-system performance of mixed Soldier and intelligent-agent teams to enable robust human system performance for manned and unmanned teams. This effort will focus on flexible, tailorable methodologies for laboratory-grade, high-resolution characterization of joint Soldier and Artificial Intelligence (AI) enabled intelligent-agent adaption in complex environments.</p> <p>FY 2023 Plans: Mature initial capability for characterizing Soldier-autonomous system teams by incorporating novel techniques that allow vehicle crews to increase the mission data viewed during after action reviews and compare to what was viewed while conducting the missions. Determine initial visualizations of dynamic systems-based measures of crew-autonomous system effectiveness. Investigate initial predictive models incorporating mission and human-in-the-loop data to predict team outcomes.</p> <p>FY 2024 Plans:</p>	1.089	2.569	2.608

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF6 / <i>Crew Augmentation and Optimization Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will develop and implement Next Generation Combat Vehicle (NGCV) Dashboard tool for subject matter experts to conduct performance assessments of Soldier-Autonomous System Teams using data collected during the mission; augment visualizations of dynamic systems-based measures of crew-autonomous system effectiveness with subject matter expert-derived labels to improve observer understanding of team states; conduct experiments on intelligent signal management techniques to improve predictive model accuracy.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Human Augmentation for Collective Training</p> <p>Description: This effort investigates assessment techniques of crew performance to inform the development of individual and collective training for military vehicles. Assessment techniques will be applicable across a wide-variety of vehicle platforms, training tasks and vehicle crew roles. This effort will support training and increased force readiness of vehicle crews in complex environments by developing accurate and efficient performance assessment techniques evaluated in complex Operational Environments (OE) enabled by the latest advances in simulation and training technology.</p> <p>FY 2023 Plans: Design and develop an embedded training architecture to be implemented within simulation environments and prototype ground vehicle platforms. Architecture development will support the conduct of experimentation into multi-modal embedded training approaches across a wide-variety of vehicle platforms and novel user interfaces. Investigate instructional design based approaches and mature tools enabling immediate point of need training, classroom based training or after action reviews, and interactive episodic training across individual and crew configurations. Investigate the underlying technical demands required for embedded or peripheral training systems to support maneuverability and fires within the robotics and autonomous systems domain.</p> <p>FY 2024 Plans: Will mature subcomponents of an embedded training architecture to facilitate crew-to-section training and conduct software validation experiments for whole system performance within applicable simulation or platform environments; conduct experiments to determine ground platform operator roles supported by the embedded training architecture, training modes for effective instruction within or outside the immersive training environment, and continued functional architecture development which will enable manned-unmanned platform teaming concepts; investigate digital terrain considerations pertinent to effective team training and operation of robotics or autonomous systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		1.809	1.890	1.918

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF6 / <i>Crew Augmentation and Optimization Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding change reflects planned lifecycle of this effort.			
<p>Title: Platoon Teaming Capability</p> <p>Description: This effort focuses on the design, development and validation of intelligent, real-time, within-vehicle task management; data-driven allocation of situational awareness (SA) across platforms within the platoon; coordinated platoon-level manned-unmanned teaming (MUM-T) semi-autonomous maneuver with complex formations; and on-the-fly, platoon-level task optimization. This effort includes WMI modification to conduct experiments with these capabilities in application of intelligent task management and data-driven prediction of crew to support changing mission goals.</p> <p>FY 2023 Plans: Validate approaches to efficiently process and share critical data for enhanced mutual crew-agent situational awareness across a mixed manned-unmanned platoon-level formation. Validate algorithms to cue the vehicle commander of possible task sharing opportunities within a crew at the platoon level.</p> <p>FY 2024 Plans: Will further develop, integrate at system level, and validate intelligent technology aids and embedded training software to increase platoon-level crew situational awareness and enable soldier adaptation of autonomous systems; integrate software algorithms at system level and validate approaches to automatically re-task critical tasks based on workload, mission requirements and operator strengths/weaknesses, across a mixed manned-unmanned platoon-level formation.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase is in accordance with the project plan and reflects the focus on automating task sharing and soldier adaptation of autonomous systems.</p>	2.085	2.905	3.691
Accomplishments/Planned Programs Subtotals	8.558	10.761	11.664

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>			Project (Number/Name) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>				
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BF8: <i>Artificial Intelligence & Machine Learning Tech</i>	-	13.261	19.906	20.329	-	20.329	17.477	17.498	17.510	17.702	0.000	123.683

A. Mission Description and Budget Item Justification

This Project develops and characterizes artificial intelligence and machine learning software and algorithms to team with soldiers in support of fully autonomous maneuver of the Next Generation Combat Vehicle (NGCV) and other autonomous systems, both physical and non-embodied. Efforts develop capabilities for NGCV and other autonomous agents that increase autonomy, unburdening the soldier operator, with a high degree of survivability and lethality in a highly contested environment. This work also investigates power distribution and conversion technologies to provide compact, efficient, and high power capabilities for electrical and electro-mechanical loads supporting both mobile and stationary unmanned platforms. Research enables combat vehicles to rapidly learn, adapt, and reason faster than the adversary; accomplish missions in contested, austere and congested environments, characterized by lack of structure, adversarial actions, and minimal a priori knowledge; and provide force reduction through self-learning vehicles that can operate in complex militarily relevant environments. This Project also matures emerging research leading to potential technology development in areas of strategic importance to the Army by bringing competitively selected Universities with research teams into Technical Alliances.

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

Work in this Project is performed by the United States (US) Army Futures Command.

This work is done in coordination with PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Scalable, Adaptive, and Resilient Autonomous Systems	2.757	8.104	8.484
Description: This effort develops emerging research in Autonomous Vehicle intelligence and decision making, human agent teaming, scalable and collaborative behaviors, embodied and embedded intelligence, and autonomous operations for next generation Army platforms in dynamic Army relevant environments, architectures, and missions. Specific focus will be on the application of Artificial Intelligence/Machine Learning (AI/ML) to autonomous systems and human-intelligent agent teaming; scalable and collaborative behaviors in support of heterogeneous air and ground manned-unmanned teaming (MUM-T) operations; methods for embodied and embedded intelligence for increased understanding, manipulation, and reflexive maneuver through and interaction with dynamic environments; techniques for improved perception, decision making, and adaptive behaviors in contested environments for MUM-T; and new methods for testing and evaluating emerging technologies for intelligent and autonomous systems under Army relevant constraints and environments and in Army relevant architectures.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Design and develop methods to increase operational speed and distances in complex terrain. Develop methods to integrate terrain awareness and platform capability into tactical decision-making process. Design and develop methods to cooperate with multiple air and ground autonomous agents for improved maneuvers in complex terrain engaging vehicle perception, learning, reasoning, navigation and physical maneuver.</p> <p>FY 2024 Plans: Will design and develop methods to rapidly identify and adapt on the fly to changing ground vehicle terrain; create methods and techniques that allow for longer-duration ground vehicle autonomy, measured by time between human interventions; conduct experiments to increase operational speed and mission distances in complex terrain; continue to identify methods to integrate terrain awareness and platform capability into tactical decision-making process; validate methods to advance cooperation with multiple air and/or ground autonomous systems for improved vehicle perception, learning, reasoning, navigation and physical maneuver in complex terrain.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>				
<p>Title: Context-Based Information Dynamics</p> <p>Description: This effort investigates techniques that integrate on-board and external information sources, and it applies ML analytic approaches to support automated intelligence analysis and decision making. The goal is to enable tactical agents to cooperatively share relevant and timely tactical information within a distributed environment.</p> <p>FY 2023 Plans: Experimentally validate intelligent system methods and interfaces that can identify, characterize, and exploit data from sensors and other information assets that are built on theories and fundamental models for human decision making. Investigate novel and emerging visualization technologies and data driven decision tools that help develop situational awareness and understanding at varying echelons to more quickly and accurately assess and integrate information across domains in Multi Domain Operations (MDO) thereby enhancing mission effectiveness by improving decision cycles.</p> <p>FY 2024 Plans: Will develop computer vision algorithms that can provide enhanced estimates of objects of relevance when operating with limited or missing information; investigate rule-based and machine learning approaches for intelligent systems that interpret multisource information to infer meaning, create shared understanding, and support decision-making; define inferencing algorithms to derive context from multi-modal multi-source information for automated decision-making and course of action generation.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		2.335	2.561	2.640

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding increase reflects the planned lifecycle of this effort.				
<p>Title: Heterogeneous Computing and Computational Sciences</p> <p>Description: This effort funds research to develop algorithms and architectures that allow adaptable, energy efficient information processing across different computing hardware platforms. The goal of this research is to provide high performance computing and processing capabilities to the Soldier on the battlefield.</p> <p>FY 2023 Plans: Apply advanced algorithms to Army-relevant tasks on low size, weight, and power (SWaP) computing devices. Exercise the proposed algorithm/compute combinations on heterogeneous datasets to measure performance and efficiency. Implement scalable task scheduling mechanisms that are robust to adversarial and organic failures and can be applied in centralized, distributed, and decentralized agent environments. Develop scheduling routines to enable flexibility and efficiency under tactical environments and constraints.</p> <p>FY 2024 Plans: Will explore automated data and model optimization and reduction methods for advanced intelligence, surveillance, reconnaissance (ISR) algorithms to be executed on low size, weight, and power (SWaP) computing devices; investigate combined optimization of heterogeneous datasets and measure performance and increase efficiency through implementing scalable task scheduling methods on networked edge devices; develop methods that are applied in centralized, distributed, and decentralized agent environments and schedule routines to enable processing in tactical environments and under associated constraints.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>		1.719	1.888	1.943
<p>Title: Machine Learning with Constrained Resources</p> <p>Description: This effort will research new ML and reinforcement learning methods to address issues of statistically mismatched and incomplete information which must be annotated, collected, classified, and used for rapid decisions by joint intelligent agent-Human teams. In addition, multi-modal human interaction approaches will be investigated to ensure effective Soldier interactions and understanding of intent. The goal of this research is to enable joint human-intelligent agent decision making, optimizing the strengths of each in the decision process and creating an adaptive, agile team. This work applies research conducted in PE 0611102A (Defense Research Sciences) / AA6 (Robotics and Mobile Energy) and AA9 (Information and Networking).</p> <p>FY 2023 Plans: Mature algorithms for prototype platforms that allow trained models to be transferred between autonomous ground vehicles operating in different environments. Conduct experimentation to measure the ability of automated controller tuning techniques to improve autonomous navigation and coordination techniques to be executed across small teams of platforms. Implement</p>		3.988	4.434	4.570

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>techniques for network load balancing, task sharing, and computational offloading in adversarial settings for resource constrained devices at the tactical edge. Investigate artificial intelligence-based moving target defense security functionalities for software-defined networks (SDNs) and investigate the integration with signature detection systems.</p> <p>FY 2024 Plans: Will conduct experiments to assess the ability of novel navigation techniques to effectively plan routes in environments that include partially observable elements, such as obscured terrain features; investigate rule-based algorithms and data-driven machine learning methods for interpreting multi-source information to capture meaning, support cross-domain event detection, and enable effective automated text generation for knowledge and information management tasks; investigate computer vision algorithm and machine learning methods that can quantify uncertainty, rank, and prioritize visual information in ways that are consistent with human judgment; develop computational models of human behavior to predict soldier attention and biases in different contexts, detect camouflaged, obscured, or non-obvious objects, and detect rare and novel cases using contextual information.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>				
<p>Title: Intelligence for High Operational Tempo Maneuver</p> <p>Description: Applied research on intelligence for cognitive learning and control architectures to enable efficient and full use of embodied physical capabilities and create the machine intelligence required of autonomous systems to understand physical limitations. Investigates the means through which robotic physical performance attributes (e.g. speed, agility) will be coupled with artificial intelligence to enable resilient maneuver in high operational tempo missions in complex environments.</p> <p>FY 2023 Plans: Design and develop novel models and algorithms that support biologically inspired robotics capable of efficient maneuver over or through complex terrain at high operational tempos; continue research on architectures and models that provide predictable performance appropriate for tactical multi-agent teaming.</p> <p>FY 2024 Plans: Will continue to explore how novel models and algorithms function with design features of biologically inspired robotics to advance the efficiency of maneuver over or through complex terrain at high operational tempos; mature architectures and models that provide predictable performance appropriate for tactical multi-agent teaming.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>		1.462	1.603	1.652
<p>Title: Operational Assessment of Artificial Intelligence Developmental Systems</p>		1.000	1.021	1.040

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort supports the Combatant Commander's needs by performing operational assessments of AI-intense developmental weapon systems.</p> <p>FY 2023 Plans: Continue to optimize results from ongoing studies to support Combatant Commander identified needs.</p> <p>FY 2024 Plans: Will continue to optimize results from ongoing studies to support Combatant Commander identified needs.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.295	-
Accomplishments/Planned Programs Subtotals	13.261	19.906	20.329

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF9 / <i>Sensors for Autonomous Operations and Surv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BF9: <i>Sensors for Autonomous Operations and Surv Tech</i>	-	34.174	22.666	25.327	-	25.327	24.722	24.890	25.639	25.919	0.000	183.337

A. Mission Description and Budget Item Justification

This Project designs and develops modular and adaptive sensor components, novel embedded processing approaches, innovative threat cueing solutions and novel multi-function sensor payloads integrated with novel signal image processing techniques tools to provide improved manned and unmanned ground vehicle situational understanding that enables aided target recognition (AiTR) and autonomous navigation in all environments.

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

Work in this Project supports the Army Next Generation Combat Vehicle (NGCV), Soldier Lethality (SL), and Future Vertical Lift (FVL) Modernization priorities.

Work in this Project is performed by the United States (US) Army Futures Command.

This research is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology), 0603118A (Soldier Lethality Advanced Technology), 0602143A (Soldier Lethality Technology), 0602148A (Future Vertical Lift Technology) and 0603465A (Future Vertical Lift Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Sensors with Embedded Processing	25.334	17.991	16.339
Description: Designs and develops advanced, automated multi-spectral and multi-function sensor components, and image processing techniques with improved performance in all environments and against all threats to include low-contrast targets in camouflage or in degraded conditions to enable combined arms maneuvers in complex environments for NGCV via manned, optionally manned, and robotic platform applications.			
FY 2023 Plans: Validate integration of on-chip non-uniformity correction for electro-optical / infrared (EO/IR) sensor components into the Digital Readout Integrated Circuit (DROIC). Investigate on-chip signal processing to enable vast improvements in SWAP-C and System-On-Chip (SOC) capabilities. Investigate cooled, long wavelength infrared (LWIR) asynchronous laser pulse detection DROICs for utilization with LWIR avalanche photodiode detectors to enable covert threat and target ranging. Mature low-power processing threat warning component approaches and fuse contextual scene information to detect incoming threats. Validate far target location techniques and investigate optimal sensor configurations for target detectability and background reduction of cluttered scenes. Evaluate novel sensor modalities for multi-function imaging through battlefield obscurants. Research adaptive sensor components which can autonomously adjust imaging from visible through LWIR wavebands based on real-time conditions.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF9 / <i>Sensors for Autonomous Operations and Surv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Validate sensor performance and new exploitable target signatures to better detect targets in adverse conditions. Conduct experiments with polarized EO/IR sensors in multiple locations to validate sensor performance across environments, times-of-day/night, weather conditions, and targets.</p> <p>FY 2024 Plans: Will validate feasibility of on-chip compression capabilities on digital readout integrate circuits (DROICs) to enable lower data rates for high-resolution sensing, enabling more information content for down-stream processors; design and develop DROIC architectures for uncooled longwave infrared (LWIR) microbolometer detectors at new, smaller pixel pitches to enable size, weight, power, and cost (SWAP-C) and resolution improvements; continue developing cooled DROICs for integration with avalanche photodiode (APD) detectors at smaller pixel pitches for increased resolution to enable covert threat and target ranging; begin development of an extensible core software module, using a selected reasoning approach, to fuse contextual scene information or additional metadata to reduce false alarms of transitioned target detection algorithms; mature targeting and navigation sensors capable of operating on-the-move while providing far-target location and target tracking; mature and demonstrate modular sensor assemblies optimized for use in detection of threats at increased ranges; begin design of at-sensor processing hardware components to improve performance and SWAP-C of image processing and inferencing; investigate whether emerging neuromorphic processing architectures could be utilized to enable more complex processing at the sensor; determine how on-sensor processing can best conform with Modular Open System Approaches (MOSA) to reduce lifecycle costs.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease represents the realignment to task Sensors, Electronics and Processing Approaches for Threat Overmatch within this project</p>				
<p>Title: Multi-Mission Payload</p> <p>Description: Investigates, designs and develops sensor payloads for ground vehicle based unmanned aerial system to detect line of sight, and beyond line of sight threats and complex obstacles such as personnel and vehicles in all environments.</p> <p>FY 2023 Plans: Validate performance of high resolution polarized sensor components for vehicular, dismounted Soldier, and UAS mountable configurations enabling wider field of view terrain coverage, smaller threat object detectability, and extended range leading to more advantageous UAS flight paths. Determine approaches for exploiting scene features and target signatures to enable detection of targets in varying environmental conditions using concealment penetrating radar.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		3.167	2.403	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF9 / <i>Sensors for Autonomous Operations and Surv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding decrease represents completion of this effort and the realignment of funds to task Sensors, Electronics and Processing Approaches for Threat Overmatch within this project.				
<p>Title: Automated Threat Cueing</p> <p>Description: Investigates, matures and validates novel image processing and threat recognition and detection methods to enable automated search and detection of open and concealed threats for cueing and target hand-off to maintain overmatch via speed in cluttered environments.</p> <p>FY 2023 Plans: Mature processing approaches utilizing multi/hyperspectral and polarized EO/IR sensors as well as position sensors to improve on-the-move target detection and tracking. Mature image formation and processing approaches for target detection in low clutter environments using small UAS mounted compact ground and concealment radar antennas.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease represents the realignment to task Sensors, Electronics and Processing Approaches for Threat Overmatch within this project</p>		5.673	2.272	-
<p>Title: Sensors, Electronics and Processing Approaches for Threat Overmatch</p> <p>Description: This effort design, develops, matures and validates novel sensor components, sensor payloads and image processing approaches to enable enhanced detection of line of sight and beyond line of sight threats and complex obstacles in all environments via manned, optionally manned and robotic platforms. It will enable cueing and target hand-off to maintain overmatch while on-the-move, at speed, in cluttered environments.</p> <p>FY 2024 Plans: Will complete validation of sensor performance and exploitable target signatures to improve target detection performance in adverse conditions; complete experiments and validate the use of polarized electro-optic/infrared (EO/IR) sensors to suppress clutter and improve detection performance across environments, times-of-day/night, weather conditions, and targets; investigate and mature small form-factor multispectral sensors and assess performance improvements for targets obscured by vegetation or camouflage; complete data collections and an assessment of the effectiveness of using high resolution polarized sensor components for dismounted soldier and unmanned aerial system (UAS) applications to reduce the effects of clutter while providing a wider field of view, improved ability to detect smaller targets, and at greater range; investigate and mature approaches and processing techniques to exploit scene features and target signatures to enable improved detection of targets in varying environmental conditions using concealment penetrating radar; validate processing approaches and methods using additional data from multispectral and high definition polarized EO/IR sensor components and position sensing information to improve</p>		-	-	8.988

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF9 / <i>Sensors for Autonomous Operations and Surv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
target detection and tracking from a moving platform; validate image formation and processing techniques to help assess target detection performance using compact ground and concealment radar antennas mounted on a small UAS.				
FY 2023 to FY 2024 Increase/Decrease Statement: This is a new effort in FY 2024 with funds realigned from Advanced Sensors with Embedded Processing, Multi Mission Payload, and Automated Threat Cueing within this project. This is not a new start.				
Accomplishments/Planned Programs Subtotals		34.174	22.666	25.327
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BG2 / <i>Modeling and Simulation for MUMT Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BG2: <i>Modeling and Simulation for MUMT Technology</i>	-	6.473	5.591	5.526	-	5.526	4.591	4.267	4.419	4.043	0.000	34.910

A. Mission Description and Budget Item Justification

This Project develops Modeling and Simulation (M&S) tools and technologies to assess and improve freedom of movement for ground forces and supports vehicle developers by addressing challenges for robotic and ground vehicles. Through investigation and design, this project develops obstacle detection and classification algorithms for dynamic mobility hazards in urban and complex environments. This project develops tools to evaluate system performance reducing the need for physical testing including: real-time mobility decision support tools, vehicle-terrain interactive models for autonomous convoy operations, simulation tools for vehicle mobility in highly altered terrain, and M&S tools for predicting the performance of autonomous vehicles in a wide variety of weather and terrain conditions. These M&S technologies can be integrated across Army vehicle platforms as required.

Work in this Project complements Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology) / Project BG3 (Modeling and Simulation for MUMT Advanced Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Simulation Tools for Combat Vehicle Robotics (CoVeR)	6.228	3.345	-
Description: This effort develops M&S capabilities to evaluate hardware and software technologies enabling battlefield autonomy in complex environments and adaptive learning algorithms for predicting mobility performance in challenging environments.			
FY 2023 Plans: Validate high-fidelity M&S tools to support development of autonomous systems operating in mission-relevant environments; and mature tagged dataset of real and synthetic images for training autonomous algorithms through M&S.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle conclusion of this effort with transition of technologies to Program Executive Office Ground Combat Systems.			
Title: Autonomous Vehicle/Terrain Interactions	-	2.246	5.526

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG2 / <i>Modeling and Simulation for MUMT Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort develops M&S capabilities to evaluate autonomous vehicle formation performance on mission-relevant terrain and climates (i.e. soft soil, gap crossing, obstacle override, cold regions, etc.). This effort develops algorithms for improved manned/unmanned and air/ground teaming for off-road tactical behaviors.</p> <p>FY 2023 Plans: Develop complex obstacle detection and mobility predictions at tactically relevant speeds (high speed in complex terrain). Develop M&S enabled analytical tools for operational effectiveness assessments.</p> <p>FY 2024 Plans: Will develop advanced vehicle terrain interface for vehicle platforms operating in highly altered terrain and enhance Virtual Autonomous Navigation Environment (VANE) M&S tool for evaluating ground vehicle formations in various operational environments, such as degraded sensor performance environments. Will develop methods to support the identification of vulnerabilities directly related to vehicle maneuver in various operational environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle initiation of this effort to develop, refine, and integrate core mobility algorithms for the vehicle terrain interface and enhancements to the VANE M&S tool for formations.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p>	0.245	-	-
Accomplishments/Planned Programs Subtotals	6.473	5.591	5.526

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks N/A</p> <p>D. Acquisition Strategy N/A</p>

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BG6: <i>Advanced Concepts for Active Defense Technology</i>	-	29.415	33.656	32.668	-	32.668	33.005	37.824	34.056	25.215	0.000	225.839

A. Mission Description and Budget Item Justification

This Project funds research for advanced materials and mechanisms to defeat the most common and most dangerous threats that are expected to be encountered by our ground forces in the near, mid and far term. Work conducted in this Project will result in concepts for Adaptive and Cooperative Protection of ground combat vehicles. Additionally, research will focus on subcomponent/component models to predict performance of early concepts and the means to evaluate effectiveness on ground platforms. The Project will balance developments of active threat defeat measures with the necessary advanced passive and active components to provide solutions which will help meet the requirements of current and next generation ground tactical and combat vehicles.

This Project is coordinated with and transitions to Projects in PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and builds upon weapon target interaction research in PE 0602144A (Ground Technology) and PE 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics).

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

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority .

Work in this Project is performed by the United States (US) Army Futures Command.

This research is done in coordination with PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Multi-Threat Armor Technologies	7.763	8.413	8.245
Description: This effort develops multi-threat hybrid armor technologies incorporating both active and passive mechanisms for ground vehicle systems that are effective against future conventional weapons and evolving improvised threats including kinetic and chemical energy as well as blast threats.			
FY 2023 Plans: Conduct experiments on a kinetic energy projectile defeat technology to counter multiple threats; continue to mature a multi-hit projectile defeat mechanism; conduct virtual experimentation studies to provide armor performance conceptualization, improvements, optimization, and mechanistic understanding to guide experimental programs.			
FY 2024 Plans:			

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will validate armor protection mechanism for Medium Caliber (Med-Cal), Explosively Formed Projectiles (EFP), and Shaped Charged Jet (SCJ) threats, as well as Active Protection System (APS) residual effects; design and develop lab-scale solutions for more efficient, cost-effective tools and methodologies to provide data to improve vehicle protection technologies; conduct virtual experiments to assess complex warhead-penetrator orientations; finalize the development of vehicle spall protection requirements for shaped charge threats for both manned and unmanned systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort.</p>				
<p>Title: Adaptive and Cooperative Protection</p> <p>Description: This effort pursues a holistic approach toward achieving significant weight reduction and protection from future threats by utilizing real-time information, combined with threat knowledge, to provide ever-increasing protection. This approach includes integrating individual vehicle capabilities of armor, underbody blast protection, active protection systems, and advanced soft kill methods into one layered solution to maximize survivability and minimize weight for combat and tactical vehicles. This effort will investigate modern protective technologies that implement complex kinematic mechanisms in order to bend, break and disperse threat projectiles before they can injure crew or disable vehicles.</p> <p>FY 2023 Plans: Assess a laser-based soft kill system; transition an optical threat warner to PE 0603462A (Next Generation Combat Vehicle Advanced Technology) / Project BG7 (Ground Systems Active Defense (GSAD) Advanced Tech) for maturation; mature an adaptive reactive armor mechanism to defeat Anti-Tank Guided Munitions and Rocket-Propelled Grenades; mature a collaborative multi-platform defense mechanism.</p> <p>FY 2024 Plans: Will validate a collaborative multi-platform defense mechanism; explore the use of novel armor mechanisms to provide hemispherical protection against a variety of rocket propelled grenade (RPG) and Anti-Tank Guided Munitions (ATGM) threats; mature a statistical computational model for adaptive protection systems; explore alternate lasers for ATGM soft-kill active protection system.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of this effort.</p>		5.836	6.520	6.793
<p>Title: Emerging Overmatch Technologies</p> <p>Description: This effort designs, develops, and conduct experiments to validate the lethality and protection concepts that re-establish overmatch for the next generation of manned and unmanned combat platforms. It will tightly couple scientific research within a campaign of learning to form technology concepts for battlefield domination against current and future threats. This</p>		2.183	2.405	2.459

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>research will heavily leverage other efforts within PE 0602145A (Next Generation Combat Vehicle Advanced Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).</p> <p>FY 2023 Plans: Design, develop, and conduct experiments to validate technologies, coupled with autonomous behaviors, that illustrate concepts for autonomous ground combat, focused on lethality and protection; validate cooperative protection and intelligent lethal saturation in both simulation and physical experiments using a team of at least three drones and two unmanned ground vehicles; generate and analyze effectiveness of concepts.</p> <p>FY 2024 Plans: Will continue to develop technology to enable concepts of cooperative protection and collaborative lethality, emphasizing autonomous distributed task assignment across a team of robotic and autonomous systems acting in opposition to numerous surrogate threat systems; perform experiments on both simulation and physical systems in pseudo-tactical scenarios.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of this effort.</p>				
<p>Title: Survivability/Lethality/Vulnerability Analysis Tools and Methodology</p> <p>Description: This effort devises state-of-the-art survivability/lethality/vulnerability methodologies to dynamically model the interaction of conventional ballistic threats against future weapon systems.</p> <p>FY 2023 Plans: Mature capabilities to analyze and model the vulnerabilities of autonomous unmanned ground vehicle systems and teaming with other manned and unmanned systems; develop methodology for assessing capabilities of active and adaptive armor mechanisms and protection systems against combined threats; continue to mature multi-hit modeling capability in support of next generation combat vehicle protection; will mature active protection system soft kill and hard kill analysis capability for vehicle protection systems; continue to design, develop and validate multi-discipline analysis capability and transition methodologies to computational models; perform limited validation assessment of computational capabilities for the next generation combat vehicle smart munitions in electronic warfare congested environments.</p> <p>FY 2024 Plans: Will research and conduct analysis of autonomous unmanned ground vehicle systems and teamed manned and unmanned systems against multi-domain threats in a common framework while applying time-dependent failures from consumables like fuel/electric; complete development of communications linkage map between vehicle system, assistive automation, artificial intelligence, and the Soldier; expand survivability/lethality/vulnerability methodologies and proof-of-concept analyses of vehicle protection system technologies against multi-discipline threats and attacks in a common framework; conduct experiments to</p>		4.976	5.440	5.734

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
inform improved methodology, analytical techniques, and modeling capability to assess lethality of next generation combat vehicle fragmenting and high explosive munitions. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of the effort.				
Title: Ground Systems Active Defense Technology Research Description: This effort contributes to the Army's ground vehicle survivability by developing technologies which electronically or physically defeat an incoming threat before it contacts the vehicle. These technologies involve sensors and effectors interacting with an incoming threat to disrupt or destroy in while it is in flight or before it is even fired at a vehicle. This effort designs and develops modern armors that directly complement and are optimized to work with active defense technologies in order to implement sophisticated mass efficient mechanisms and leverage investments in materials to act as a system for the defeat of advanced threats and active protection system residuals. This effort designs and develops active blast mitigation technologies to counter the effects of underbody attacks to ground vehicles. This effort will also design and develop the required advanced structures required to accommodate active blast mitigation technologies into vehicles. The design of the structure and active defense technology is critical to an effective blast survivability solution. FY 2023 Plans: Build upon prior work to down-select the most promising technology concepts for defeat of emerging threats with complex defeat mechanisms, mature designs of selected technologies into components, and conduct component-level ballistic/blast experiments to validate threat defeat performance at bench-scale. Leverage U.S. Army Combat Capabilities Development Command (DEVCOM) Ground Vehicle System Center (GVSC) modelling and simulation capability to identify system-level integration considerations in preparation for packaging and integration. FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, funding realigned to Collaborative Defense within this Project.		5.570	6.631	-
Title: Advanced Threat APS Radar Technology Description: This effort develops ground combat vehicle survivability technologies including radar techniques to support hard-kill countermeasures as a part of an integrated survivability suite for ground combat platforms in all-weather, day or night conditions with 360 degree situational awareness and Kinetic Energy threat defeat. FY 2023 Plans:		3.087	3.374	2.209

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Perform signature characterization of experimental prototype radar candidate technologies, investigate signature management techniques, and evaluate radiated sensor signatures during live fire tests against kinetic energy threats. Provide hard-kill active protection system impact analysis for addressing additional future armor piercing threats.</p> <p>FY 2024 Plans: Will finalize studies to provide signature management improvements and optimization; develop resource management techniques to counter threats while maintaining radar search modes; assess sensor resource management techniques and algorithm performance via experiments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease represents focus on the development and assessment of resource management techniques necessary to support future, more costly multi-hit projectile defeat mechanisms.</p>				
<p>Title: Detection Avoidance Applique Technology Research</p> <p>FY 2023 Plans: Investigate multiple passive signature management technologies and conduct experiments to characterize performance in spectrums of interest for new and existing ground combat vehicles. Leverage modeling and simulation capabilities to define experimental plan.</p> <p>FY 2024 Plans: Will build upon FY 2023 effort by down-selecting component technologies based on experimental results; design and develop a technology concept for ground vehicles that integrates multiple signature management component technologies into a system in order to create a holistic solution to avoid detection across spectrums of interest; conduct system-level modeling and simulation to refine the concept.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: The funding increase supports additional modeling and simulation efforts required to refine the holistic system concept.</p>		-	0.616	0.728
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.257	-
Title: Collaborative Defense		-	-	6.500

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG6 / <i>Advanced Concepts for Active Defense Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort expands the capability to protect ground vehicles by conducting research into technologies that can enable the sharing of protection resources across multiple platforms in real time to expand the zone of protection on the battlefield beyond a single vehicle and its protection system. These technologies include sensors to identify and track incoming threats, radios/networks to allow local communication of threat detection and tracking information, and effectors that disrupt or destroy threats before terminal engagement with the platform. This effort will study various system-level approaches to integrating these aforementioned technologies to enable collaboration across multiple platforms, including integration factors such as size, weight, power consumption, and cost impacts to the platform. This effort will validate performance of the system in the laboratory environment.</p> <p>FY 2024 Plans: Will research technology approaches for the application of a distributed, autonomous countermeasure for ground vehicle formations; conduct component and system-level modeling of collaborative countermeasure concepts to explore feasibility; conduct experiments into vehicle-to-vehicle threat sensing and response; investigate feasibility of system-level concepts for integration with the Army's modular active protection system architecture.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This is a new effort in FY 2024 with funding realigned from Ground Systems Active Defense Technology Research within this Project in order to shift focus to research technologies that enable the sharing of protection resources across multiple platforms.</p>			
Accomplishments/Planned Programs Subtotals	29.415	33.656	32.668

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG8 / <i>Obscuration Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BG8: <i>Obscuration Technology</i>	-	2.482	2.722	-	-	-	-	-	-	-	0.000	5.204

Note

In FY24, funding administratively realigned to Program Element 0602144 Project N15 Development of Obscurants

A. Mission Description and Budget Item Justification

This Project investigates and evaluates obscurant technologies that degrade threat force surveillance sensors and defeat the enemy's target acquisition devices, missile guidance, and directed energy weapons. This Project focuses on advanced infra-red and multi-spectral obscurant materials that provide effective, affordable, and efficient screening of deployed forces, while being safe and environmentally acceptable.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering Priority focus areas and the Army Modernization Strategy.

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority.

Work in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is related to and fully coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Obscuration Enabling Technologies	2.482	2.722	-
Description: This effort investigates new materials and compounds to enable safe, effective screening of personnel and equipment across the electromagnetic spectrum. This effort also provides vulnerability assessments against enemy threat systems.			
FY 2023 Plans: Mature risk factor mitigation technologies for bi-spectral materials that show promise to replace lower performing fielded bi-spectral obscurants. Investigate improvements to advanced microwave obscuring materials. Collaborate with subject matter experts from universities, private industry, other Military Services, and other government agencies to develop unique approaches to fabricate a spectrally selective obscurant for ground platform use.			
FY 2023 to FY 2024 Increase/Decrease Statement: This effort is realigned in FY 2024 to Program Element 0602144 Project DG1 Development of Obscurants.			
Accomplishments/Planned Programs Subtotals	2.482	2.722	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BG8 / <i>Obscuration Technology</i>

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) BH5 / Platform Electrification and Mobility Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BH5: Platform Electrification and Mobility Tech	-	13.278	14.226	13.763	-	13.763	17.168	19.957	15.514	14.398	0.000	108.304

A. Mission Description and Budget Item Justification

This Project researches and develops advanced power and energy technologies for combat ground vehicles that are necessary for parallel hybrid, series hybrid and all-electric vehicle systems.

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

Work in this effort is performed by the United States (US) Army Futures Command.

Work in this Project supports the Army Modernization Priority Next Generation Combat Vehicle (NGCV).

Work in this Project is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Scalable Electrification & Control Architecture	1.378	1.977	1.999
Description: This effort designs and develops the power distribution and control components to implement a common, scalable, electrified vehicle power architecture to enable advanced lethality and protection capabilities, fast vehicle charging from the grid, and silent mobility on combat platforms across light to heavy weight classes. This power architecture enables the hybrid electric, fuel cell electric, and all-electric powertrains.			
FY 2023 Plans: Conduct experiments to optimize the design of the high voltage power converter enabling directed energy weapons, high voltage batteries, and fuel cells.			
FY 2024 Plans: Will validate the high voltage power converter developed in FY 2023, allowing integration of high voltage batteries and range extending technologies.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort			
Title: Platform Electrification Research	7.952	10.519	6.374

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BH5 / <i>Platform Electrification and Mobility Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort designs and develops the electric power generation, energy storage and electrified components and sub-systems required to electrify combat vehicles across light to heavy weight classes.</p> <p>FY 2023 Plans: Validate the component level performance of the electric generator, electric drive motors, and final drive components of a modular electrification architecture. Conduct experiments to quantify cell level performance of novel battery chemistry. Design and develop a small integrated multi-cell module for high voltage storage system. Develop concepts for plug-in hybrid combat vehicle technology focused on advanced batteries and compact electric sprocket drive systems. Develop concepts for high speed battlefield charging capability for hybrid and battery electric vehicles to enable charging at a comparable rate to refueling.</p> <p>FY 2024 Plans: Will mature design of the high-power density in-hub electric sprocket module; mature designs for electrified cooling components; mature battery cell concept for extreme high-energy storage system; perform component optimization and maturation for multi-cell module for high voltage energy storage system.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort as electric drive motor work concluded.</p>			
<p>Title: Advanced Mobility Research</p> <p>Description: This effort develops a lightweight composite running gear system for medium combat vehicle applications which offers significantly reduced system weight, maintenance, noise and vibration over conventional running gear systems. Advanced composite tracks coupled with low cost, low complexity suspension systems improve operational capability via increased mobility.</p>	1.979	-	-
<p>Title: Robotic Combat Vehicle Silent Watch and Mobility Range Extension</p> <p>Description: This effort designs and develops the Jet Propellant 8 (JP8) reformer based silent watch and mobility extension subsystem required to electrify robotic combat vehicles. The Army's robotic combat vehicles are expected to have increased silent watch and silent mobility requirements that are not met by current technologies.</p> <p>FY 2023 Plans: Mature components for JP8 reformer with metal supported solid oxide fuel cell.</p> <p>FY 2024 Plans: Will validate the component level performance of JP8 fuel reformer based silent watch and mobility extension subsystem; explore higher power density technologies for range extension subsystem.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	1.969	1.710	3.340

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BH5 / <i>Platform Electrification and Mobility Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase to investigate higher power range extension systems that will be required for the Army to field unmanned ground systems.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.020	-
Title: Battlefield Electric Vehicle Recharge Technology Description: This effort develops technologies to enable highly mobile Electric Vehicle (EV) rechargers that are essential to allow highly electrified tactical and combat platforms to be fielded by the Army to enable capabilities such as persistent silent mobility.? Effort includes highly mobile power generation and wireless power transfer to the tactical and combat platforms. FY 2024 Plans: Will design components of a wireless recharge system. FY 2023 to FY 2024 Increase/Decrease Statement: This is a new effort in FY 2024.	-	-	2.050
Accomplishments/Planned Programs Subtotals	13.278	14.226	13.763

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) B12 / <i>Sensor Protection Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
B12: <i>Sensor Protection Technology</i>	-	5.615	6.229	5.532	-	5.532	5.955	8.462	7.734	7.819	0.000	47.346

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops techniques for masking friendly force capabilities and intentions. The Project pursues technologies to reduce the susceptibility of sensor systems to detection and targeting by threat forces, as well as to inform the development of next generation signature reduction schemas. This Project also designs, investigates, fabricates, evaluates and characterizes advanced sensor protection technologies, components, and concepts that will enable the future soldier to see and operate through a laser directed energy weapon attack. Both active and passive protection technologies will be investigated to protect Army sensors that operate in the visible, short-wave infrared, mid-wave infrared, and long-wave infrared spectra from battlefield laser threats. Areas of research include passive optical limiters such as nonlinear organic dyes, semiconductors, and meta-materials, as well as fast active switches and tunable filters. Technologies investigated include novel optics designs combined with signal processing, spectral filtering, and threat sensing algorithms.

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

Work in this Project supports the Army Science and Technology Next Generation Combat Vehicle, Soldier Lethality, and Future Vertical Lift modernization priorities.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0603118A (Soldier Lethality Advanced Technology), PE 0603465A (Future Vertical Lift Advanced Technology), and PE 0602143A (Soldier Lethality Technology)

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

	FY 2022	FY 2023	FY 2024
Title: Sensor Protection Technology	5.615	6.100	5.532
Description: This effort will design and develop component technology to improve protection of sensors and sensor electronics from threats via techniques to harden optics, reduce sensor optical cross sections, novel coating approaches, filter improvements, and emerging signature reduction schemas.			
FY 2023 Plans: Validate out-of-band longwave infrared (LWIR) window coatings against commercially available threats and begin to investigate coating performance against ultra-short pulsed lasers. Conduct experiments validating the protection approaches of emerging			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) B12 / <i>Sensor Protection Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>high performance uncooled LWIR camera systems. Determine capability gaps, and design and simulate mitigation techniques. Validate effectiveness of visible filter materials against newly identified threats.</p> <p>FY 2024 Plans: Will validate the interactions and effects of ultra-short pulsed lasers (USPL) on current higher performance sensors and optical materials; develop new USPL protection techniques for high performance cooled electro-optical / infrared sensorsystems; investigate enhanced laser identification techniques to improve the speed and accuracy of protective responses; investigate and report on emerging spectrally agile filter approaches for the visible and infrared (speed, transmission, and blocking ability) for protection.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease represents threat mitigation investigations and reporting activities versus validation of techniques to mitigate reported threats.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.129	-
Accomplishments/Planned Programs Subtotals	5.615	6.229	5.532

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p>
<p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BL4 / <i>Materials Application and Integration Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BL4: Materials Application and Integration Tech</i>	-	7.369	7.722	7.505	-	7.505	7.508	7.047	7.051	7.128	0.000	51.330

A. Mission Description and Budget Item Justification

This Project designs, develops, fabricates and evaluates a variety of materials (e.g. metals, ceramics, polymers and composites) to enable more survivable, lighter weight vehicle armor, chemical and biological protection, armaments and electronics for the next generation combat vehicle. Research focuses on unique and /or novel materials properties, developing physics-based models, materials characterization techniques, non-destructive testing methods and advanced fabrication/processing methodologies to transition candidate solutions for maturity, scale-up, and integration into systems.

This Project also continues the Advanced Vehicle Power Technology Alliance between the Department of Energy and the Department of the Army with a focus on materials, providing an emphasis on developing advanced technologies that enable military ground vehicles to become significantly more energy efficient. The Alliance is chartered to accelerate the conceptualization and transition into deployment of inventive and creative energy-saving concepts that the Nation needs to achieve energy security. This Project matures and integrates lightweight materials and joining technologies in support of lighter military vehicles which are more fuel-efficient and expeditionary with superior mobility and protection of both vehicles and occupants.

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

Work in this Project supports the Next Generation Combat Vehicle Army Modernization Priority.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project leverages research from Program Element (PE) 0601102A (Defense Research Sciences) / Project AA7 (Mechanics and Ballistics) and 0602144A (Ground Technology) / Project BL1 (Materials and Manufacturing Research Technology). This work is also coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Novel Armor Materials and Processes for Vehicle Protection	7.369	7.651	7.505
Description: Develop novel metal alloys and associated processes through the scale-up and exploitation of revolutionary new metal alloys, which have demonstrated capabilities to overcome traditional engineering trade-offs (e.g., strength and ductility) with exceptional high temperature stability.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) B14 / <i>Materials Application and Integration Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Design and develop novel aluminum-magnesium alloys based on microstructurally-informed models that meet Army objectives for ballistic performance without requiring additional processing. Conduct experiments to expand the range of thickness for which high toughness, low cost, high hard steel armor alloy is weldable for structural applications and transition the new material for evaluation in vehicle trials and assessments. If the welded steel meets performance requirements, investigate performance of composition-optimized oxide dispersion strengthened plates manufactured using nanocrystalline powders and transition to full-scale ballistic assessments. If strengthened plates meet performance requirements, systematically investigate integration of shape changing molecules and dynamic bonding molecules into adhesively bonded multilayer composite structures for reducing damage under high rate impact. Design and develop scalable chemical agent resistant coatings (CARC) that provide enhanced camouflage reflectance and chemical agent resistivity.</p> <p>FY 2024 Plans: Will develop lightweight, low cost transparent glass/polymer laminates with optical transmissivity at wavelengths suitable for personnel and sensor protection; conduct experiments to maximize the thickness for weldable high toughness, low cost, high hard steel armor alloy for structural and armor applications for vehicle assessment; develop service temperature-time-mechanical property map for aluminum alloys to understand service properties of platform alloys and inform selection and development of alternative materials; design and develop scalable extreme environmental coatings that provide enhanced camouflage reflectance and chemical agent resistivity; develop capabilities for characterizing and modeling performance of dissimilar material joints (welded, solid state joined, adhesively joined) under extreme loading conditions.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease supports planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.071	-
Accomplishments/Planned Programs Subtotals	7.369	7.722	7.505

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

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BI4 / <i>Materials Application and Integration Tech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology			Project (Number/Name) B19 / Vehicle System Security Technology				
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
B19: Vehicle System Security Technology	-	2.273	-	-	-	-	-	-	-	-	0.000	2.273

A. Mission Description and Budget Item Justification

This Project develops ground vehicle cyber protection and resilience technologies to increase the cybersecurity of ground vehicles and ensure their continued operation in near-peer cyber contested environments. This Project will develop cybersecurity technologies at the vehicle platform level to defeat cybersecurity threats and maintain assured vehicle functionality and freedom of maneuver in the cyber warfighting domain. This effort is critical to address the continuous expanding vulnerability of military platforms to cyber threats due to their increasing reliance on computers, networks, data, digitization, and communications technology.

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

Work in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority.

Work in this Project is performed by the United States (US) Army Futures Command.

Work in this Project is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and 0602213A (C3I Applied Cyber).

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

	FY 2022	FY 2023	FY 2024
Title: Vehicle System Security Technology	2.273	-	-
Description: This effort develops cybersecurity technologies to defeat cybersecurity threats and maintain assured vehicle functionality and freedom of maneuver in the cyber warfighting domain. This effort develops technologies required to maintain operating tempo and overmatch capability during offensive digital attacks to ground vehicle systems. Additionally, the technologies developed will maintain critical vehicle functionality in peer and near-peer cyber-contested environments through robust cyber-defensive protections. The effort will also develop cyber-defensive technologies to mitigate risk of future and emerging enemy cyberattack vectors by designing highly assured systems with cybersecurity designed from the beginning.			
Accomplishments/Planned Programs Subtotals	2.273	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) B19 / Vehicle System Security Technology

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology				Project (Number/Name) BJ2 / Tactical and Navigation Lasers Sensors Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BJ2: Tactical and Navigation Lasers Sensors Technology	-	5.168	5.673	5.790	-	5.790	5.851	5.854	5.857	5.921	0.000	40.114

A. Mission Description and Budget Item Justification

This Project designs and develops novel laser sensor technologies which provide improved maneuver, lethality, and survivability capabilities via manned and autonomous navigation, adversary sensor threat detection, and target detection and designation in all environments. It will deliver novel laser technologies which will provide low size, weight, and power (SWaP) laser sources for optical augmentation detection systems; and compact Laser Detection And Ranging (LADAR) sources for situational awareness and air and ground vehicle operations and navigation in all environments. This Project is a critical enabler for autonomous operations in environments where other imaging technologies are not sufficient.

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

Work in this Project supports the Next Generation Combat Vehicle (NGCV), Soldier Lethality, and Future Vertical Lift (FVL) Army Modernization Priorities.

Work in this Project is performed by the United States (US) Army Futures Command.

This Project is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology), 0603118A (Soldier Lethality Advanced Technology), 0603465A (Future Vertical Lift Advanced Technology), and 0602143A (Soldier Lethality Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Tactical and Navigation Lasers Sensors Technology	5.168	5.596	5.790
Description: This effort designs and develops novel low SWaP, compact, high peak power pulsed laser sources and receivers for optical augmentation detection systems; and compact LADAR sources for situational awareness and manned and unmanned air and ground vehicle operations and navigation in all environments. Effort delivers component technologies needed to support future Army autonomous, covert targeting approaches.			
FY 2023 Plans: Develop approaches to decrease the pulse duration of advanced longwave infrared (LWIR) lasers through maturation of the laser configuration and non-linear crystals for use in LWIR optical parametric oscillators. Mature LWIR laser sources combined with pulse-detecting LWIR detector arrays such as avalanche photodiodes to increase detection range and improve range resolution. Design LWIR based three-dimensional (3-D) ranging components.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BJ2 / <i>Tactical and Navigation Lasers Sensors Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will investigate pixel pitch optimization of high-sensitivity laser detectors for enhanced resolution capabilities of the arrays; investigate dark current optimization of the high-sensitivity laser detectors through detector short loops to increase detection ranges when coupled with the short-pulse laser sources; begin development of a physics-based optical link error budget and laser detector model to guide development and predict future system performance.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.077	-
Accomplishments/Planned Programs Subtotals		5.168	5.673	5.790
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BJ9 / <i>Autonomous Mobility Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BJ9: <i>Autonomous Mobility Tech</i>	-	3.671	-	-	-	-	-	-	-	-	0.000	3.671

Note

In FY (Fiscal Year) 2023, funding in this project was realigned to: PE 0603462A (Next Generation Combat Vehicle Advanced Technology) Project BK1 (Autonomous Mobility Adv Tech)

A. Mission Description and Budget Item Justification

This Project designs and develops Artificial Intelligence and Machine Learning (AI/ML) technologies to increase autonomy and mobility to perform teamed operations with manned and unmanned air and ground vehicles in a military relevant environment through data collection on relevant platforms. Data collection investigates the usage of both live and simulation-based data. Simulation will provide a baseline to collect, clean, and analyze data that meets the need for developing algorithms to enable both intelligent formation control and Unmanned Aerial Systems (UAS) map input for unmanned ground vehicle Mobility. This Project will allow proper collection techniques, tools, and data to maximize embedded autonomy using ML and other AI methods before utilizing live data collection. The Project will use AI/ML techniques to develop intelligent formation control to be used on maintained roads and in complex terrain without the need for Global Positioning System. Data will be collected from mounted platforms utilizing special internal and external sensors to develop algorithms for exact positioning, undistributed formation control, and increased speeds of unmanned platforms. Also, the Project will use AI/ML techniques to develop intelligent autonomous ground platform planning through the use of UAS mapped areas. Data collected from the UAS will be converted to maneuverable information for manned ground platform with the identification of enemy positions, go/no-go areas, terrain classification, and optimal suggested paths.

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

Research in this Project supports the Next Generation Combat Vehicle (NGCV) Army Modernization Priority.

Research in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is coordinated with Program Element (PE) 0603462A (Next Generation Combat Vehicles Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Formation Control - Novel Technique Investigation	3.671	-	-
Description: This effort focuses on performing the applied research needed to investigate cutting edge ML techniques to be used for advanced collaborative movement. Areas of investigation here look to advance the utility of ML mobility beyond the current, widely utilized algorithms to allow for more natural coordination of autonomous vehicles and Soldiers.			
Accomplishments/Planned Programs Subtotals	3.671	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BJ9 / <i>Autonomous Mobility Tech</i>

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK2 / <i>Virtual Prototyping Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BK2: Virtual Prototyping Technology</i>	-	7.871	9.622	9.910	-	9.910	9.934	10.648	10.656	10.772	0.000	69.413

A. Mission Description and Budget Item Justification

This Project matures an integrated Virtual Prototyping capability that investigates Next Generation Combat Vehicle (NGCV) technology integration into a range of novel ground vehicle design concepts that will be analyzed and evaluated through modeling, simulation, and virtual experimentation to provide engineering data and operational feedback to inform NGCV requirements to strengthen and accelerate acquisition decisions. This Project designs and analyzes novel NGCV system level ground vehicle concepts by integrating advanced mobility, survivability, lethality, sensing and electrical/electronic technologies to address emerging and future advanced threats. This Project provides system level ground vehicle design concepts and performance analysis, assesses cost and performance trades, and provides real-time soldier feedback on technology performance for the Army's NGCVs. Technologies to be evaluated include high efficiency advanced powertrains, power generation, vehicle electrification, active protection systems, active blast, advanced lethality and robotic control and autonomy technologies. The NGCV Virtual Prototypes include Virtual Soldier Operational Experiments (VSOE) with System Integration Labs (SILs) to give warfighters an understanding into how behaviors and tactics change given emerging Operation concepts based on new technologies and capabilities. Future integration of VSOEs with software and hardware SILs with realistic interfaces and utilizing mixed reality technology will provide higher fidelity Soldier evaluations, without the time and cost associated with physical prototypes. The Virtual Prototyping results provide critical inputs to the Army's NGCV program by providing independent technical and operational performance results for the Army's next generation of ground combat vehicles while reducing risk and accelerating transition to physical prototypes.

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

Research in this Project supports the NGCV Army Modernization Priority.

Research in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is coordinated with Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2022	FY 2023	FY 2024
Title: Virtual Prototyping	7.871	9.622	9.910
Description: This effort utilizes virtual prototyping to address technical and integration challenges in the areas of mobility, survivability, lethality, vehicle architecture, and systems integration for the Army's next generation of ground combat vehicles. Specifically, this effort focuses on developing integrated design concepts, performance analysis, identifying and assessing trade space, and conducting virtual operational experiments for the NGCV. The combination of technical performance and operational feedback provides insights that will inform designs and reduce development and testing time.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK2 / <i>Virtual Prototyping Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p><i>FY 2023 Plans:</i> Continue modeling and simulation to virtually design, develop, and assess new NGCV manned and unmanned systems that include projected lethality, mobility, sensing, and protection technologies. Analyze these technologies integrated into multiple tank and Robotic Combat Vehicle (RCV) design approaches using multiple methods that include trade analysis tools that provide tradespace exploration, understanding, and traceability of NGCV requirements. Continue to use knowledge and analyses to provide focus and targets for science and technology investments as well as inform NGCV acquisition planning and requirements development. Virtual Prototyping will also implement a public private partnership with industry to generate and advance tank design concepts to expand the knowledge of enabling technologies, obtain innovative design approaches, and provide additional data analyses for multiple NGCV efforts. Conduct Soldier-in-the-loop virtual experiments and develop System Integration Labs to assess the government and industry concepts for Military Utility, mission performance, Soldier preference, and explore Soldier derived tank TTPs for the new technologies and capabilities.</p> <p><i>FY 2024 Plans:</i> Will continue modeling and simulation to virtually design, develop, and assess new Next Generation Combat Vehicle (NGCV) manned and unmanned systems that include projected lethality, mobility, sensing, protection, and autonomous vehicle technologies. Will integrate technologies into multiple combat vehicle concepts with a focus on Robotic Combat Vehicle (RCV) design approaches that are then analyzed for performance, cost, and traceability of NGCV requirements. Inform S&T and NGCV plans with knowledge and analyses. Will conduct Soldier-in-the-loop virtual experiments and build an initial virtual soldier operational exercise capability including system integration labs with realistic hardware/software interfaces and mixed reality technology to provide higher fidelity Soldier evaluations. Will assess ground vehicle concepts for military utility, mission performance, Soldier preference, and to explore Soldier derived Tactics, Techniques, and Procedures (TTPs).</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>			
Accomplishments/Planned Programs Subtotals	7.871	9.622	9.910

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) BK3 / Next Gen Intelligent Fire Control (NG-IFC) Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BK3: Next Gen Intelligent Fire Control (NG-IFC) Tech	-	0.926	-	-	-	-	-	-	-	-	0.000	0.926

A. Mission Description and Budget Item Justification

This Project will develop armament specific hardware, algorithms and architectures to support Next Generation Combat Vehicle (NGCV) with the necessary fire control on future manned and unmanned platforms.

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

Research in this Project supports the NGCV Army Modernization Priority.

Research in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is related to and fully integrated with the efforts funded in PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Title: Next Generation Intelligent Fire Control Technology	0.926	-	-
Description: This effort investigates image sets for computer vision algorithms, target acquisition validation schemes and experimentation of large caliber armament systems.			
Accomplishments/Planned Programs Subtotals	0.926	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BK5 / <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BK5: <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>	-	8.845	13.526	11.043	-	11.043	11.812	8.582	7.078	7.128	0.000	68.014

A. Mission Description and Budget Item Justification

This Project matures and conducts experiments on component technologies for large caliber direct fire light-weight armament systems that will exceed the current capability of 120mm direct fire and be optimized for future operational environment with cross-domain engagement capability. This Project also researches large caliber direct fire munitions to project overwhelming lethality while ensuring maneuver forces remains mobile and sustainable during close-combat engagements at extended ranges.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Research in this Project supports the Next Generation Combat Vehicle Army Modernization Priority.

Research in this Project is performed by the United States (US) Army Futures Command.

Research in this Project is related to and fully integrated with the efforts funded in PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and PE 0602141A (Lethality Technology).

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

	FY 2022	FY 2023	FY 2024
<p>Title: Advanced Lethality - Kinetic Energy (AL-KE)</p> <p>Description: This effort designs and develops component technologies for large caliber direct fire light-weight armament systems that will exceed the current 120mm direct fire cannon performance for future operational environments, including dense urban, with multi-domain engagement capability. The component technologies that support rapid fire on-the-move (direct & indirect) engagements include: compact ammunition design with advanced ignition, reduced gun impulse on platform through advanced recoil mitigation techniques, fire control and automated ammunition handling and reloading.</p> <p>FY 2023 Plans: Investigate direct fire kinetic energy cartridge technologies and novel kinetic energy lethal mechanisms to defeat future threat(s). Conduct experiments to improve accuracy and decrease engagement time at extended ranges; will mature sensor fusion, real time processing, and penetrator diversion techniques.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This effort completes in FY 2023.</p>	1.390	1.613	-
<p>Title: NGCV Penetrator Technology for Decisive Lethality</p>	2.974	3.340	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK5 / <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort develops energy-efficient lethal mechanism technologies for next-generation warheads and projectiles for large-caliber ammunition launched from direct fire weapon systems that maximize the lethality against an array of targets and provide tactical advantage at extended ranges for next generation threats. The results of this research will provide the basis for the lethality required for the next generation of combat vehicles and enable the development of the next generation of ammunition to ensure lethal overmatch throughout the operational environment.</p> <p>FY 2023 Plans: Investigate improvements in threat armor technology designed to protect against US systems. Investigate attributes of promising penetrator concepts and identify suitable projectile technology to enable decisive lethality. Refine attributes of high energy armaments and explore integration challenges.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, funding for this effort is realigned to the Decisive Lethality effort (within this project).</p>			
<p>Title: Advanced Lethality Armament System- Large Caliber (ALAS-LC)</p> <p>Description: Investigate increased lethality solutions for next generation large caliber direct fire armament systems that will ensure battlefield dominance of US ground forces. Design reduced recoil armament systems capable of increased rate of fire enabled by a compact autoloader with performance that exceeds current state of the art 120mm direct fire cannons for current and future Army platforms.</p> <p>FY 2023 Plans: Design and develop large caliber system and component technologies to increase direct fire lethal overmatch capabilities for current and future combat platforms. Investigate system modeling and simulation techniques for assessing complex armament system component technologies including: fire control, weapon, and munition technologies. Develop concepts to inform Army large caliber lethality.</p> <p>FY 2024 Plans: Will develop modeling and simulation to assess armament system component technologies for future large caliber direct fire systems. Will validate models of large caliber system and component technologies to increase direct fire lethal overmatch. Will design and develop concepts for component hardware and software to reduce recoil and increase rate of fire of next generation large caliber direct fire armament systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	4.481	8.100	4.564

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK5 / <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding change reflects planned lifecycle of this effort as validation of models of component technologies will be completed in FY24 and realigned to PE0603462A BK4 Next Gen Intelligent Fire Control Adv Tech.				
Title: SBIR/STTR Transfer		-	0.473	-
Description: Funding transferred in accordance with Title 15 USC §638				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Title: Decisive Lethality		-	-	6.479
Description: This effort develops energy-efficient lethal mechanism technologies for the next-generation of large-caliber ammunition launched from direct fire weapon systems to maximize the lethality against an array of targets and provide tactical advantage at extended ranges against current and future threats. This includes research and development to produce a compact, high energy density propelling charge, engineered aerodynamics for improved accuracy, a novel kinetic penetrator with next generation lethal mechanism, and the ability to defeat advanced and smart armors.				
FY 2024 Plans: Will investigate robust penetrators for greater lethality; explore the development of compact, high-energy propellant charges for direct fire which provide increased energy as well as advanced ignition technologies; conduct research into accuracy improvements needed for future large-caliber weapon systems; investigate approaches to survive, counter, and defeat smart armor technologies such as active protection system.				
FY 2023 to FY 2024 Increase/Decrease Statement: This is a new effort in FY 2024 with funding realigned from the NGCV Penetrator Technology for Decisive Lethality effort within this project and from PE 0602144A Project CG7 Ground Protection Concepts and Technologies.				
Accomplishments/Planned Programs Subtotals		8.845	13.526	11.043
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK5 / <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BP5 / <i>Ground Vehicle Technology (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BP5: <i>Ground Vehicle Technology (CA)</i>	-	73.800	103.500	-	-	-	-	-	-	-	0.000	177.300

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Ground Vehicle Technology.

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

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

	FY 2022	FY 2023
<i>Congressional Add:</i> Program Increase - Silicon Carbide Electronics	5.500	6.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Silicon Carbide Electronics		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Silicon Carbide Electronics		
<i>Congressional Add:</i> Program Increase - Highly Electrified Vehicles	5.000	3.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Highly Electrified Vehicles		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Highly Electrified Vehicles		
<i>Congressional Add:</i> Program Increase - Prototyping Energy Smart Autonomous Ground Systems	10.000	10.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Prototyping Energy Smart Autonomous Ground Systems		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Prototyping Energy Smart Autonomous Ground Systems		
<i>Congressional Add:</i> Advanced Materials Development for Survivability	5.000	10.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Advanced Materials Development for Survivability		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Materials Development for Survivability		
<i>Congressional Add:</i> Advanced Optics Program	4.300	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Advanced Optics Program		
<i>Congressional Add:</i> Program Increase - Digital Design and Simulated Testing	4.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023	
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BP5 / <i>Ground Vehicle Technology (CA)</i>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Digital Design and Simulated Testing			
FY 2023 Plans: Congressional Interest Item funding provided for Digital Design and Simulated Testing			
Congressional Add: Program Increase - Fast-Refueling Fuel Cell Engines	7.000	7.000	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Fast-Refueling Fuel Cell Engines			
FY 2023 Plans: Congressional Interest Item funding provided for Fast-Refueling Fuel Cell Engines			
Congressional Add: Program Increase - Hydrogen Technologies	10.000	15.000	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Hydrogen Technologies			
FY 2023 Plans: Congressional Interest Item funding provided for Hydrogen Technologies			
Congressional Add: Program Increase - Machine Learning Optimized Power Electronics	3.000	3.000	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics			
FY 2023 Plans: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics			
Congressional Add: Systems Engineering for Autonomous Ground Vehicles	9.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Systems Engineering for Autonomous Ground Vehicles			
Congressional Add: Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms	5.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms			
Congressional Add: Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles	3.000	-	
FY 2022 Accomplishments: Congressional Interest Item funding provided for Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles			
Congressional Add: Program Increase - Zero Emission Combat Vehicles	3.000	3.000	

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BP5 / <i>Ground Vehicle Technology (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)		
	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Zero Emission Combat Vehicles		
FY 2023 Plans: Congressional Interest Item funding provided for Zero Emission Combat Vehicles		
Congressional Add: Program Increase - ADVANCED MANUFACTURING FOR COMBAT LOGISTICS SUPPORT	-	2.000
FY 2023 Plans: Congressional Interest Item funding provided for ADVANCED MANUFACTURING FOR COMBAT LOGISTICS SUPPORT		
Congressional Add: Program Increase - ENTERPRISE AND CROSS-FUNCTIONAL LVC FOR ACCELERATED DEVELOPMENT	-	8.000
FY 2023 Plans: Congressional Interest Item funding provided for ENTERPRISE AND CROSS-FUNCTIONAL LVC FOR ACCELERATED DEVELOPMENT		
Congressional Add: Program Increase - MOBILITY MATERIALS RESEARCH	-	5.000
FY 2023 Plans: Congressional Interest Item funding provided for MOBILITY MATERIALS RESEARCH		
Congressional Add: Program Increase - MODULAR ELECTRIC MOTORS	-	5.500
FY 2023 Plans: Congressional Interest Item funding provided for MODULAR ELECTRIC MOTORS		
Congressional Add: Program Increase - SMALL UNIT TECHNOLOGY ADVANCEMENTS	-	10.000
FY 2023 Plans: Congressional Interest Item funding provided for SMALL UNIT TECHNOLOGY ADVANCEMENTS		
Congressional Add: Program Increase - SOLID OXIDE FUEL CELL DEVELOPMENT	-	5.000
FY 2023 Plans: Congressional Interest Item funding provided for SOLID OXIDE FUEL CELL DEVELOPMENT		
Congressional Add: Program Increase - STRUCTURAL THERMOPLASTICS	-	6.000
FY 2023 Plans: Congressional Interest Item funding provided for STRUCTURAL THERMOPLASTICS		
Congressional Adds Subtotals	73.800	103.500
C. Other Program Funding Summary (\$ in Millions)		
N/A		
Remarks		

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BP5 / <i>Ground Vehicle Technology (CA)</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) CU5 / <i>Platform Agnostic Armaments Applied Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CU5: Platform Agnostic Armaments Applied Technology</i>	-	-	1.031	-	-	-	-	-	-	-	0.000	1.031

Note

In FY 2024 this effort is administratively realigned to PE 0602141 Project N18 Platform Agnostic Armaments Applied Tech

A. Mission Description and Budget Item Justification

This Project investigates technologies that holistically maximize armament performance, minimize target engagement timelines, reduce crew workloads, enhance responsiveness and enable collaborative lethal effectiveness on target across distributed platforms & missions. This project researches cross caliber weapon, munition & fire-control technologies to enhance Remote Weapon Systems (RWS) responsiveness and single or combined platform lethality in Multi-Domain Operations (MDO) environments.

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

Research in this Project supports the Next Generation Combat Vehicle Army Modernization Priority.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Platform Agnostic Armaments Technology	-	0.993	-
Description: This effort designs and develops technologies that enables platform performance by increasing range without degrading accuracy, reducing size, weight, and power and impact to lighter platforms, enhancing weapon, munitions, fire control, and agnostic remote weapon automation tech to reduce the kill chain timeline. This effort enables Army Modernization and Multi-Domain Operations (MDOs) in support of the Army's future and planned vehicles.			
FY 2023 Plans: Investigate critical enabling technologies to increase range, accuracy, and lethal effectiveness for distributed remote armament systems; determine methods to reduce engagement time while decreasing size, weight, and power usage, as well as increasing performance and safety of remote weapon systems.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding is administratively realigned to PE 0602141A Project CIA Applied Armaments Tech for Distributed Lethality.			
Title: SBIR/STTR Transfer	-	0.038	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) CU5 / <i>Platform Agnostic Armaments Applied Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.031	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	161.759	212.115	81.618	-	81.618	83.477	75.474	67.432	70.609	0.000	752.484
AM6: Modular RF Communications Technology	-	-	-	5.986	-	5.986	8.318	-	-	-	0.000	14.304
AM8: Protected SATCOM Technology	-	1.639	-	6.599	-	6.599	11.997	3.652	2.234	-	0.000	26.121
AN3: Non Traditional Waveforms Technology	-	0.474	3.415	14.000	-	14.000	5.487	9.846	7.456	2.026	0.000	42.704
AN7: COE - Every Receiver is a Sensor Technology	-	2.401	2.543	1.044	-	1.044	-	-	2.120	2.143	0.000	10.251
AN9: UNT - Every Receiver is a Sensor Technology	-	1.891	2.074	2.115	-	2.115	2.115	2.118	-	-	0.000	10.313
AO2: Stand-In Advanced RF Effects (STARE)	-	1.899	-	-	-	-	-	-	-	-	0.000	1.899
AO4: Energy Efficient Devices Technology	-	5.501	5.480	5.589	-	5.589	5.645	5.652	5.656	5.717	0.000	39.240
AP5: Electronic Warfare Technology	-	2.821	5.246	5.355	-	5.355	5.389	2.873	2.874	2.906	0.000	27.464
AQ2: EW Techniques Technology	-	0.476	0.532	0.541	-	0.541	3.694	3.699	-	-	0.000	8.942
AQ7: High Tempo Data Driven Decision Tools Technology	-	-	1.289	1.306	-	1.306	2.351	2.354	4.157	7.664	0.000	19.121
AR1: Robust, Resilient and Intelligent C3I Technology	-	10.127	-	-	-	-	-	-	-	-	0.000	10.127
AR3: Intelligent Environmental Battlefield Awareness	-	2.947	-	-	-	-	-	-	-	-	0.000	2.947
AR5: Understanding the Environment as a Threat Technolo	-	1.884	1.314	-	-	-	0.404	3.314	2.149	1.647	0.000	10.712

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army											Date: March 2023	
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					PE 0602146A / Network C3I Technology							
AR7: Sensing in Contested Environments Technology	-	1.149	-	-	-	-	-	-	-	-	0.000	1.149
AR9: Persistent Geophysical Sensing-Infrasound Tech	-	3.290	-	-	-	-	-	-	-	-	0.000	3.290
AT7: Network-Enabled GeoSpatial-GEOINT Services Tech	-	4.466	3.137	2.555	-	2.555	3.537	2.091	-	-	0.000	15.786
AT9: Tactical GeoSpatial Information Capabilities Techn	-	1.711	0.518	2.717	-	2.717	2.065	1.906	2.523	5.550	0.000	16.990
AV3: Foundational S&T for Network C3I Technology	-	4.487	0.743	-	-	-	-	-	-	-	0.000	5.230
AV5: Protective Technologies	-	7.273	6.428	6.553	-	6.553	6.620	6.628	6.632	6.704	0.000	46.838
AV7: Atmospheric Modeling and Meterological Technology	-	5.714	-	-	-	-	-	-	-	-	0.000	5.714
AV9: Advanced PNT for GPS Independent Environments Tech	-	9.747	8.850	9.022	-	9.022	8.796	8.754	8.759	8.854	0.000	62.782
AW1: Autonomous Navigation Technology	-	1.990	2.052	-	-	-	-	-	1.007	4.823	0.000	9.872
AW5: Modular GPS Independent Sensors Technology*	-	-	-	-	-	-	2.064	8.265	7.264	7.917	0.000	25.510
BP2: Sensor and Electronic Network Initiatives (CA)	-	80.300	148.000	-	-	-	-	-	-	-	0.000	228.300
CG3: Assured PNT Communications Applied Research	-	1.709	5.486	5.652	-	5.652	5.858	4.755	4.817	4.869	0.000	33.146
CI3: Mobile and Survivable Command Post (MASCP) Tech	-	6.008	5.728	3.268	-	3.268	0.610	0.611	0.612	0.618	0.000	17.455
CK1: Assured PNT Enabling Technologies	-	1.855	-	-	-	-	-	-	-	-	0.000	1.855
CU6: Adaptive Information Mediation and Analytics	-	-	7.089	7.226	-	7.226	7.273	7.282	7.287	7.366	0.000	43.523

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>											
<i>CV4: Pathfinder 3D Applied Technology</i>	-	-	2.191	2.090	-	2.090	1.254	1.674	1.885	1.805	0.000	10.899

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2024

A. Mission Description and Budget Item Justification

This Program Element (PE) is aligned to the Network and Assured Positioning, Navigation, & Timing (APNT) Army Modernization Priorities. This PE investigates technologies, techniques, components and tools to provide an Army tactical network and enabling infrastructure that support Multi-Domain operations in contested, congested, degraded, and/or denied environments. This is accomplished through the design and development of technologies and components (e.g., electronic components, software and protocols) that provide unified transport and are supportable; mobile, and survivable, and robust mission command on the move; assured and secure positioning, navigation, and timing in all environments; converged and coordinated cyber and electronic warfare activities; resilient communication and intelligence, surveillance, and reconnaissance payloads for tactical space and high-altitude platforms, and the collection, processing, and dissemination of intel/ops information into a common operating environment. Commercial technologies are continuously investigated and leveraged where possible.

Work in this PE complements PE 0602143A (Soldier Lethality Technology), PE 0602145A (Next Generation Combat Vehicle Technology), PE 0602147A (Long Range Precision Fires Technology), PE 0602148A (Future Vertical Lift Technology), PE 0602150A (Air and Missile Defense Technology), PE 0603118A (Soldier Lethality Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0603464A (Long Range Precision Fires Advanced Technology), PE 0603465A (Future Vertical Lift Advanced Technology), PE 0603466A (Air and Missile Defense Advanced Technology), PE 0603463A (Network C3I Advanced Technology).

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

Work in this performed by the United States Army Futures Command, the United States Army Space and Missile Defense Command and the Army Engineer Research and Development Center.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	164.804	64.115	81.095	-	81.095
Current President's Budget	161.759	212.115	81.618	-	81.618
Total Adjustments	-3.045	148.000	0.523	-	0.523
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	148.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-3.045	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.523	-	0.523

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BP2: *Sensor and Electronic Network Initiatives (CA)*

Congressional Add: *Program Increase - Energy Efficient Devices*

Congressional Add: *Program Increase: Urban Subterranean Mapping Technology*

Congressional Add: *Program Increase: Mobile Environmental Contaminant Sensors*

Congressional Add: *ALTNAV*

Congressional Add: *Program Increase - Anti-Tamper Technology*

Congressional Add: *Backpackable COMINT System*

Congressional Add: *Distributed Radio Frequency and Sensor Technology Development*

Congressional Add: *Program Increase EW and Advanced Sensing*

Congressional Add: *Program Increase - Integrated Photonics for Contested RF Environments*

Congressional Add: *Mass-Distributed Acoustic Surveillance Network*

Congressional Add: *Social Network Analysis*

Congressional Add: *Program Increase - BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT*

Congressional Add: *Program Increase - INERTIAL NAVIGATION SYSTEMS*

Congressional Add: *Program Increase - KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY*

Congressional Add: *Program Increase - MAN PORTABLE DOPPLER RADAR*

	FY 2022	FY 2023
	5.000	10.000
	4.000	-
	5.000	-
	13.800	-
	5.000	25.000
	5.000	-
	8.000	-
	6.500	6.500
	15.000	14.000
	8.000	-
	5.000	5.000
	-	5.000
	-	11.500
	-	1.000
	-	10.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2022	FY 2023
Congressional Add: <i>Program Increase - SECURE ELECTRONIC PACKAGING</i>	-	10.000
Congressional Add: <i>Program Increase - SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY</i>	-	5.000
Congressional Add: <i>Program Increase - WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS</i>	-	5.000
Congressional Add: <i>Program Increase - BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS</i>	-	9.000
Congressional Add: <i>Program Increase - ALTERNATIVE POSITION, NAVIGATION, AND TIMING</i>	-	19.000
Congressional Add: <i>Program Increase - MASS-DISTRIBUTED ACOUSTIC SURVEILLANCE NETWORK</i>	-	8.000
Congressional Add: <i>Program Increase - URBAN SUBTERRANEAN MAPPING TECHNOLOGIES</i>	-	4.000
Congressional Add Subtotals for Project: BP2	80.300	148.000
Congressional Add Totals for all Projects	80.300	148.000

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AM6 / Modular RF Communications Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AM6: Modular RF Communications Technology	-	-	-	5.986	-	5.986	8.318	-	-	-	0.000	14.304

Note

Modular RF Communications Technology is a new start within the Network C3I Technology program in FY 2024.

In Fiscal Year (FY) 2024 this Project is a New Start.

A. Mission Description and Budget Item Justification

This Project investigates and develops techniques, methods, and standards for automation and intelligence to optimally broadcast data among available radio frequency (RF) and networking technologies. This Project adds resiliency to the network through diversity and automation techniques to make automated network decisions (e.g., automated Primary, Alternate, Contingency, and Emergency (PACE)) for the tactical Army to maintain operation in continually changing environments.

Work in this Project complements Program Element (PE) 0603463A Network C3I Advanced Technology / Project AM7 (Modular RF Communications Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Predictive Intelligent Network (PIN)	-	-	5.986
Description: The PIN project enhances the Automated PACE plan capability by developing predictive algorithms and using various sources of information to create a resilient and adaptive network configuration that allows continued and secure communications in Anti-Access/Area Denial (A2AD) environments. The PIN predictive algorithms will plan the optimal network topology and configuration by leveraging information on network loads, cyber activities, terrain, weather, movement, and RF situational awareness. In addition, this effort will leverage and disseminate RF sensing electronic support information for use by operational forces, to coordinate and enable continued communications through electronic and navigation warfare effects.			
FY 2024 Plans: Will investigate the use of Artificial Intelligence/ Machine Learning (AI/ML) techniques to proactively respond to negative network anomalies before they occur by monitoring and processing information such as traffic patterns, congestion conditions, routing patterns and routing stability, movement patterns, and RF information from various sensors and detected cyber events; perform			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AM6 / <i>Modular RF Communications Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
a simulation study to inform decisions on applying detected cyber activities to influence the selection of transports or selection of radio modalities to further protect communications in challenging environments; investigate the use of the prediction and automated PACE decision engines to provide resilient communications for aspects of electronic and navigation warfare missions, to include electronic protection, electronic support and electronic attack; investigate the use of the automated PACE capability to facilitate the transmission of electronic support data to planning and management tools; investigate use cases in which the predictive and automated PACE decision engines can enable continued communications through electronic attack and disseminate electronic support information for use by operational forces. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned initiation of this effort.			
Accomplishments/Planned Programs Subtotals	-	-	5.986

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AM8 / Protected SATCOM Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AM8: Protected SATCOM Technology	-	1.639	-	6.599	-	6.599	11.997	3.652	2.234	-	0.000	26.121

A. Mission Description and Budget Item Justification

This Project investigates resiliency of Wideband Satellite Communications (SATCOM) in contested and congested electromagnetic environments. Wideband SATCOM is the primary high-bandwidth Beyond Line of Sight (BLOS) communications used by the tactical Army. This Project designs and develops technologies and components, such as interference cancellation, to increase availability and reliability of Wideband SATCOM in spectrum-challenged environments.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / AM9 (Protected SATCOM Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Protected Satellite Communication Technology</p> <p>Description: This effort designs and develops technologies and components to increase resiliency of Wideband SATCOM in contested and congested electromagnetic environments. This effort develops resiliency through science and technology investigation.</p>	1.639	-	-
<p>Title: Multi-Orbit Modem (MOM)</p> <p>Description: This effort designs and develops Satellite Communications (SATCOM) ground terminal modem and management technology components to enable operation over multiple satellite constellations to increase performance and resiliency of wideband SATCOM in contested and congested electromagnetic environments. Modem components will include a software based terminal controller for modem management, repository of modem waveforms, and supporting network management. This effort develops resiliency through a flexible modem technology investigation and is complementary with Protected SATCOM efforts focused on antenna development.</p> <p>FY 2024 Plans: Will investigate a SATCOM Multi-Orbit-Modem system of systems architecture through modeling and simulations that improves size, weight, and power requirements to access current SATCOM orbit constellations and integrate with SATCOM aperture technologies; validate modem architecture in relevant test events coordinated with stakeholders for initial single beam operations capabilities; investigate Multi-Orbit-Modem system, to determine initial requirements for simultaneous multi-beam capabilities</p>	-	-	6.599

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AM8 / <i>Protected SATCOM Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
both current and emerging SATCOM constellation; validate an integrated modem system to include an integrated virtual software environment with hardware based integrated circuit.			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding increase reflects planned initiation of this effort.			
Accomplishments/Planned Programs Subtotals	1.639	-	6.599

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AN3 / Non Traditional Waveforms Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AN3: Non Traditional Waveforms Technology	-	0.474	3.415	14.000	-	14.000	5.487	9.846	7.456	2.026	0.000	42.704

A. Mission Description and Budget Item Justification

This Project investigates non-traditional protocols and technologies to provide spectrum efficiency, high bandwidth, low latency, lower spectrum footprint, and/or anti-jam capabilities to tactical networks. This Project develops network resiliency for the dismounted and vehicular units through science & technology investigation.

Work in this Project complements Program element (PE) 0603463A (Network C3I Advanced Technology) / Project AN4 (Non Traditional Waveforms Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: 5G Technologies</p> <p>Description: This effort investigates the use of 5G communication services and associated technologies to support high bandwidth, low latency communications for tactical environments with mobile infrastructures.</p> <p>FY 2023 Plans: Design and begin implementation of tactically relevant 5G capabilities in support of expeditionary and highly mobile communications by leveraging the results of the Fiscal Year 2022 (FY22) investigations. Incorporate anti-jam and LPI / LPD and increase network robustness through spectrum diversity and efficiency across dispersed nodes and different terrain types.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects administrative realignment to task Tactical Application of Advanced Comms within this project</p>	0.474	3.290	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.125	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AN3 / <i>Non Traditional Waveforms Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638				
<p>Title: Tactical Application of Advanced Comms</p> <p>Description: This effort investigates the use of commercial communication services and associated technologies to support high bandwidth, low latency communications for tactical environments with mobile infrastructures.</p> <p>FY 2024 Plans: Will investigate tactically relevant advanced communications capabilities for air-to-ground and mature communications components such as antennas and waveforms. Will continue incorporation of anti-jam and LPI / LPD and increase network robustness through spectrum diversity and efficiency across dispersed nodes and different terrain types.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects administrative realignment from task 5G Technologies within this project to continue the maturation of advanced communications components.</p>		-	-	2.946
<p>Title: Spectrum Superstorm</p> <p>Description: This effort investigates the use of obfuscation and technical effects in the radio frequency spectrum using distributed and dispersed techniques to coordinate signal effects against adversaries from distant transmitters.</p> <p>FY 2024 Plans: Will investigate the use of distributed techniques, such as coherent and adaptive beamforming for technical effects. Will develop methods of obfuscating the spectrum while providing awareness and coordination with spectrum activities of blue forces. Will research multiple-input multiple-output (MIMO) algorithms aiming to have single obfuscation nodes appears as many systems on the battlefield.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned initiation of this effort.</p>		-	-	1.857
<p>Title: Relay for Aerial to Non-line-of-sight Ground Environments (RANGE)</p> <p>Description: This effort investigates the use of aerial platforms as communications relays ensuring communications coverage is maintained in non-line-of-sight (NLOS) environments, while considering communications resiliency such as anti-jam and low probability of detection. This effort will mature covert, multiband, and embedded antenna elements using new antenna materials for compact antenna aperture designs.</p> <p>FY 2024 Plans:</p>		-	-	6.580

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AN3 / <i>Non Traditional Waveforms Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will investigate small form factor aerial relay communications payloads capable of enabling both low-band (e.g. L-band (1-2 GHz)/ S-band (2-4 GHz)/C-band (4-8 GHz)) and high-band (e.g. millimeter-wave (30-300 GHz)) operations. Will mature directional communications components and determine applicability of novel waveforms and antennas for aerial relay. Will develop novel software and hardware for tracking and steering directional links. Will design and develop new antenna apertures. Will validate spatial low probability of detection is effective versus the threat using modeling and simulation. Will investigate impact of directional communications on spectrum re-use in congested and contested frequency bands.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned initiation of this effort.</p>				
<p>Title: Quantum Sensing</p> <p>Description: This effort investigates the use of novel quantum-enhanced spectral receivers capable of wideband sensing of extremely low power signals at very large standoff distances. This effort matures quantum component technologies for use in very high receiver sensitivity. This effort designs and develops tactically relevant quantum sensors, considering form-factor, size, weight, power, and receiver performance.</p> <p>FY 2024 Plans: Will investigate Josephson Junction (JJ) and Rydberg receiver quantum sensor technologies via modeling and simulation. Will begin development of classical auxiliary components to support and enable quantum sensors for tactical Army applications. Will validate range of frequencies in which Rydberg sensors can reliably detect signals. Will investigate optimal frequency bands for both Rydberg and JJ quantum receivers. Will investigate methods to continue to improve the sensitivity to detect even weaker signals and expand detection protocols for more complicated waveforms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned initiation of this effort.</p>		-	-	2.617
Accomplishments/Planned Programs Subtotals		0.474	3.415	14.000
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AN7 / COE - Every Receiver is a Sensor Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AN7: COE - Every Receiver is a Sensor Technology	-	2.401	2.543	1.044	-	1.044	-	-	2.120	2.143	0.000	10.251

A. Mission Description and Budget Item Justification

This Project investigates, designs, and codes advanced automated exploitation and fusion analysis tools, applications, and software services that harvest, correlate and fuse tactical receiver sources with new and emerging data sources to improve understanding of the threat picture and more efficiently support near-real time Situational Understanding of the battlefield.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AN8 (COE - Every Receiver is a Sensor Advanced Tech) and PE 0602146A (Network C3I Technology) / Project AN9 (UNT - Every Receiver is a Sensor Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Intelligence Surveillance and Recognizance (ISR) Optimization for MDO Support Technology</p> <p>Description: This effort investigates and designs Intelligence Surveillance and Reconnaissance (ISR) collection management technologies and analytics to enhance performance and optimize use of Army ISR resources during multi-domain operations (MDO). Efforts focus on developing the analytics necessary to increase situational awareness of non-organic collections across all domains (Air, Land, Maritime, Space, Cyber and Electromagnetic spectrum), determine highest payoff use of tactical ISR assets, and optimize sensor selection and placement to answer unit intelligence requirements.</p> <p>FY 2023 Plans: Investigate sensor scheduling optimization to include sensor selection and routing; conduct experiment to support an initial capability to task full spectrum ISR sensor availability to units across the army; investigate how to integrate national and Joint ISR capabilities via advanced sensor frameworks.</p> <p>FY 2024 Plans: Will develop threat forecasting technologies to validate derivation of prioritized collection requirements to optimize application of Army ISR resources during MDO in contested environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	2.401	2.450	1.044

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AN7 / COE - Every Receiver is a Sensor Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding decrease reflects conclusion of preliminary collection optimization technology investigation which began in FY22.			
Title: SBIR/STTR Transfer	-	0.093	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	2.401	2.543	1.044

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AN9 / UNT - Every Receiver is a Sensor Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AN9: UNT - Every Receiver is a Sensor Technology	-	1.891	2.074	2.115	-	2.115	2.115	2.118	-	-	0.000	10.313

A. Mission Description and Budget Item Justification

This Project develops algorithms that enable every communication receiver in the tactical environment to operate as a sensor while maintaining the systems' original networking capability. This Project matures standards and protocols to expand the Cyber-Electromagnetic Activity (CEMA) situational understanding.

Work in this Project complements Program element (PE) 0603463A (Network C3I Advanced Technology) Project AO1 (UNT - Every Receiver is a Sensor Advanced Tech) and PE 0602146A (Network C3I Technology) \ Project AN7 (COE - Every Receiver is a Sensor Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Multi Intelligence Modernization Components and Architecture</p> <p>Description: This effort investigates underlying architectures for dynamic resource management and technology underpinnings for advanced signal processing, exploitation, and novel sensor hardening to better understand our ability to detect, intercept, identify, and geo-locate radiated radio frequency (RF) energy to command our use of the electromagnetic spectrum while denying its use to our adversaries.</p>	1.891	-	-
<p>Title: Multi-Int Modernization Combined Architecture (MIMCA)</p> <p>Description: This effort investigates optimization of radio frequency transmit and receive resources to conduct simultaneous electronic warfare (EW), signals intelligence (SIGINT) and offensive cyber missions.</p> <p>FY 2023 Plans: Investigate and assess existing commercial investments in Simultaneous transmit and receive (STAR) technology for integration into EW/Cyber/SIGINT Army systems.</p> <p>FY 2024 Plans: Will leverage interference mitigation techniques primarily designed for low power systems and investigate their feasibility to support multifunction operations; investigate applications for sensor assets that operate in the same portion of the spectrum.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	1.998	2.115

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AN9 / UNT - Every Receiver is a Sensor Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects planned lifecycle of this effort			
Title: SBIR/STTR Transfer	-	0.076	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	1.891	2.074	2.115

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology			Project (Number/Name) AO2 / Stand-In Advanced RF Effects (STARE)				
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AO2: Stand-In Advanced RF Effects (STARE)	-	1.899	-	-	-	-	-	-	-	-	0.000	1.899

Note
In Fiscal Year (FY) 2023 funding is realigned to Program Element (PE) 0602146A (Network C3I Technology) / Project AP5 (Electronic Warfare Technology).

A. Mission Description and Budget Item Justification

This Project investigates distributed and synchronized electronic warfare (EW) techniques and applications for future distributed Army operations in complex environments, designs algorithms for synchronization, and investigates stable radio frequency transceivers and techniques for information distribution across dynamic channels.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AO3 (Stand-In Advanced RF Effects (STARE) Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

Title: STAND-IN Advanced RF Effects	FY 2022	FY 2023	FY 2024
Description: This effort investigates emerging technologies to enable EW applications in a grey environment. The goal is to develop software and reconfigurable radio frequency (RF) hardware in a low size, weight, and power form factor for distributed EW and communications.	1.899	-	-
Accomplishments/Planned Programs Subtotals	1.899	-	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) AO4 / <i>Energy Efficient Devices Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AO4: <i>Energy Efficient Devices Technology</i>	-	5.501	5.480	5.589	-	5.589	5.645	5.652	5.656	5.717	0.000	39.240

A. Mission Description and Budget Item Justification

This Project addresses sustainment operations by unburdening the Soldier and reducing logistics requirements (e.g., fewer batteries) for communications, computing, and sensing. The objective is to improve the underlying energy efficiency of supply and demand for Soldier-portable and distributed sensor electronics to enable the dismounted Soldier to maintain communications, freedom of movement, and increase mission duration. The majority of the electronics power used by the dismounted Soldier and by distributed electronics is attributable to radio frequency (RF) communications. In addition, freedom of movement and action during sustained and high tempo operations requires seamless battery recharging. To address these challenges, energy efficient electronics research includes RF and optoelectronic circuits, devices, materials and wireless power (and data) transfer.

Work in this Project complements Program Element (PE) 0602146A (Network C3I Technology) / Project AN3 (Non Traditional Waveforms Technology), PE 0602143A (Soldier Lethality Technology) / Project BD8 (Soldier & Sm Unit Tactical Energy Tech), and PE 0601102A (Defense Research Sciences) / Project AA9 (Information and Networking).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Energy Efficient Electronic and Photonic Components	5.501	5.280	5.589
Description: This effort investigates energy efficiency improvements in support of four key areas: RF component devices, optoelectronic devices for alternative communications modes, long-lived and high efficiency power sources, and efficient wireless power and data transfer technologies. These components enable energy-efficient communications and networked energy, specifically leading to increased Soldier mission duration and long-lived networked electronics.			
FY 2023 Plans: Investigate aluminum gallium nitride semiconductors as Ultraviolet (UV) sources for communications; investigate piezoelectric transformer performance with integrated circuit envelope detectors at 100-500 MHz frequencies; determine coupled magnetic acoustic matching for efficient wireless power transfer; investigate novel energy efficient transceiver architectures for radar applications; investigate novel silicon based field programmable neural array circuits for efficient computation close to the network edge.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AO4 / Energy Efficient Devices Technology
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Will investigate approaches to increase efficiency in Ultraviolet (UV) sources for communications; conduct research of 'time folding' radio frequency (RF) circuits for efficient operation of small size, weight and power (SWaP) systems, encompassing techniques for increasing the RF power in short pulses, while utilizing charging from a small battery; investigate power density limitations of textured silicon carbide betavoltaic devices coupled with nickel-63 radioisotope beta emission; design piezoelectric transformer for temperature robustness as well as model and experimentally assess wake-up receiver sensitivity as a function of operation frequency and power draw; continue to investigate novel silicon based field programmable neural array circuit with in-memory computing for efficient computation close to the network edge.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.200	-
Accomplishments/Planned Programs Subtotals	5.501	5.480	5.589

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AP5 / Electronic Warfare Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AP5: <i>Electronic Warfare Technology</i>	-	2.821	5.246	5.355	-	5.355	5.389	2.873	2.874	2.906	0.000	27.464

A. Mission Description and Budget Item Justification

This Project investigates emerging technologies related to Electronic Warfare (EW) applications, non-kinetic survivability/lethality, and emerging concepts of employment in the increasingly contested and congested electromagnetic environment, with the goal of enhancing the survivability/lethality of Army platforms through Electronic Attack (EA), electronic warfare support (ES), and Electronic Protection (EP).

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Electronic Warfare Technology Research	2.206	2.416	2.499
Description: This research investigates emerging Electromagnetic Warfare technologies and novel approaches to apply distributed and combined effects to a broader class of threats, with a goal of adequately degrading threat performance.			
FY 2023 Plans: Validate concepts with multi-channel hardware-in-the-loop (HIL) experiments using low-cost distributed hardware; implement algorithms for spectrum analysis for low SWaP platforms; validate techniques for dynamic RF emitter characterization; design experiments and validate complex and cognitive radar threats with research HIL environment; implement distributed and complex scenario generation tools with research HIL environment.			
FY 2024 Plans: Will investigate cognitive countermeasures to emerging complex and cognitive radar threats whereby reducing reliance on human operators and a priori information; validate effects in multi-channel Hardware-in-the-Loop (HIL) environment thus increasing scenario complexity to enable distributed electronic warfare applications while incorporating a high-level of operational realism; validate indoor HIL simulated results in a relevant outdoor test environment.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.			
Title: Electronic Warfare Assessment Technologies	0.615	0.675	0.686

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AP5 / <i>Electronic Warfare Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
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<p>Description: This research investigates emerging technologies related to EW applications (e.g., digital RF memory, software defined radios, cognitive radars) and electromagnetic-enabled cyberspace operations in the increasingly contested and congested environment. Research is focused on near-peer and future threats to enhance survivability/lethality, and discover critical vulnerabilities, of Army technologies and systems through cyber and electromagnetic activities (CEMA).</p> <p>FY 2023 Plans: Initiate development of distributed EA within hardware-in-the-loop capability to analyze distributed EA operation and measures of effectiveness; investigate and develop EW capabilities for assessment and analysis of advanced electromagnetic attack; initiate measures of effectiveness for advanced EW analytical capabilities in network and horizontal integrated technologies and systems that assess defensive and cognitive EW in controlled environments; use AFC sponsored events such NetModX and PC to execute developed EA techniques and identify candidates for distributed EA operation.</p> <p>FY 2024 Plans: Will develop EW techniques and processes for use as cognitive countermeasures for emerging complex and cognitive radar threats; conduct laboratory, HIL, and field experimentation for assessment of developing technology; mature techniques for low-cost emitting targets and countermeasure assets.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
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<p>Title: Combined and Distributed Electromagnetic Warfare (CDEW)</p> <p>Description: This research investigates emerging Electromagnetic Warfare technologies and novel approaches to apply distributed and combined effects to a broader class of threats, with a goal of adequately degrading threat performance.</p> <p>FY 2023 Plans: Investigate, develop and assess stable transceiver architecture designs suitable for high carrier frequency and large signal bandwidth with optimal component technologies; validate techniques for scalable synchronization and multi-aperture beamforming from RF transceivers agnostic of use case; research methods for rapid technique generation and design reconfigurable transceiver hardware to enable a widely-applicable architecture; validate modeling and simulation framework with hardware experiments for scalability and synchronization for large-scale effects.</p> <p>FY 2024 Plans: Will investigate, develop, and assess EW techniques requiring the use of distributed apertures; investigate combined and distributed techniques against emerging multi-static emitters; refine and assess a 2-node synchronization technique that includes</p>	-	2.139	2.170
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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AP5 / <i>Electronic Warfare Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
feedback electronics to correct node phase in real-time; assess multi-aperture beam-forming performance for improved pointing-angle for electronic support and electronic attack. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.016	-
Accomplishments/Planned Programs Subtotals	2.821	5.246	5.355

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AQ2 / EW Techniques Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AQ2: EW Techniques Technology	-	0.476	0.532	0.541	-	0.541	3.694	3.699	-	-	0.000	8.942

A. Mission Description and Budget Item Justification

This Project develops countermeasures against adversarial counter-fire systems that obscure and create distractive blue force locations.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Simultaneous Counter Measures (CM) for Active Reconnaissance and Surveillance (SCARS)</p> <p>Description: This effort will provide investments in Electronic Warfare (EW), against advancing counter-fire sensors. This effort will investigate highly synchronized techniques to achieve advanced effects.</p> <p>FY 2023 Plans: Validate electronic decoy techniques using advanced signal apertures via modeling and simulation. Research techniques and waveforms for counter radar applications.</p> <p>FY 2024 Plans: Will validate reduced efficacy of adversary counterfire systems to target friendly forces via modeling and simulation; overlay counter ISR and counterfire applications to assess the impact decoy techniques have on adversarial targeting capabilities.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of project.</p>	0.476	0.513	0.541
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.019	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AQ2 / <i>EW Techniques Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	0.476	0.532	0.541

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AQ7 / High Tempo Data Driven Decision Tools Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AQ7: High Tempo Data Driven Decision Tools Technology</i>	-	-	1.289	1.306	-	1.306	2.351	2.354	4.157	7.664	0.000	19.121

A. Mission Description and Budget Item Justification

This Project investigates and develops data driven decision tools that increase operational tempo and allow commanders to dominate decision spaces over adversaries. The tools will provide the commander with contextually relevant data and adaptive decision models. Information and recommendations will be made and disseminated to commander and staff in a cognitively appropriate manner.

Work in this Project complements Program Element (PE) 0603463A Network C3I Advanced Technology / Project AQ8 (High Tempo Data Driven Decision Tools Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: RoadRunner</p> <p>Description: This effort investigates and develops stakeholder prioritized capabilities that fuse intel and ops perspectives that drive decisions to enable dominance in complex Multi-Domain Operations.</p> <p>FY 2023 Plans: Conduct basic software development help Commanders and staff manage time constraints and cognitive limitations in the synchronization of Warfighting functions to maintain dominance in evolving and compressed / complex decision spaces. Research and develop digital battle damage assessments and after action reports to automatically update proposed force structures and operations. Investigate the use of battlespace data and intelligence information to adjust running estimates, in order to continually analyze the changing battlespace and drive friendly Observe, Orient, Decide, and Act (OODA) loops that outpace the enemy.</p> <p>FY 2024 Plans: Will develop fused intel and ops software assisting Commanders and staff by managing time constraints and cognitive limitations to synchronize warfighter functions; validate battle damage assessments and after action reports automatically with proposed force structures and operations; conduct experiments with live and simulated battlespace data and intelligence information, adjusting running estimates by analyzing the changing battlespace OODA loops.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	1.242	1.306

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AQ7 / <i>High Tempo Data Driven Decision Tools Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.047	-
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.289	1.306

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AR1 / Robust, Resilient and Intelligent C3I Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AR1: Robust, Resilient and Intelligent C3I Technology	-	10.127	-	-	-	-	-	-	-	-	0.000	10.127

A. Mission Description and Budget Item Justification

This Project develops and characterizes machine learning and artificial intelligence methods for processing, analysis and provisioning control of smart, distributed, networked sensors and devices. It provides situational understanding and decision support to enable fast, adaptive and interoperable Command, Control, Communications and intelligence (C3I) network-integrated applications, resilient to adversarial activity in contested and complex environments. Effective use of distributed networked sensors, autonomous agents and automated decision support tools is critical to address threats posed by peer competitors and more capable asymmetric forces, particularly in complex environments where traditional sensors provide an incomplete understanding of the tactical situation due to adversarial activity, occluded sightlines and small fields of regard.

Work in this Project complements Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) / Project BF8 (Artificial Intelligence & Machine Learning Tech), PE 0603463A (Network C3I Advanced Technology) / Project AQ5 (Sensor CE - Integrated Sensor Architecture Adv Tech) and Project AN8 (COE - Every Receiver is a Sensor), and PE 0602146A (Network C3I Technology) / Project AN7 (COE- Every Receiver is a Sensor Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Intelligent Signal and Image Analytics for C3I</p> <p>Description: This effort designs and characterizes technologies for multi-modal (Electro-Optical/Infra-Red (EO/IR) imaging, acoustic, seismic, infrasound, electric and magnetic (E/H) field, and passive radio frequency (RF), low-cost networked sensors to enhance persistent sensing capabilities for increased probability of target localization, tracking, classification, and reduced false alarms. These combined sensors have unique capabilities that enable passive discrimination from deception and decoys, detection of electrical equipment operation, underground facilities, vehicles, weapons launch, gunfire, and explosions. The work includes development of learning algorithms to improve situational understanding.</p>	3.132	-	-
<p>Title: Smart Networks and Distributed Sensing for C3I</p> <p>Description: This effort will develop and assess a concept to link physical sensors and information sources to Soldiers and small units. Specifically, the research focuses on (1) multi-modal sensor fusion for detection and classification of human activities and infrastructures such as personnel, vehicles, machinery, RF emissions, chemicals, and computers in hidden and confined</p>	5.067	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AR1 / <i>Robust, Resilient and Intelligent C3I Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
spaces, (2) interoperability and networking of disparate sensors and information sources, (3) distributed information for decision-making, and (4) approaches for fusing results of processed outputs of multi-modal sensors, such as visible, infrared (IR), and hyperspectral imagers, and acoustic, magnetic, and electric field sensors.			
Title: Information Processing and Analysis Description: This effort investigates techniques that integrate local and external information sources and applies machine learning and artificial reasoning approaches to support automated intelligence analysis, command/control, and decision-making. The goal is to enable tactical users to cooperatively interact with relevant and timely tactical information supported by methods that are network-aware/adaptive and deliver transparent and uniform transport.	1.928	-	-
Accomplishments/Planned Programs Subtotals	10.127	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AR3 / Intelligent Environmental Battlefield Awareness			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AR3: <i>Intelligent Environmental Battlefield Awareness</i>	-	2.947	-	-	-	-	-	-	-	-	0.000	2.947

A. Mission Description and Budget Item Justification

This Project investigates, develops, and designs technologies to allow Soldiers to maneuver faster in dynamic environments as informed by physical, geological, and biological constraints. This Project enhances visualization tools for mission planning through delivery of web modules/software tools which contain crucial geo-chemical resources and advanced knowledge of geo-environmental infrastructure for mission planners.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AR4 (Intelligent Env Battlefield Awareness Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Arctic Threat	0.824	-	-
Description: This effort delivers a geospatial decision aid to United States Army units conducting expeditionary operations to anticipate threats, hazards and dependencies posed by terrain and weather extremes in cold regions.			
Title: Predictive Geographic Information System (GIS) Mapping (physical)	0.731	-	-
Description: This effort develops a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions outside the continental U.S. (OCONUS) dark sites from the statistical analysis of known datasets and the application of geophysical principles.			
Title: Hydrology Mapping	1.392	-	-
Description: This effort provides data tools and models to support high-fidelity battlefield overlay maps that accurately show hydrologic/soil moisture threats (soil, hydrology, and snow/ice) not captured by current terrain mapping capabilities.			
Accomplishments/Planned Programs Subtotals	2.947	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AR3 / Intelligent Environmental Battlefield Awareness

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

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AR5 / Understanding the Environment as a Threat Technolo
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AR5: <i>Understanding the Environment as a Threat Technolo</i>	-	1.884	1.314	-	-	-	0.404	3.314	2.149	1.647	0.000	10.712

A. Mission Description and Budget Item Justification

This Project designs and advances mission planning software enabling the Soldier to identify, track, and plan for industrial or commercial chemical/environmental threats. Software modules will increase capability of mission based planning technologies providing new operational routing options for mission execution with environmental threat overlays.

Work in this Project complements Program element (PE) 0603463A (Network C3I Advanced Technology) / Project AR6 (Understanding the Environment as a Threat Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Subsurface Forensics</p> <p>Description: This effort will prepare Soldiers for the risks of deliberate or accidental release of toxic industrial chemicals and materials by investigating and developing methods to collect data to characterize and predict the fate and transport of hazards of concern.</p> <p>FY 2023 Plans: Develop techniques to achieve ultra-low detection levels of explosive constituents and non-weaponized radiological hazards for reverse-point sourcing threats.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort as applied research products are transferred to PE 0603463A Project AR6.</p>	1.812	1.297	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans:</p>	0.072	0.017	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AR5 / <i>Understanding the Environment as a Threat Technolo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638				
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i>				
Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		1.884	1.314	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AR7 / Sensing in Contested Environments Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AR7: Sensing in Contested Environments Technology</i>	-	1.149	-	-	-	-	-	-	-	-	0.000	1.149

A. Mission Description and Budget Item Justification

This Project characterizes through direct or inferential methods the identification of non-weaponized biological hazards posed to Soldiers in operational environments by advancing sensor technologies and software modules that will detect and characterize hazards including water quality, heavy metals in soils, breath-ability, and non-weaponized radiological hazards within confined environments. This Project supports the Common Operating Environment program.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AR8 (Sensing in Contested Environments Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Non-Traditional Threat Detection in Contested Environment	1.106	-	-
Description: This effort identifies, examines and prioritizes commercial of the shelf (COTS) capabilities from multiple sources that can accurately detect biological hazards relevant to operations in subterranean environments from point of ingress/egress to evaluate exposure potential and affects.			
Title: SBIR/STTR Transfer	0.043	-	-
Description: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	1.149	-	-

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

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AR9 / Persistent Geophysical Sensing-Infrasound Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AR9: Persistent Geophysical Sensing-Infrasound Tech	-	3.290	-	-	-	-	-	-	-	-	0.000	3.290

A. Mission Description and Budget Item Justification

This Project designs and develops algorithms, software, and hardware components to enable near-real-time battlespace awareness to persistently monitor (through non-line-of-sight sensing including infrasound) critical infrastructure conditions and threat activities in dynamic battlefields. These technologies provide near real time data collection, processing, and alerts of infrastructure go/no-go condition required for maneuver planning. This Project also designs and develops methodologies to assign maneuver relevant engineering attributes to geospatial feature data such as bridge load classification, road condition, and bathymetry.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AS9 (Persistent Geophysical Sensing-Infrasound Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	3.166	-	-
Description: This effort develops a suite of geophysical and geo-sensing technologies to persistently assess battlefield elements to include infrastructure and additional sources of interest such as explosive and fires events and various air platforms; refines terrain, topography, and meteorological models related to acoustic propagation detected by the employed sensor suite as well as detection and classification signal processing algorithms for a broader range of sources and/or threats.			
Title: SBIR/STTR Transfer	0.124	-	-
Description: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	3.290	-	-

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

N/A

Remarks

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AR9 / <i>Persistent Geophysical Sensing-Infrasound Tech</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AT7 / Network-Enabled GeoSpatial-GEOINT Services Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AT7: Network-Enabled GeoSpatial-GEOINT Services Tech</i>	-	4.466	3.137	2.555	-	2.555	3.537	2.091	-	-	0.000	15.786

A. Mission Description and Budget Item Justification

This Project investigates and develops an integrated capability to rapidly share mission critical 3-dimensional (3D) information that supports planning and execution at the Soldier level. This will be achieved through the maturation of next-generation geospatial analytical models for 3D complex urban environment data, delivering enriched understanding of dynamic Operational Environments and distributed to a tactical Common Operating Environment. This Project will result in improved situational awareness and autonomy at low echelons, contributing to increased maneuver and mobility during manned and unmanned teaming operations.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial and GEOINT Services AdvTech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Geo-registration, Analytical Tool Development and Visualization</p> <p>Description: This effort investigates the design and formulation of new urban terrain data models, frameworks and processes to automate the geo-registration of 3D and 2-dimensional (2D) source data (e.g. light detection and ranging (LiDAR), imagery, Open Street Maps, and full motion video derived data) to new model constructs for rapid alerting to changes in the Operational Environment of interest.</p>	2.238	-	-
<p>Title: Geospatial Data for Tactical Visualization</p> <p>Description: This effort develops new open source software, data models and processes to generate a vision-based geospatial foundation layer to enable end-users systems to visualize real-time mission critical geospatial content at the required level-of-detail (LOD) and enable position-navigation self-localization capability applicable to end-user devices at required accuracies optimized for the device, application, and mission.</p> <p>FY 2023 Plans:</p>	2.228	1.057	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AT7 / Network-Enabled GeoSpatial-GEOINT Services Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Develop the geospatial extraction and protocols to allow position-navigation self-localization capability on end-user systems. Advance development of computer visual navigation, fusion, error modeling and dissemination tools for rigorous position, orientation and navigation that would support targeting and maneuver.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This applied research effort completes in Fiscal Year 2023 as technologies are transferred to PE 0603463A Network C3I Advanced Technology, Project AT8 Network-Enabled GeoSpatial-GEOINT Services AdvTech.</p>				
<p>Title: Geospatial - Intelligence Community Merge Research</p> <p>Description: This effort researches different approaches to automatically search Intelligence Community databases to discover and then extract relevant attributes to be added as new metadata to adaptively scaled 3D terrain features and/or geographic areas. Geospatial and relevant intelligence data will be merged together, discoverable, and capable of user-selected query from a single computing environment. An enhanced 3D common operating picture will be developed.</p> <p>FY 2023 Plans: Investigate automated approaches for designation of geospatial search terms followed by discovery and extraction from intelligence community (IC) data bases; will design a revised schema for geospatial data stored within the 3D data repository Program of Record (POR)-- GRiD-- to enable IC attributes to be adaptively appended as new metadata with view options from individual 3D terrain features scalable to regional and larger geographic areas.</p> <p>FY 2024 Plans: Will develop an automated approach for connectivity and integration of enriched specific geospatial products and selected Intelligence community (IC) databases/schemas for the purpose of developing and refining situational understanding of a triggered or selected situation.?Will investigate automated approaches for designation of intelligence search terms that will spawn discovery, or automated processing, of geospatial/GeoINT products that improve situational understanding.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned milestones and deliverables for enriched 3D terrain by additional attribution and features.</p>		-	1.062	1.675
<p>Title: Geospatially Relevant Intuitive Propagation Services Technology</p> <p>Description: This effort researches a novel expert propagation model to integrate battlefield sensor data with environmental predictive modeling (weather and terrain influences). The resulting technology will optimize collection asset employment against adversaries as well as providing situational awareness of friendly units' multi-modal signature footprint (e.g. radio frequency, thermal, acoustic) and will reduce analyst cognitive load.</p> <p>FY 2023 Plans:</p>		-	1.018	0.880

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AT7 / <i>Network-Enabled GeoSpatial-GEOINT Services Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Investigate workflows within common operating environment to enable automated extraction of physical and operational parameters used in sensor performance analyses. <i>FY 2024 Plans:</i> Will design realistic use cases within the Common Operating Environment to evaluate and gather relevant data and submit sensor performance analysis requests to optimize collection assets. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding decrease reflects completion of workflows.			
Accomplishments/Planned Programs Subtotals	4.466	3.137	2.555

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AT9 / Tactical GeoSpatial Information Capabilities Techn			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AT9: Tactical GeoSpatial Information Capabilities Techn	-	1.711	0.518	2.717	-	2.717	2.065	1.906	2.523	5.550	0.000	16.990

A. Mission Description and Budget Item Justification

This Project investigates and develops next generation geospatial analytical tools for 3-dimensional complex environments for low echelon and tactical edge exploitation. Research focuses on improving geospatial and Geospatial Intelligence (GEOINT) aspects of situational awareness at the tactical edge in the complex environment by exploiting new data sources, automating analytical tasks, and testing new collection technologies, including interiors of infrastructure. Research develops capabilities to enhance/update provisioned (baseline) standard, sharable, geospatial foundation (SSGF) data through automated analytics on multi-sourced spatial data resulting in streamlined, enhanced high fidelity terrain analysis products. Reducing data gaps and processing timelines will greatly increase Soldier situational awareness and support faster decision making in complex terrain.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: 3D Terrain Analysis	1.646	-	-
Description: This effort investigates and develops software models and workflows provisioned on the geospatial and GEOINT workstations for improved capabilities to generate, process and exploit terrain products enabling situational awareness and rapid decision making at the tactical edge.			
Title: Geospatial Analytics and Prediction Technology	-	0.499	2.717
Description: This effort designs and develops automated/semi-automated geospatial tools implementing spatial/temporal data analysis, creation of predictive scenarios, anomaly detection and cross-scale and local scale analysis of terrain.			
FY 2023 Plans: Investigate optimized workflows for 3-Dimensional data from collection through product generation for building interiors and subterranean spaces.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AT9 / <i>Tactical GeoSpatial Information Capabilities Techn</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Will develop a high resolution 3-Dimensional workflow from building interiors and subterranean spaces. Will investigate temporal nature of landscape and anomaly detection and cross-scale analysis of terrain.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned milestones for development of cloud based automated/semi-automated geospatial tools.				
Title: SBIR/STTR Transfer				
Description: Funding transferred in accordance with Title 15 USC §638		0.065	0.019	-
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		1.711	0.518	2.717
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AV3 / Foundational S&T for Network C3I Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AV3: Foundational S&T for Network C3I Technology	-	4.487	0.743	-	-	-	-	-	-	-	0.000	5.230

Note

In Fiscal Year (FY) 2024 this Project is Terminated.

A. Mission Description and Budget Item Justification

This Project develops underlying technologies applicable to artificial intelligent agents and holistic network integration as applied to, but not limited to autonomous manned-unmanned teaming for ground and air platforms. This Project also matures emerging research leading to potential technology development in areas of strategic importance to the Army in network technologies, by bringing competitively selected Universities with research teams into Technical Alliances.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

Research in this project is done in coordination with PE 0603463A (Network C3I Advanced Technology) / Project AV4 (Foundational S&T for Network C3I Advanced Tech).

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

	FY 2022	FY 2023	FY 2024
<p>Title: Development of Disruptive, Innovative Research for Emerging (DIRE) Applied Network Capabilities</p> <p>Description: This effort develops innovative network capabilities using a rapid and agile methodology to examine feasibility of incorporation into Army network problem sets.</p> <p>FY 2023 Plans: Completing innovative technology pilot for discovering and developing innovative and disruptive network capabilities in the space of network resiliency, artificial intelligence, and autonomy.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease to support Army high priority effort for agile acceleration of Directed Energy in the Air and Missile Defense Advanced Technology (0603466A) Project CV6.</p>	4.487	0.716	-
<p>Title: SBIR/STTR</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p>	-	0.027	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AV3 / Foundational S&T for Network C3I Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	4.487	0.743	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AV5 / Protective Technologies			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AV5: Protective Technologies	-	7.273	6.428	6.553	-	6.553	6.620	6.628	6.632	6.704	0.000	46.838

A. Mission Description and Budget Item Justification

This Project develops Anti-Tamper tools, devices, and techniques to protect acquisition program systems and Critical Program Information (CPI) from evolving adversarial threats.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Protective Technologies</p> <p>Description: This effort develops tools, devices, and techniques to protect acquisition program systems and (CPI) from adversarial threats.</p> <p>FY 2023 Plans: Develop advanced packaging microelectronics security solutions for anti-tamper application through continued rigor development and analysis. Investigate and evaluate new protective technologies for integration in Army and DoD systems to protect critical technology with improved resilience to exploitation.</p> <p>FY 2024 Plans: Will continue to explore the latest exploitation threats faced by DoD and Army weapons systems and focus design and development efforts toward new protective technologies to be made available to Army and DoD weapons system programs and their developers in meeting their Ant-Tamper requirements.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort programmed in coordination with the DoD Executive Agent for Anti-Tamper.</p>	7.273	6.236	6.553
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.192	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AV5 / <i>Protective Technologies</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	7.273	6.428	6.553

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AV7 / Atmospheric Modeling and Meteorological Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AV7: Atmospheric Modeling and Meteorological Technology</i>	-	5.714	-	-	-	-	-	-	-	-	0.000	5.714

A. Mission Description and Budget Item Justification

This Project develops tactical atmospheric sensing, modeling, and decision support technologies. New atmospheric sensing technologies are developed that enable near-real-time, high-resolution measurements of atmospheric parameters via light-weight systems that can be employed in tactical domains. Efforts include high-resolution local assessments and forecasts of meteorological conditions that can accommodate the effects of dense urban and complex, mountainous terrain. Both physics-based and rule-based decision support systems are developed for assessing the impacts of weather/atmosphere across a spectrum of friendly and threat weapons systems, sensors, platforms, and operations. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. Information can be applied to mission planning and execution, battlefield visualization, reconnaissance, surveillance, and target acquisition, route planning to maximize stealth and efficiency, web-enabled tactical decision aids, long-range precision fires, and modeling of environmental impacts for combat simulations and war games.

This work provides technologies for evaluation by and/or transitions to the Department of Defense weather and operations community including: Program Executive Office (PEO) Ammunition-PM Combat Ammunition Systems (CAS) and Marine Corps Systems Command (MCSC) for meteorological message input to field artillery targeting systems, Project Manager, Distributed Common Ground System-Army (DCGS-A), the United States Air Force 557th Weather Wing, and the Air Force Life Cycle Management Center (AFLCMC) to improve their operational weather support to the Army.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Atmospheric Characterization, Modeling, and Impacts	5.714	-	-
Description: This effort develops environmental situational understanding enabled through coupled sensing, modeling, and decision support technologies for data-sparse, computationally-limited, and network-constrained domains.			
Accomplishments/Planned Programs Subtotals	5.714	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AV7 / <i>Atmospheric Modeling and Meteorological Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AV9 / Advanced PNT for GPS Independent Environments Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AV9: Advanced PNT for GPS Independent Environments Tech	-	9.747	8.850	9.022	-	9.022	8.796	8.754	8.759	8.854	0.000	62.782

A. Mission Description and Budget Item Justification

This Project develops technologies that will enable precise and assured Positioning, Navigation, and Timing (PNT) in Global Positioning System (GPS)-denied environments by addressing the PNT's toughest Scenario - Scenario 4 (no available GPS signal during the mission duration) with a goal of enabling Soldier missions of up to seven days in a GPS denied environment. This is achieved by researching advanced quantum timing circuits, advanced inertial measurement unit (IMU) components, multi-sensor modalities, perception techniques, geo-location data, vision aided navigation sensors, and available radio frequency (RF) signals.

This work also addresses the PNT Scenario 1 (GPS operations that start well and have degraded GPS signals throughout the mission duration) through Scenario 3 (GPS operations that have bad or limited availability of GPS signals throughout the entire mission). This is achieved by investigating the ability to transmit jam-resistant, precision timing synchronized signals using optical fibers, free-space using lasers, and in the RF domain using innovative RF antenna concepts to extend the reach of Soldier compatible capabilities in heavily contested GPS environments.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Modular GPS Independent Sensors Advanced Tech) and Program Element (PE) 0602146A (Network C3I Technology) / Project AW5 (Modular GPS Independent Sensors Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Precision Measurement Technology for Contested Environments	2.968	3.260	3.309
Description: This effort will develop technologies that will enable precise and assured PNT in GPS-denied environments for up to 1 hour. This research will improve the accuracy while also focusing on size, weight, power, cost (SWAP-C) of current IMUs through the design, fabrication, and assessment of novel micro-electromechanical system (MEMS) sensor designs and materials and the integration of multiple sensor modalities with the IMUs using sensor fusion and perception techniques to reduce drift and increase positional accuracy. Research will also include the ability to transmit jam-resistant precision position, navigation, and timing signals via electro-optical and/or RF transmission methods.			
FY 2023 Plans:			
Develop chip embodiment of the self-stabilization circuitry for frequency stabilization of linked micro-resonator optical frequency combs; mature and optimize novel MEMS inertial sensors using advanced MEMS materials and micro-structures to develop path			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AV9 / <i>Advanced PNT for GPS Independent Environments Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>to low-cost, navigation-grade MEMS IMU accuracy and improved drift correction techniques tested over temperature; continue to validate performance of chip-scale, low-noise stabilized frequency sources and integrated frequency combs for low SWAP-C clocks; validate and optimize algorithms to process RF signals of opportunity and multi-sensor/multi-waveband vision-based geolocalization.</p> <p>FY 2024 Plans: Will fabricate, characterize, and optimize micro-electromechanical systems (MEMS) gyroscopes and accelerometers with novel self-calibration techniques; apply inertial measurement unit (IMU) system-level modeling techniques to determine expected performance improvements due to novel materials and calibration techniques; validate inertial sensor performance improvements with integrated control electronics; design, fabricate, and characterize performance of resonators and inertial sensors leveraging novel piezoelectric materials.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>			
<p>Title: Quantum Effects for Assured PNT in Zero-GPS Environments</p> <p>Description: This effort will conduct research on SWAP-C quantum based timing sub-systems, incorporating advanced sensors, RF signals (beyond GPS), navigation databases, and advanced algorithms. This effort incorporates advanced quantum timing circuits, advanced IMU components, multi-sensor modalities, perception techniques, geolocation data, vision aided navigation sensors, and available RF signals in order to increase precise and assured PNT operations in a GPS denied environments for up to seven days.</p> <p>FY 2023 Plans: Assess rackmount atomic clock under relevant environments and optimize design for ruggedization and clock manufacturing considerations; assess and optimize gyro and accelerometer performance with novel self-calibration techniques; validate hybrid, modular multi-sensor fusion engine with continuous Inertial Navigation System (INS) calibration capable of interfacing with the Department of Defense PNT Open Architecture standards; develop and optimize novel algorithms and architecture for sensor fusion state estimation.</p> <p>FY 2024 Plans: Will validate and integrate novel PNT sensors with hybrid, modular multi-sensor fusion engine; develop and optimize novel algorithms and architecture for sensor fusion state estimation; continue to develop self-stabilization circuitry for frequency stabilization of micro-resonator optical frequency combs; design and develop integration techniques for micro-resonator optical</p>	6.779	5.569	5.713

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AV9 / Advanced PNT for GPS Independent Environments Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
frequency combs, injection-locked laser, and self-stabilization circuit that enable low-SWAP chip-scale optical clocks/oscillators; develop low SWAP-C optical transmit/receive unit for free-space optical positioning and time transfer. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.021	-
Accomplishments/Planned Programs Subtotals	9.747	8.850	9.022

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AW1 / Autonomous Navigation Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AW1: Autonomous Navigation Technology	-	1.990	2.052	-	-	-	-	-	1.007	4.823	0.000	9.872

A. Mission Description and Budget Item Justification

This Project investigates use of sensors on the platform and available navigation signals to the localization and decision making of Robotic/Autonomous Systems. Additionally, it examines the use of machine learning algorithms for cooperative navigation to aid in a Positioning, Navigation and Timing (PNT) solution. This will enable the user to achieve operational overmatch in a Global Positioning System (GPS) impeded environment as well as enhanced navigation (reducing dependence on GPS) through challenging terrains. This project investigates and develops techniques and algorithms to provide assured access to PNT in degraded electromagnetic (jamming), space, or cyber environments and notify Soldiers, Systems, and Platforms when PNT cannot be trusted for mission duration

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AV8 (Navigation Warfare (NAVWAR) Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Intelligent Electronic Protect (IEP)</p> <p>Description: This effort provides assured access to PNT in degraded electromagnetic (jamming), space, or cyber environments; notifies Soldiers, Systems, and Platforms when PNT cannot be trusted for mission duration; provides Soldiers, Systems, and Platforms a reduction in the likelihood of being spoofed for mission duration; provides unhindered access to military GPS level of accuracy when access to military GPS is unavailable; and facilitates graceful degradation of PNT systems when military GPS is denied or degraded.</p> <p>FY 2023 Plans: Continue to mature techniques to detect and identify RF signals. Conduct lab based experiments to validate the maturity and feasibility of algorithmic approach in GPS challenged environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle conclusion of this effort.</p>	1.990	1.977	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p>	-	0.075	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AW1 / <i>Autonomous Navigation Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	1.990	2.052	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) BP2 / Sensor and Electronic Network Initiatives (CA)			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BP2: Sensor and Electronic Network Initiatives (CA)	-	80.300	148.000	-	-	-	-	-	-	-	0.000	228.300

Note
Congressional Interest Item funding provided for Sensor and Electronic Network Initiatives.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Sensor and Electronic Network Initiatives.

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

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

	FY 2022	FY 2023
Congressional Add: Program Increase - Energy Efficient Devices	5.000	10.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Energy Efficient Devices		
FY 2023 Plans: Congressional Interest Item funding provided for Energy Efficient Devices		
Congressional Add: Program Increase: Urban Subterranean Mapping Technology	4.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Urban Subterranean Mapping Technologies		
Congressional Add: Program Increase: Mobile Environmental Contaminant Sensors	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Mobile Environmental Contaminant Sensors		
Congressional Add: ALTNAV	13.800	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for ALTNAV		
Congressional Add: Program Increase - Anti-Tamper Technology	5.000	25.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Anti-Tamper Technology		
FY 2023 Plans: Congressional Interest Item funding provided for Anti-Tamper Technology		
Congressional Add: Backpackable COMINT System	5.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) BP2 / Sensor and Electronic Network Initiatives (CA)
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Backpackable COMINT System		
Congressional Add: Distributed Radio Frequency and Sensor Technology Development	8.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Distributed Radio Frequency and Sensor Technology Development		
Congressional Add: Program Increase EW and Advanced Sensing	6.500	6.500
FY 2022 Accomplishments: Congressional Interest Item funding provided for EW and Advanced Sensing		
FY 2023 Plans: Congressional Interest Item funding provided for EW and Advanced Sensing		
Congressional Add: Program Increase - Integrated Photonics for Contested RF Environments	15.000	14.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Integrated Photonics for Contested RF Environments		
FY 2023 Plans: Congressional Interest Item funding provided for Integrated Photonics for Contested RF Environments		
Congressional Add: Mass-Distributed Acoustic Surveillance Network	8.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Mass-Distributed Acoustic Surveillance Network		
Congressional Add: Social Network Analysis	5.000	5.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Social Network Analysis		
FY 2023 Plans: Congressional Interest Item funding provided for Social Network Analysis		
Congressional Add: Program Increase - BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT	-	5.000
FY 2023 Plans: Congressional Interest Item funding provided for BEYOND-LINE-OF-SIGHT NETWORKING ENHANCEMENT		
Congressional Add: Program Increase - INERTIAL NAVIGATION SYSTEMS	-	11.500
FY 2023 Plans: Congressional Interest Item funding provided for Inertial Navigation System		
Congressional Add: Program Increase - KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY	-	1.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) BP2 / Sensor and Electronic Network Initiatives (CA)
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for KU-BAND PHASED-ARRAY RADAR EMPLOYING 5G TECHNOLOGY		
<i>Congressional Add:</i> Program Increase - MAN PORTABLE DOPPLER RADAR	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for MAN PORTABLE DOPPLER RADAR		
<i>Congressional Add:</i> Program Increase - SECURE ELECTRONIC PACKAGING	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for SECURE ELECTRONIC PACKAGING		
<i>Congressional Add:</i> Program Increase - SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for SPECTRUM SHARING AND MANAGEMENT WITH ADAPTIVE AND RECONFIRURABLE TECHNOLOGY		
<i>Congressional Add:</i> Program Increase - WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for WAVEFORM DIVERSITY EXPERIMENTAL RESEARCH FOR SENSORS		
<i>Congressional Add:</i> Program Increase - BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS	-	9.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for BIOLOGICAL SENSORS FOR REMOTE ENVIRONMENTS		
<i>Congressional Add:</i> Program Increase - ALTERNATIVE POSITION, NAVIGATION, AND TIMING	-	19.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Alternative Position, Navigation, and Timing		
<i>Congressional Add:</i> Program Increase - MASS-DISTRIBUTED ACOUSTIC SURVEILLANCE NETWORK	-	8.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Mass-Distributed Acoustic Surveillance Network		
<i>Congressional Add:</i> Program Increase - URBAN SUBTERRANEAN MAPPING TECHNOLOGIES	-	4.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Urban Subterranean Mapping Technologies		
Congressional Adds Subtotals	80.300	148.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) BP2 / Sensor and Electronic Network Initiatives (CA)

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) CG3 / Assured PNT Communications Applied Research			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CG3: Assured PNT Communications Applied Research	-	1.709	5.486	5.652	-	5.652	5.858	4.755	4.817	4.869	0.000	33.146

A. Mission Description and Budget Item Justification

Tactical Land Component Forces require access to Space and High Altitude (HA) capabilities to enable force projection and maneuver during Multi-Domain Operations (MDO). The capability need is documented in the Abbreviated Capability Description Document (A-CDD) for Middle Tier Acquisition for Army Tactical Space Layer which was validated on 17 April 2021 and in the Combatant Command Integrated Priority Lists under the following Gap Identification numbers: 2021-SPACE COMMAND-11 (SPACECOM) for Positioning Navigation and Timing (PNT) Resilience; 2021-SPACECOM-12 for Persistent Intelligence and Reconnaissance (ISR) for Mobile Counter Space System Defeat; and 2021 NORTHERN COMMAND-22 for PNT. Space and HA payloads provide persistent/deep sensing to increase the number of actionable targets, decrease target discovery time, extend the range of Army sensing capabilities, improve commander's situational understanding of the Electromagnetic Spectrum and enable lethal and non-lethal fires, and increase/accelerate improved MDO data to assist Commander's decision making process.

Project designs and develops technologies for Space-Based and HA applications to support Army tactical ground forces. Focus is on advanced technology development in support of Army objectives for Joint Operating Environment 2035. Investigations conducted leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Efforts include, but not limited to, research to mature current technologies in quantum sciences based communications, sensing, and data teleportation for small spacecraft and high altitude applications.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

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

Work in this Project is performed by the United States Army Space and Missile Defense Command.

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

	FY 2022	FY 2023	FY 2024
Title: Assured PNT Communications Applied Research	1.709	5.333	5.652
Description: This effort will design, develop, and validate Space and High Altitude technologies, components, and tools that lead to smaller, lighter, more responsive payloads and applications. These technologies will allow for the rapid integration and development of tactical payloads in support of responsive Space or High Altitude environments.			
FY 2023 Plans:			
Expand capability development across multiple channel domains starting with fiber connectivity, followed by open transmission in a configuration supporting nonmoving platforms, and then to a configuration to track, lock, and maintain connectivity in open			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CG3 / Assured PNT Communications Applied Research

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
transmission supporting moving platforms (ground, air, and space vehicles). Extend quantum science technologies to warfighter needs such as opportunities in ground launched systems. FY 2024 Plans: Will develop High Altitude (HA) testbed environment. Will continue classified capability development. Will validate Quantum Entanglement (QE) in the lab. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.153	-
Accomplishments/Planned Programs Subtotals	1.709	5.486	5.652

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CI3 / Mobile and Survivable Command Post (MASCP) Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CI3: Mobile and Survivable Command Post (MASCP) Tech	-	6.008	5.728	3.268	-	3.268	0.610	0.611	0.612	0.618	0.000	17.455

A. Mission Description and Budget Item Justification

This Project develops and investigates emerging communications, tactical cloud, distributed computing, power management and storage, and shielding materials necessary to improve Command Post (CP) survivability and effectiveness for near-peer Multi-Domain Operations (MDO) engagements.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

The cited work is consistent with the Under 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 United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: CP Modularity and Dispersion Technology</p> <p>Description: Funds research to enable CP's to reconfigure and reconstitute at speeds consistent with a near-peer MDO engagement. Investigates emerging low probability of interception (LPI)/low probability of detection (LPD) radio technologies, distributed computing, tactical data and security architectures, and distributed collaboration methods. Initiates analysis to develop mobile, and integrated power systems that enable CP's to disperse geographically and create extended at-the-halt and on-the-move command and control.</p> <p>FY 2023 Plans: Research concepts refined from gap and threat analysis of peer competitors; investigate technology solutions applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution); conduct analysis and begin development of component level technologies to increase resiliency of Command Post specific communications systems.</p> <p>FY 2024 Plans: Will mature technology solutions applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution); design and develop dispersed Command Post node communications with</p>	3.994	2.554	2.657

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CI3 / Mobile and Survivable Command Post (MASCP) Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
resilient (e.g. anti-jam, low probability of detection (LPD)) and redundant (e.g. spectrum agile, multiple transport path) capabilities; investigate directional antennas and components for each command post node for spatial LPD and improved frequency reuse. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort				
Title: Signature Management and Reduction Technology Description: Investigates and develops electromagnetic spectrum (EMS) management tools to model CP signatures and optimize the employment of CP nodes and communication assets. FY 2023 Plans: Continue validation of the software model for visualizing CP emissions to incorporate automatic recognition and learning of CP radio frequency signatures. FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned conclusion of this effort and transition to PE 0603463 / Project CI7 (Mobile & Survivable Command Post (MASCP) Adv Tech)		1.341	2.409	-
Title: Technology Supporting Camouflage, Concealment, and Deception Description: This effort matures innovative camouflage, concealment and deception technologies for expeditionary high-value assets to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats, and to reduce the probability of detection in multi-domain operations. Matures physics-based models for material and system performance that support probability of detection metrics in the multi-domain operational environment, assisting in closing the capability gap between current camouflage, concealment and deception technologies and defeating enemy sensorial capabilities in future operating environments. FY 2023 Plans: Validate natural fiber camouflage material performance based on analysis of alternatives; perform trade space analysis for concealment properties from ISR threats; conduct experiments to validate concealment properties for command post survivability; perform capability assessments of command post structure and enclosure mobility. FY 2024 Plans: Will validate the performance of biomimetic camouflage materials or other solutions (Fibers, Coatings, and Pigments) based on analysis of alternatives; perform trade space analysis for concealment properties from ISR threats; conduct investigations to validate concealment properties for command post survivability. FY 2023 to FY 2024 Increase/Decrease Statement:		0.673	0.577	0.611

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) C13 / Mobile and Survivable Command Post (MASCP) Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.188	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	6.008	5.728	3.268

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) CK1 / Assured PNT Enabling Technologies			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CK1: Assured PNT Enabling Technologies	-	1.855	-	-	-	-	-	-	-	-	0.000	1.855

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CZ6 (Assured PNT Enabling Applied Technology).

A. Mission Description and Budget Item Justification

Tactical Land Component Forces require access to Space and High Altitude capabilities to enable force projection and maneuver during Multi-Domain Operations. Space and High Altitude sensors provide resilient communications, Assured Positioning Navigation and Timing (APNT) and deep sensing capabilities required in the targeting process to enable rapid and responsive sensor-to-shooter applications to engage and defeat Anti-Access/Area Denial (A2/AD) forces.

This Project investigates and matures technologies for Space-Based and High Altitude (HA) applications for Army tactical ground forces. Efforts include the development of sensors and electronic components for communications, signal and information processing, target acquisition, position/ navigation, and threat warning within Space and High Altitude environments. Investigations leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Efforts include research to mature current technologies in quantum sciences based communications, sensing, and data teleportation for small spacecraft applications.

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

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

Work in this Project is performed by the United States Army Space and Missile Defense Command in Huntsville, AL.

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

	FY 2022	FY 2023	FY 2024
Title: Assured PNT Enabling Technologies	1.784	-	-
Description: This effort supports validation of hardware and software components and models to further anchor laboratory capabilities enabling Space/HA sensor or Deep Sensing capabilities, payload design and development.			
Title: SBIR/STTR Transfer	0.071	-	-
Description: Funding transferred in accordance with Title 15 USC 638.			
Accomplishments/Planned Programs Subtotals	1.855	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CK1 / Assurred PNT Enabling Technologies
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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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) CU6 / <i>Adaptive Information Mediation and Analytics</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU6: <i>Adaptive Information Mediation and Analytics</i>	-	-	7.089	7.226	-	7.226	7.273	7.282	7.287	7.366	0.000	43.523

A. Mission Description and Budget Item Justification

This Project develops techniques to accelerate decision-making at lower echelons where data, information systems (IS), and Soldiers are distributed across complex and hostile environments. With robust multi-modal distributed information analytics and adaptive information mediation, decision makers can share understanding across echelons through a cross-reality information interaction. Research focuses on operational issues and gaps concerning decision uncertainty, at-the-edge situational awareness/understanding, and secure low-Size, Weight, and Power (SWAP) IS that support converged capabilities. These capabilities are critical in overcoming limitations in traditional uni-modal machine learning architectures that depend on extensive training data and stove-piped Command and Control systems that cannot provide a shared, adaptive common operating picture across echelons.

Work in this Project complements Program Element (PE) 0603462 (Next Generation Combat Vehicle Advanced Technology) / Project BF4 (Combat Vehicle Robotics Adv Tech) and Program Element (PE) 0603463 (Network C3I Advanced Technology) / Project AQ8 (High Tempo Data Driven Decision Tools Adv Tech).

The cited work is consistent with the Under 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 United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Adaptive Cross Reality Information Mediation	-	2.038	2.146
Description: This effort investigates and develops techniques that intelligently integrate local and external data sources across different interaction modalities to enable enhanced situational awareness, shared understanding between echelons, augmented information representations, and accelerated decision-making. It provides techniques that support at-the-edge situational awareness and accelerate decision-making among distributed humans and agents. Specifically, the research focuses on improving decentralized, yet collaborative decision-making agents through intelligent mediation and delivery of tactical information to dynamic immersive, augmented, and conventional displays that are adaptive to the user and context.			
FY 2023 Plans: Examine methods for intelligent information mediation and adaptive information representation that explore information selection and filtering approaches such as policy-based Value-of-Information/Quality-of-Information (VoI/QoI); investigate the utilization of ubiquitous Internet of Things (IoT) (smart) sensors to augment situational awareness and understanding and hence, increase effectiveness of military operations; investigate methods for resilient information network and processing which integrate			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) CU6 / <i>Adaptive Information Mediation and Analytics</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>heterogeneous IoT sensors, autonomous systems, and Command and Control (C2) systems and platforms, perform analytics, and deliver critical information with value-based selection, prioritization, and dissemination of information reliably over constrained tactical networks; explore methods for improving an immersive Common Operating Picture (COP) by designing cross reality technology to support synthetic data.</p> <p>FY 2024 Plans: Will explore a framework for prioritized data management, filtering, processing, and dissemination; investigate knowledge-based strategies and methods for quantifying the value of information to provide the right information to the right people at the right time; develop a framework for seamless integration with program of records and heterogeneous Internet of Things (IoT) smart sensors to enable a Common Operating Picture (COP) and Situational Awareness (SA) via information representation and visualization in an immersive environment; explore cross-echelon and cross-reality information exchange in secure and controlled Joint Action Partner and Multi Domain Operation (MDO) environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>				
<p>Title: Multi-Domain Information Analytics (MDIA)</p> <p>Description: This effort develops Artificial Intelligence/Machine Learning (AI/ML) approaches for providing Situational Awareness (SA) across echelons that are robust to compromised, corrupted, or limited data and networks in contested and unpredictable battlespace environments. These approaches will provide increased probability of discernment of true vs. false targets, and incorporate uncertainty-aware neuro-symbolic AI/ML to calibrate confidence in algorithm predictions. Research will incorporate multimodal analysis with multi-view scene understanding from heterogeneous sensor systems for context-aware inference, utilize transfer learning techniques to bridge domain gap between real and synthetic data for improved machine learning, and employ Size, Weight and Power-Time (SWaP-T) constrained processing at the edge on emerging low power secure compute architectures through neural network pruning and compression. Simulations of Command and Control (C2) strategies will incorporate the MDIA approaches.</p> <p>FY 2023 Plans: Develop aided target recognition (AiTR) algorithms for real-time detection and recognition of military vehicles and dismount target sets on small unmanned aerial vehicles (UAVs); develop synthetic data generation approaches to generate inherently labeled synthetic electro-optical infrared (EO/IR) data of vehicles and dismounts to substantially augment the limited availability of real training data; validate the AiTR algorithms using collected field data; investigate algorithm-architecture co-optimization frameworks with Field Programmable Gate Arrays (FPGAs) to increase neural network inference speed through optimal algorithm mapping to hardware; explore how machine learning algorithms implemented on size, weight, power and cost (SWaP-C) constrained devices can overcome uncertainty and limited network connectivity for battlefield sensors and Assured Position Navigation and Time (A-</p>		-	4.792	5.080

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) CU6 / <i>Adaptive Information Mediation and Analytics</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>PNT) uses; research and develop event-triggered consensus-based distributed learning methods that are robust to adversarial manipulation for machine learning models meeting constraints of low SWaP computing devices; research techniques to develop and characterize synthetic data sets that include novel synthetic objects and backgrounds; experiment with larger and more varied synthetic augmentations to traditional training data sets; identify and correlate effects of synthetic training data augmentation to trained object classifier performance; develop methodologies to enhance classification performance against uncommon targets with synthetic training data augmentation; develop methods for incorporating synthetic scenes, real scenes, and SA in AI-driven multi-echelon C2 simulations.</p> <p>FY 2024 Plans: Will develop enhanced aided target recognition (AiTR) and scene understanding algorithms for both ground based (manned and unmanned ground vehicles) and unmanned aerial vehicles (UAVs) applications; mature synthetic data generation techniques for simulation of militarily-relevant targets and environments, and optimize algorithm training through hybrid datasets of real and synthetic target data for both electro-optical/visible and infrared spectral bands; explore artificial intelligence (AI) for command and control approaches, integrating real-time in situ cursor on target information for course of action generation by an artificial commander; conduct holistic experiments of developed AiTR models and decision aid/command and control software at large scale Army field experimentation events to validate the efficacy of approaches and inform further technology development and maturation; develop uncertainty-aware evidential reasoning methods for processing over light weight SWaP computing devices and assess their robustness due to limited training data and adversarial manipulations; develop neuro-symbolic complex event processing algorithms for recognition of complex events.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.259	-
Accomplishments/Planned Programs Subtotals	-	7.089	7.226

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

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) CU6 / <i>Adaptive Information Mediation and Analytics</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) CV4 / <i>Pathfinder 3D Applied Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CV4: <i>Pathfinder 3D Applied Technology</i>	-	-	2.191	2.090	-	2.090	1.254	1.674	1.885	1.805	0.000	10.899

A. Mission Description and Budget Item Justification

This Project investigates and develops a geospatial rapid position and navigation solution in Global Positioning System (GPS) degraded and denied environments. Research focuses on using onboard sensors and high-resolution digital terrain geospatial alternative solution based upon Visual Three-Dimensional (3-D) Terrain Referencing and Navigation (VTRAN). This Project will result in the linkage of air and ground assets integrating sensory and (One World Terrain and Reference) geospatial data within the modular GPS Independent Sensors architecture. This Project provides critical alternatives to maneuver forces for position and navigation in a multi-domain operational environment.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project DB6 (PATHFINDER 3D Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: PATHFINDER 3-D Navigation Technology	-	2.111	2.090
Description: This effort will design and develop enhanced feature classification for improved position navigation performance and will improve 3-D data extraction techniques to reduce computation.			
FY 2023 Plans: Advance development in testing integrated foundation geospatial intelligence (GEOINT), sensory sources (from both air and ground) to derive state estimation for a semi-autonomous robotic system; investigate routing capabilities, sensors and a basic inertial accuracy for VTRAN Geospatial solutions.			
FY 2024 Plans: Will develop algorithms and methods to generate position/orientation from geospatially-based Visual Terrain Reference and Navigation and onboard sensors in the absence of GPS as an assured position navigation technology.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.080	-
Description: Funding transferred in accordance with Title 15 USC §638			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) CV4 / <i>Pathfinder 3D Applied Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	2.191	2.090

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	107.454	128.529	34.683	-	34.683	30.525	38.190	46.582	47.127	0.000	433.090
AE7: Land-Based Anti-Ship Missile (LBASM) Technology	-	13.540	-	-	-	-	-	-	-	-	0.000	13.540
AF1: Long Range Maneuverable Fires (LRMF) Technology	-	20.865	2.595	-	-	-	-	-	-	-	0.000	23.460
AF3: Extended Range Propulsion Technology	-	9.526	8.834	11.201	-	11.201	-	4.162	14.403	14.560	0.000	62.686
AF8: Affordable Extended Range Precision Technology	-	8.367	9.609	9.929	-	9.929	9.133	9.151	9.169	9.274	0.000	64.632
AG4: Extended Range Artillery Munition Suite Technology	-	10.744	6.434	1.310	-	1.310	9.341	12.968	11.303	11.459	0.000	63.559
AG6: Energetic Materials and Advanced Processing Techno	-	3.341	3.664	-	-	-	-	-	-	-	0.000	7.005
AH4: Precision and Coop Weapons in a Denied Env Tech	-	9.083	9.163	8.950	-	8.950	9.241	9.096	8.892	8.988	0.000	63.413
BN5: Fuze and Power for Munitions	-	2.488	2.730	3.293	-	3.293	2.810	2.813	2.815	2.846	0.000	19.795
BO9: WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)	-	29.500	85.500	-	-	-	-	-	-	-	0.000	115.000

A. Mission Description and Budget Item Justification

This Program Element (PE) is directly aligned to the Army Long Range Precision Fires (LRPF) Modernization Priority. Work in this PE investigates and develops LRPF technologies to destroy, neutralize, or suppress the enemy by cannon artillery and missile fire and enable integration of fire support assets into combined arms operations. Major Focus Areas for LRPF Science and Technology include: Missiles, Cannon Artillery, and Supporting LRPF Technologies covering Strategic, Operational and Tactical Fires Lines of Effort. LRPF Missiles Applied Research investigates and develops a broad range of Missile technologies to enhance Army integrated LRPF capabilities at extended range. Cannon Artillery Applied Research investigates and develops critical technologies to increase range, precision, and both point and area effects for cannon artillery. Supporting LRPF Technologies Applied Research investigates and develops a broad range of component technologies to address weapon cost drivers and enhance performance of future LRPF munitions and systems.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602147A / <i>Long Range Precision Fires Technology</i>
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Research in this PE complements PE 0603464A (Long Range Precision Fires Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research is performed by the United States Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	93.785	43.029	39.089	-	39.089
Current President's Budget	107.454	128.529	34.683	-	34.683
Total Adjustments	13.669	85.500	-4.406	-	-4.406
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	85.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	13.669	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-4.406	-	-4.406

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BO9: *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)*

Congressional Add: *Program Increase - Extended Range Hybrid and Precision Gun Launched Projectiles*

Congressional Add: *Program Increase - Novel Printed Armament Components*

Congressional Add: *Extended Range Propulsion Technology*

Congressional Add: *High Speed Structures for Advanced Materials*

Congressional Add: *Program Increase - ADVANCED GRAPHITIC FOAM FOR LONG-RANGE PRECISION FIRES*

Congressional Add: *Program Increase - ALUMINUM LITHIUM ALLOY SOLID ROCKET ADVANCEMENT*

Congressional Add: *Program Increase - EXTENDED RANGE AND HYBRID GUN LAUNCHED UNMANNED AERIAL SYSTEMS*

Congressional Add: *Program Increase - HIGH SPEED MISSILE MATERIALS*

Congressional Add: *Program Increase - HIGH TEMPERATURE SUPER ALLOYS*

Congressional Add: *Program Increase - LOW COST MISSILE TECHNOLOGY DEVELOPMENT*

Congressional Add: *Program Increase - REACTIVE MATERIALS*

	FY 2022	FY 2023
	10.000	-
	3.000	-
	6.500	-
	10.000	-
	-	15.000
	-	15.000
	-	15.000
	-	10.000
	-	5.000
	-	10.000
	-	10.500

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602147A / <i>Long Range Precision Fires Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

Congressional Add: *Program Increase - THERMODYNAMIC LATENT PROPULSION*

Congressional Add Subtotals for Project: BO9

Congressional Add Totals for all Projects

	FY 2022	FY 2023
	-	5.000
	29.500	85.500
	29.500	85.500

Change Summary Explanation

Funding decrease result of efforts transitioning from Budget Activity 2.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology				Project (Number/Name) AE7 / Land-Based Anti-Ship Missile (LBASM) Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AE7: Land-Based Anti-Ship Missile (LBASM) Technology	-	13.540	-	-	-	-	-	-	-	-	0.000	13.540

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by investigating and developing critical technologies to detect, engage, and defeat moving land or maritime surface targets under all conditions, and developing technologies for Precision Strike Missile (PrSM) modular payloads for the delivery of dedicated Army intelligence, surveillance and reconnaissance (ISR) payloads and attack capabilities via long range missiles.

Research in this Project complements Program Element (PE) 0603464A (Long Range Precision Fires Advanced Technology) / AE8 (Land Based Anti-Ship Missile (LBASM) Advanced Tech).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Precision Strike Missile Modular Payload Technology	13.540	-	-
Description: Investigate and develop critical technologies for the delivery of dedicated Army ISR payloads and attack capabilities via long range missiles. Technology examples include: ISR sensor and associated signal processing technologies for target acquisition, identification, and engagement; datalink and communications technologies to transmit targetable data; compact propulsion technologies to enable loiter time on station; and payload dispensing technologies for deploying these payloads from high speed long range missiles.			
Accomplishments/Planned Programs Subtotals	13.540	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AF1 / Long Range Maneuverable Fires (LRMF) Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AF1: Long Range Maneuverable Fires (LRMF) Technology	-	20.865	2.595	-	-	-	-	-	-	-	0.000	23.460

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by developing next generation Multi-Domain Operations extended range weapon system technology for Precision Strike Missile to increase survivability, penetration, and range in anti-access/area-denial (A2/AD) and denied environments.

Research in this Project complements Program Element (PE) 0603464A (Long Range Precision Fires Advanced Technology) / AF2 (Long Range Maneuverable Fires (LRMF) Advanced Tech).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Long Range Maneuverable Fires (LRMF) Technology	20.865	2.595	-
Description: Investigates and develops critical technologies for next generation Multi-Domain Operations extended range weapon system technology for Precision Strike Missile to increase survivability, penetration, and range in complex A2/AD and denied environments.			
FY 2023 Plans: Design and develop critical combined cycle propulsion technologies for integration into the Precision Strike Missile (PrSM) and assess autonomy technologies for unmanned launcher operation.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding realigned to PE 0603464A (Long Range Precision Fires Advanced Technology) / AF2 (Long Range Maneuverable Fires (LRMF) Advanced Tech).			
Accomplishments/Planned Programs Subtotals	20.865	2.595	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / <i>Long Range Precision Fires Technology</i>	Project (Number/Name) AF1 / <i>Long Range Maneuverable Fires (LRMF) Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology				Project (Number/Name) AF3 / Extended Range Propulsion Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AF3: Extended Range Propulsion Technology	-	9.526	8.834	11.201	-	11.201	-	4.162	14.403	14.560	0.000	62.686

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by designing, fabricating, and investigating missile enabling propulsion technologies to enable range extension and/or block speed improvement for long range applications; and enables improvement in High Performance Propellants (HPP) via gains in energy density and burn rate control.

Research in this Project complements Program Element (PE) 0603464A (Long Range Precision Fires Advanced Technology) / Project AF2 (Long Range Maneuverable Fires (LRMF) Advanced Tech).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Extended Range Propulsion Technology	9.526	8.667	11.201
Description: Designs, fabricates, and investigates missile enabling propulsion technologies to enable significant range extension and/or block speed improvement for long range applications and enables improvement in HPP via gains in energy density and burn rate control.			
FY 2023 Plans: Complete flight weight combined cycle air-breathing propulsion subsystem design and begin fabrication and integration for follow-on experiments and assessments. Expand and validate a propulsion modeling toolkit that allows rapid motor development; continue developing new mixing techniques to produce higher performance propellants; determine optimized parameters for advanced, high energy propellants that will improve long range performance capability.			
FY 2024 Plans: Will conduct a flight weight air-breathing propulsion system experiment to validate and advance the component design; conduct a static test to determine capability of new mixing techniques to produce higher performance and minimized smoke propellants; determine feasibility and applicability of air-breathing pressure-gain combustion technology; continue to conduct experiments			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AF3 / Extended Range Propulsion Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
to establish understanding of solid thermodynamic latent propulsion technology for potential to enable throttling of solid rocket propellants, enhancing system capabilities and survivability. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned additional experiments to advance technology readiness level of air-breathing motor technology.				
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.167	-
Accomplishments/Planned Programs Subtotals		9.526	8.834	11.201
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AF8 / Affordable Extended Range Precision Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AF8: Affordable Extended Range Precision Technology	-	8.367	9.609	9.929	-	9.929	9.133	9.151	9.169	9.274	0.000	64.632

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires (LRPF) Modernization Priority capabilities by investigating the design and fabrication of components and subsystems critical to produce affordable extended range precision missiles as well as critical component technologies including: advanced propulsion, seekers/sensors, fire control, datalink, guidance, navigation and controls, airframes, and additional high payoff areas.

Research in this Project complements Program element (PE) 0603464A (Long Range Precision Fires Advanced Technology) / AE8 (Land-Based Anti-Ship Missile (LBASM) Advanced Tech); PE 0602147A (Long Range Precision Fires Technology) / AF1 (Long Range Maneuverable Fires (LRMF) Technology) and PE 0603464A (Long Range Precision Fires Advanced Technology) / AF2 (Long Range Maneuverable Fires (LRMF) Advanced Tech)

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: LRPF High Payoff Missile Technology	8.367	9.385	9.929
Description: Identify and explore potential breakthrough technologies to mitigate or eliminate warfighter gaps in Long Range Precision Fires to gain overmatch against potential peer and near-peer adversaries.			
FY 2023 Plans: Develop and conduct assessments of improved target state estimation techniques for strategic hypersonic missiles to enhance endgame performance; verify analysis tools that provide insight into high temperature structural composites; compare alternative navigation technology and guidance options to allow operation in GPS denied environments; integrate and verify improved navigation components for higher inertial accuracy for long range fires; finalize compact thermal management solutions to optimize board level sensor-on-a-chip operation for integrated application; investigate active enhanced image stabilization for improved sensor accuracy in high vibration environments.			
FY 2024 Plans: Will complete assessments and validation of improved target state estimation techniques for strategic hypersonic missiles to enhance endgame performance; conduct experiments to validate analysis tools for high temperature structural composites; investigate reachback datalinks to support employment of on-board missile sensors for deep fires targeting; research missile			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AF8 / Affordable Extended Range Precision Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
battery size, weight, power, and cost upgrades over existing off the shelf components; develop alternative navigation technology and guidance algorithms to allow operation in GPS denied environments. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects lifecycle plan for this effort.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.224	-
Accomplishments/Planned Programs Subtotals	8.367	9.609	9.929

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology				Project (Number/Name) AG4 / Extended Range Artillery Munition Suite Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AG4: <i>Extended Range Artillery Munition Suite Technology</i>	-	10.744	6.434	1.310	-	1.310	9.341	12.968	11.303	11.459	0.000	63.559

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by investigating critical enabling component technologies and designing high precision terminal guidance in denied environments, capable of surviving high gun shock loads, at extended ranges, and automated cannon artillery technologies to increase operational tempo and unburden the soldier.

Research in this Project complements Program Element (PE) 0603464A Long Range Precision Fires Advanced Technology / AG5 (Extended Range Artillery Munition Suite Adv Tech).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Precision At Range Technologies	3.087	-	-
Description: Investigates technologies that provide affordable precision capabilities for projectiles fired into Global Positioning System (GPS) denied environments.			
Title: Extended Range Artillery Munition Suite Enabling Technologies	1.935	2.133	-
Description: This effort develops, matures and integrates a gun hardened suite of components (software, sensors, navigation and communications) to enable the application of distributed, cooperative and collaborative tactics for munitions and Radio Frequency (RF) seeking components.			
FY 2023 Plans: Validate component technologies for extended range artillery projectiles using refined guidance and navigation system design concepts; mature component level technologies to validate size, weight, and power allocations required for future munition systems; validate solutions to enable in-flight, intra-munition communications, enhancing performance against targets in highly cluttered environments.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AG4 / Extended Range Artillery Munition Suite Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Efforts in support of 6.2 activities are complete in FY23.				
Title: Optionally Manned Artillery Platform Technology		2.786	-	-
Description: This effort designs and develops cannon artillery automation technologies including automated fuze/fuze setting technologies, automated prognostics/diagnostics, automated and rapid rearm technologies, and automated ammunition inventory to increase operational tempo of current and future cannon artillery systems to unburden the soldier				
Title: Large Caliber Cannon Technologies		2.936	3.198	-
Description: This effort will advance the current state of the art in cannon and barrel technology for compatibility with higher velocity and precision munitions, harder rotating bands, high temperature operation, robustness against non-firing loads, and minimized weight and imbalance. This effort will investigate cannon concepts focused on residual stress & dynamic strain reduction, coating metallurgy, and barrel cooling to increase tube life and performance in high demand environments.				
FY 2023 Plans: Continue to investigate and develop technologies to improve the life and performance of large caliber cannons. Conduct experiments on novel materials using modeling and simulation to include: impacts on dynamic strain; residual stress through tri-axial stress/strain measurements of cannon tubes; novel refractory coating technologies; and barrel cooling techniques to reduce temperature at high rates of fire. Modeling and experiments will be conducted to mature component technologies for future armament systems.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding reflects planned life cycle for this effort as all the modeling and experiments on the component technologies will be completed in FY23.				
Title: Precision Munitions Technology		-	1.103	1.310
Description: This effort develops technology enablers which are critical to increasing precision and effectiveness for large caliber armaments at extended ranges in extreme launch and flight environments. These technology enhancements are required for sustaining and increasing mission capabilities in degraded and contested environments.				
FY 2023 Plans: Design munition precision technology enablers including: RF converged seeker technologies, gun hardened inertial navigation systems, and on-board targeting algorithms. Investigate small form factor gun hardened systems to evaluate performance against				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AG4 / Extended Range Artillery Munition Suite Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
aerial and ground targets. Validate modeling and simulation results of Integrated Aerial Defense System (IADS) penetration by precision artillery munitions. FY 2024 Plans: Will develop munition technology enablers which will increase precision and effectiveness for large caliber armaments at extended ranges. These technologies will include: RF converged and multimodal seeker technologies, gun hardened inertial navigation systems, on-board targeting algorithms, and munition self-protection capabilities. Will design small form factor gun hardened components to investigate the performance against aerial and ground targets. Will validate prior modeling and simulation results of Integrated Aerial Defense Systems penetration of precision artillery munitions. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	10.744	6.434	1.310

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology				Project (Number/Name) AG6 / Energetic Materials and Advanced Processing Techno			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AG6: Energetic Materials and Advanced Processing Techno	-	3.341	3.664	-	-	-	-	-	-	-	0.000	7.005

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by investigating critical component technology of propellants and energetic materials to increase the range of artillery and mortar rocket assisted projectiles.

Research in this Project complements (Program Element) PE 0602141A (Lethality Technology) / AH9 (Advanced Warheads Technology) and PE 0603464A (Long Range Precision Fires Advanced Technology) / AG5 (Extended Range Artillery Munition Suite Adv Tech).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Scale-up of Insensitive Energetic Materials	3.341	3.664	-
Description: Conduct research to advance the maturity of disruptive energetic materials.			
FY 2023 Plans: Validate the synthesis and fabrication of energetic materials applicable to a wide range of additive manufacturing technologies; conduct experiments of additive energetic components and novel energetic materials initiated with additive energetic component materials to reduce sensitivity; design energetic processing technologies for advanced energetic materials.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle conclusion of this effort			
Accomplishments/Planned Programs Subtotals	3.341	3.664	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AH4 / Precision and Coop Weapons in a Denied Env Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AH4: Precision and Coop Weapons in a Denied Env Tech	-	9.083	9.163	8.950	-	8.950	9.241	9.096	8.892	8.988	0.000	63.413

A. Mission Description and Budget Item Justification

This Project investigates technologies to deliver accurate fires from extended ranges in denied environments and informs future close- and deep-range Long Range Precision Fires capabilities (e.g., Extended Range Cannon Artillery, Precision Strike Missile).

Research in this Program Element (PE) researches technologies for navigation of munitions without Global Positioning System (GPS) and flying munitions to much greater distances against advanced threat Area Denial Assets by delivering navigation technology for multiple munitions with complementary sensors and maneuverability technology for munitions with enhanced lift and control characteristics.

Research in this Project transitions foundational research obtained in PE 0601102A (Defense Research Sciences) / AA7 (Mechanics and Ballistics) and complements PE 0602141A (Lethality Technology) / Project AH6 (Disruptive Energetics and Propulsion Technologies), Project AH7 (Lethal and Scalable Effects Technologies), and Project AH8 (Lethality Materials and Processes Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
<p>Title: Munition Navigation Technology in Contested Environments</p> <p>Description: This effort investigates, designs, and transitions technologies to improve navigation (e.g., better accuracy, more information/aim-point refinement, reduce GPS dependency) of munitions subject to denied environments (e.g., electro-magnetic spectrum contested, counter-measures). Key technologies include algorithms for image processing, state estimation, and communications, embedded processing and electronics, and sensors (e.g., inertial, imagers with optics, software-defined radios and antennae).</p>	4.817	-	-
<p>Title: Munition Maneuvering Technology in Extreme Environments</p> <p>Description: This effort investigates and designs technologies to improve maneuverability (e.g., extended range glide, intercept moving target, course- correct to imperfectly located target, perform evasive terminal maneuver to increase survivability) of munitions subject to extreme environments (set-back, set-forward, and balloting loads encountered during gun launch and thermal</p>	4.266	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) AH4 / Precision and Coop Weapons in a Denied Env Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
loads encountered during high speed/long time flights). These technologies include the maneuvering airframe, control actuation, and flight control algorithms.				
<p>Title: Foundational Weapons Flight and Guidance Technology in Extreme Environments</p> <p>Description: This effort investigates, designs, and develops technologies to improve guidance (e.g., better accuracy, more information/aim-point refinement, reduce GPS dependency) and flight (extended range glide, intercept moving target, course correct to imperfectly located target, perform evasive terminal maneuver to increase survivability) of munitions subject to extreme environments (e.g., set-back, set-forward and balloting load, electro-magnetic spectrum contested, counter-measures). Key navigation technologies include algorithms for image processing, state estimation, communications, embedded processing and electronics, and sensors (e.g., inertial, imagers with optics, software-defined radios and antennae). Key maneuvering technologies include the airframe, control actuation, and flight control algorithms.</p> <p>FY 2023 Plans: Validate mid-course navigation technologies (image and radio frequency based); mature terminal guidance algorithms using simulation and experimental data capture; conduct experiments on collaborative engagements to include multiple unmanned aerial systems equipped with imagers, software-defined radios, inertial measurement units, and embedded processors for validation of unanchored multi-agent localization (UMAL), UMAL-Aided anchored localization, formation control, multi-agent tracking, and weapon-target assignment; conduct experiments to better understand and characterize complex control vehicle flight response, validate spiral technologies for long-range precision fires airframe design concepts and flight control algorithms; conduct analysis of unique ballistic launch and flight system simulations; design munition guidance algorithms and required system characteristics to improve terminal survivability against integrated air defense system targets.</p> <p>FY 2024 Plans: Will investigate novel flight control algorithms and vehicle control mechanisms to improve stability and maneuverability while surviving high-G cannon launch, high thermal load in flight, and defenses from integrated air defense systems; recommend design paths for high-lift, low-drag munition configurations for future Army cannon and missile fires; define limitations of algorithms for image-based mid-course navigation of Army munitions in Global Positioning System (GPS)-denied environments; formulate algorithms for delivering collaborative weapons in contested environments using multi-agent simulation and surrogate unmanned aerial system experiments; develop Army launch and flight platform and improved instrumentation for laboratory firing range facilities; confirm maturity of select weapon flight and guidance technologies in extreme Army environments of high mechanical and thermal loading, terminal survivability, and contested electro-magnetic spectrum; improve understanding of complex weapon flight and guidance problems through advancing combined experimental-modeling capabilities.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	9.124	8.950

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / <i>Long Range Precision Fires Technology</i>	Project (Number/Name) AH4 / <i>Precision and Coop Weapons in a Denied Env Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding decrease supports planned lifecycle of this effort.				
Title: SBIR/STTR Transfer		-	0.039	-
Description: Funding transferred in accordance with Title 15 USC §638				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		9.083	9.163	8.950
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) BN5 / Fuze and Power for Munitions
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BN5: Fuze and Power for Munitions	-	2.488	2.730	3.293	-	3.293	2.810	2.813	2.815	2.846	0.000	19.795

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by investigating critical component technologies and designs capable to enable advanced lethality and scalable warheads for future munitions as well as exploring new power technologies for extended run time and extended range munitions.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Energetics	2.488	2.730	3.293
Description: This effort develops advanced fuze and power technologies for future munition applications that enable an increase in range and lethality, of ammunitions.			
FY 2023 Plans: Investigate hardened electronic and energetic interface concepts for future initiation systems; wireless communications designs for global positioning system (GPS) synchronization and secure data transfer; design novel thermal batteries for increased range munition applications; validate captive flight testing for tracking proximity sensor algorithm development.			
FY 2024 Plans: Will design fuze and power component technology supporting electronic countermeasure evaluations for proximity. Will develop wireless synchronization between GPS components. Will conduct experiments on advanced initiation scheme for lethality concepts. Will develop advanced thermal batteries for future munitions.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	2.488	2.730	3.293

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / <i>Long Range Precision Fires Technology</i>	Project (Number/Name) BN5 / <i>Fuze and Power for Munitions</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology				Project (Number/Name) BO9 / WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BO9: WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)	-	29.500	85.500	-	-	-	-	-	-	-	0.000	115.000

Note
Congressional Interest Item funding provided for Weapons and Munitions Tech Program Initiative.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Weapons and Munitions Tech Program Initiative.

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

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

	FY 2022	FY 2023
Congressional Add: Program Increase - Extended Range Hybrid and Precision Gun Launched Projectiles	10.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Extended Range and Hybrid Gun Launched Unmanned Aerial System		
Congressional Add: Program Increase - Novel Printed Armament Components	3.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Novel Printed Armament Components		
Congressional Add: Extended Range Propulsion Technology	6.500	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Extended Range Propulsion Technology		
Congressional Add: High Speed Structures for Advanced Materials	10.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for High Speed Structures for Advanced Materials		
Congressional Add: Program Increase - ADVANCED GRAPHITIC FOAM FOR LONG-RANGE PRECISION FIRES	-	15.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602147A / Long Range Precision Fires Technology	Project (Number/Name) BO9 / WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2023 Plans: Congressional Interest Item funding provided for ADVANCED GRAPHITIC FOAM FOR LONG-RANGE PRECISION FIRES		
Congressional Add: Program Increase - ALUMINUM LITHIUM ALLOY SOLID ROCKET ADVANCEMENT FY 2023 Plans: Congressional Interest Item funding provided for ALUMINUM LITHIUM ALLOY SOLID ROCKET ADVANCEMENT	-	15.000
Congressional Add: Program Increase - EXTENDED RANGE AND HYBRID GUN LAUNCHED UNMANNED AERIAL SYSTEMS FY 2023 Plans: Congressional Interest Item funding provided for EXTENDED RANGE AND HYBRID GUN LAUNCHED UNMANNED AERIAL SYSTEMS	-	15.000
Congressional Add: Program Increase - HIGH SPEED MISSILE MATERIALS FY 2023 Plans: Congressional Interest Item funding provided for HIGH SPEED MISSILE MATERIALS	-	10.000
Congressional Add: Program Increase - HIGH TEMPERATURE SUPER ALLOYS FY 2023 Plans: Congressional Interest Item funding provided for HIGH TEMPERATURE SUPER ALLOYS	-	5.000
Congressional Add: Program Increase - LOW COST MISSILE TECHNOLOGY DEVELOPMENT FY 2023 Plans: Congressional Interest Item funding provided for LOW COST MISSILE TECHNOLOGY DEVELOPMENT	-	10.000
Congressional Add: Program Increase - REACTIVE MATERIALS FY 2023 Plans: Congressional Interest Item funding provided for Reactive Materials	-	10.500
Congressional Add: Program Increase - THERMODYNAMIC LATENT PROPULSION FY 2023 Plans: Congressional Interest Item funding provided for THERMODYNAMIC LATENT PROPULSION	-	5.000
Congressional Adds Subtotals	29.500	85.500

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	130.108	104.348	73.844	-	73.844	70.486	62.163	70.978	63.016	0.000	574.943
AI9: Future UAS Engine Technology	-	3.014	-	-	-	-	-	-	-	-	0.000	3.014
AJ2: Next Generation Rotorcraft Transmission Technology	-	4.001	-	-	-	-	-	-	-	-	0.000	4.001
AJ6: Advanced Rotors Technology	-	2.358	-	-	-	-	-	-	-	-	0.000	2.358
AJ8: Experimental and Computational Aeromechanics Techn	-	5.753	-	-	-	-	-	-	-	-	0.000	5.753
AK2: Aviation Survivability Technology	-	2.081	1.236	-	-	-	9.908	6.492	-	-	0.000	19.717
AK4: Multi-Role Small Guided Missile Technology	-	3.599	-	-	-	-	-	-	-	-	0.000	3.599
AK9: Adv Teaming for Tactical Aviation Operations Tech	-	13.468	14.546	14.863	-	14.863	14.868	14.882	14.892	15.054	0.000	102.573
AL2: High Performance Computing for Rotorcraft App Tech	-	1.126	-	-	-	-	-	-	-	-	0.000	1.126
AL4: High Speed and Efficient VTOL Vehicle Technology	-	1.412	-	-	-	-	-	-	-	-	0.000	1.412
AL5: Air Vehicle Structures and Dynamics Technology	-	2.696	-	-	-	-	-	-	-	-	0.000	2.696
AL8: Holistic Situational Awareness and Dec Making Tech	-	0.857	-	1.004	-	1.004	3.017	3.020	-	-	0.000	7.898
BP7: Future Vertical Lift Air Platform Tech (CA)	-	42.000	35.000	-	-	-	-	-	-	-	0.000	77.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602148A / <i>Future Vertical Lift Technology</i>											
BZ7: <i>Future Vertical Lift Medical Technologies</i>	-	7.818	7.503	7.644	-	7.644	7.449	7.443	7.564	7.662	0.000	53.083
CC3: <i>FVL Radar Technologies</i>	-	0.428	-	-	-	-	5.188	3.593	3.596	3.635	0.000	16.440
CG9: <i>Adapt & Resilnt Tact Autnmy Cont & Struct Tech</i>	-	6.270	-	-	-	-	-	-	-	-	0.000	6.270
CH2: <i>Air Launched Effects Technology</i>	-	7.291	4.168	4.312	-	4.312	3.483	3.383	3.280	-	0.000	25.917
CH3: <i>Holistic Team Survivability Technology</i>	-	10.808	10.819	11.041	-	11.041	11.044	11.057	11.065	11.110	0.000	76.944
CH4: <i>Power & Thermal Management for FVL Tech</i>	-	6.913	7.613	9.766	-	9.766	11.918	7.841	7.809	7.893	0.000	59.753
CI4: <i>Adaptive Avionics Technologies</i>	-	-	-	1.005	-	1.005	3.611	3.615	3.618	3.657	0.000	15.506
CI5: <i>High Speed Maneuverable Missile (HSMM) Tech</i>	-	8.215	23.463	24.209	-	24.209	-	0.837	19.154	14.005	0.000	89.883

Note

In Fiscal Year (FY) 2024, this Program Element (PE) is increased to research technologies directly supporting Future Vertical Lift modernization priorities.

A. Mission Description and Budget Item Justification

This Program Element (PE) is directly aligned to the Future Vertical Lift (FVL) Army Modernization Priority. This PE conducts air vehicle and mission system component design, fabrication, and evaluation to enable Army Future Vertical Lift. Emphasis is on developing aviation platform and mission system technologies to enhance manned and unmanned air vehicle combat and combat support operations for attack, reconnaissance, air assault, survivability, logistics, and command and control missions.

Research in this PE contributes to the Army Science and Technology (S&T) air systems portfolio and is fully coordinated with efforts in PE 0603465A (Future Vertical Lift Advanced Technology), PE 0602183A (Air Platform Applied Research) and PE 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy.

Research in this PE is performed by the United States Army Futures Command (AFC) and the Army Engineering Research and Development Center (ERDC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	133.158	69.348	70.393	-	70.393
Current President's Budget	130.108	104.348	73.844	-	73.844
Total Adjustments	-3.050	35.000	3.451	-	3.451
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	35.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-3.050	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	3.451	-	3.451

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BP7: *Future Vertical Lift Air Platform Tech (CA)*

Congressional Add: *Program Increase - High Strength Functional Composites*

Congressional Add: *Program Increase: Adaptive Flight Control Technology*

Congressional Add: *Program Increase - High Density eVTOL Power Source*

Congressional Add: *Program Increase - Individual Blade and Higher Harmonic Control*

Congressional Add: *Missile Technology Transfer and Innovation*

Congressional Add: *Rotor Blade Operational Readiness*

Congressional Add: *Program Increase - DIGITAL TWIN PATHFINDER*

Congressional Add: *Program Increase - SEAT TRACK INTEGRATED REPLACEABLE/UPGRADABLE PROTECTION SYSTEM*

Congressional Add Subtotals for Project: BP7

Congressional Add Totals for all Projects

	FY 2022	FY 2023
	5.000	5.000
	7.000	3.000
	15.000	-
	5.000	-
	5.000	-
	-	17.000
	-	10.000
	42.000	35.000
	42.000	35.000

Change Summary Explanation

In FY24, funding is increased to support research in Aviation Survivability, Holistic Situational Awareness and Decision Making, Power & Thermal Management, and Adaptive Avionic technologies to support Future Vertical Lift priorities

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) A19 / Future UAS Engine Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
A19: Future UAS Engine Technology	-	3.014	-	-	-	-	-	-	-	-	0.000	3.014

A. Mission Description and Budget Item Justification

This Project designs and evaluates current and Future Unmanned Aircraft Systems (FUAS) advanced engine/power system component technologies to support the goals of multi-fuel capability, reduced fuel consumption, engine size, weight, and cost, as well as improved reliability, survivability, and maintainability.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Multi-fuel Capable Hybrid Electric Propulsion	3.014	-	-
Description: Applied research to enable intelligent and robust propulsion performance and noise signature reduction via multi-fuel and optimized hybrid electric capability for small engines (20kW to 150kW) powering future aircraft systems. The research focuses on the establishment of concepts to enable reduced fuel consumption, engine size, weight, and cost as well as improved group 3 and 4 FUAS reliability, survivability, and maintainability.			
Accomplishments/Planned Programs Subtotals	3.014	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AJ2 / Next Generation Rotorcraft Transmission Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AJ2: Next Generation Rotorcraft Transmission Technology</i>	-	4.001	-	-	-	-	-	-	-	-	0.000	4.001

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) advanced drive train technologies that increase performance and double current drivetrain life cycles while improving their reliability and maintainability.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: High Reduction Ratio Transmission Components	4.001	-	-
Description: Effort investigates advanced materials and component designs that allow a 60:1 reduction ratio two-stage gearbox design that provides significant weight and volume reduction for extended range and component life for manned and unmanned applications.			
Accomplishments/Planned Programs Subtotals	4.001	-	-

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 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AJ6 / <i>Advanced Rotors Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AJ6: Advanced Rotors Technology</i>	-	2.358	-	-	-	-	-	-	-	-	0.000	2.358

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) technologies that mature high speed and highly efficient rotor and hub system designs.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology Development).

The cited work is consistent with the Under 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 United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Hubs	2.358	-	-
Description: Investigate advanced rotor system and hub technologies to support goals of increased speed and lift by developing configurations and technologies that reduce drag and enable more efficient rotor system performance.			
Accomplishments/Planned Programs Subtotals	2.358	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AJ8 / Experimental and Computational Aeromechanics Techn
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AJ8: <i>Experimental and Computational Aeromechanics Techn</i>	-	5.753	-	-	-	-	-	-	-	-	0.000	5.753

A. Mission Description and Budget Item Justification

This Project investigates new high fidelity computational methods to simulate aerodynamic effects and test methods of emerging rotorcraft lift technologies that could be incorporated into Future Vertical Lift (FVL) designs.

Research in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this effort is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Experimental Aeromechanics for FVL	3.632	-	-
Description: Develop and explore new methods to simulate aerodynamic effects for future FVL configurations.			
Title: Computational Aeromechanics for FVL	2.121	-	-
Description: Investigate experimental aeromechanics technologies and test methods for FVL.			
Accomplishments/Planned Programs Subtotals	5.753	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) AK2 / Aviation Survivability Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AK2: Aviation Survivability Technology	-	2.081	1.236	-	-	-	9.908	6.492	-	-	0.000	19.717

A. Mission Description and Budget Item Justification

This Project investigates advanced technologies to reduce Future Vertical Lift (FVL) platform susceptibility and vulnerability to damage from guided and unguided threats, as well as technologies to defeat small arms, rocket and missile threats. It also investigates and develops an integrated team-based system of systems survivability approach for Integrated Air Defense Systems breaching through purpose driven mix of improved survivability situational awareness, signature management, vulnerability reduction, route and maneuver optimization, expendables, advanced sensors, and Electro-optical (EO) & Radio Frequency (RF) jamming across distributed platforms.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited work is consistent with the Under 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 United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Tunable Pyrotechnics Technologies</p> <p>Description: Develop and investigate technologies for nano, reactive, and advanced/novel materials to enable, customize and "tune" a family of Countermeasure Decoys for FVL platforms.</p> <p>FY 2023 Plans: Conduct experiments on miniaturized electronics and antenna for active Radio Frequency countermeasure technologies. Design and develop modeling and simulation techniques supporting countermeasure development and future applications.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle conclusion of this effort.</p>	2.081	1.191	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans:</p>	-	0.045	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AK2 / <i>Aviation Survivability Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638				
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i>				
Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		2.081	1.236	-
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) AK4 / Multi-Role Small Guided Missile Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AK4: Multi-Role Small Guided Missile Technology	-	3.599	-	-	-	-	-	-	-	-	0.000	3.599

A. Mission Description and Budget Item Justification

The Project investigates, designs, and evaluates modular missile component technologies compatible with Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) aviation platforms in a Multi-Domain Battle/Cross-domain Maneuver operational environment. Also investigates critical component technologies and designs for future missiles that can be launched simultaneously, can operate autonomously and/or under human supervision, and can form advanced, cooperative teams to defeat one or more hard/soft targets which are stationary and/or moving.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Multiple Simul Engagement Technologies (MSET)	3.599	-	-
Description: Investigate critical missile and fire control component technologies and designs for future missiles that can be launched simultaneously, can operate autonomously and/or under human supervision, and can form advanced, cooperative teams to defeat one or more hard/soft targets which are stationary and/or moving targets.			
Accomplishments/Planned Programs Subtotals	3.599	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AK9 / <i>Adv Teaming for Tactical Aviation Operations Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AK9: Adv Teaming for Tactical Aviation Operations Tech</i>	-	13.468	14.546	14.863	-	14.863	14.868	14.882	14.892	15.054	0.000	102.573

A. Mission Description and Budget Item Justification

This Project investigates and develops subsystem and component level technologies that enable advanced teaming behaviors for mixed platform formations in combined arms operations. Primary component technologies to develop are in the areas of resilient autonomy algorithms, team-based communications and situational awareness management, decision aiding for weapons systems engagement, autonomous terrain and collision avoidance, and human autonomy interface design.

Research in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Teaming Concepts	8.052	8.495	8.715
Description: Investigates and develops subsystem and component level technologies that enable advanced manned and unmanned teaming behaviors for mixed air and ground platform formations in combined arms operations.			
FY 2023 Plans: Design autonomy and teaming technologies that enable seamless unmanned aircraft systems (UAS) team of teams operations, including dynamic retasking with autonomous team reconfigurability, across multiple domains and in highly-contested, complex environments. Design and enhance technologies for team coordination over long ranges with degraded networks and autonomous navigation in featureless (e.g. water) or highly cluttered (e.g. urban) environments.			
FY 2024 Plans: Will investigate and develop technologies that enhance autonomous team of teams operations in complex urban / fringe and littoral environments, including highly-autonomous coordinated team mission behaviors, navigation and mission execution at low altitude in featureless and cluttered terrain, and sophisticated behaviors for employment of targeted electronic attack using teams of UAS. Will further enhance technologies for collaborative team operations over extended ranges with degraded networks, and improve human to machine supervisory interfaces for complex dynamic UAS team operations.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AK9 / <i>Adv Teaming for Tactical Aviation Operations Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding change reflects planned lifecycle of this effort.				
Title: Enhanced Optics for Long Range Targeting		5.416	6.051	6.148
Description: This effort will deliver advanced airborne optics and reconfigurable filtering devices to enable agile, multi-task sensors for compact, long-range targeting, enhanced survivability and lethality of the Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS). This effort will restore visual overmatch in any (day/night) environment through visual penetration of all obscurants (e.g. brownout, white out, engineered smokescreens) from a single sensor, as well as narrowband filtering for active imaging through obscurants while maintaining advanced target acquisition. Improved detection and identification and long range target acquisition capability will result from filtering out scattered light and enabling 3-dimensional ranging through environmental obscurants.				
FY 2023 Plans: Conduct experiments on the efficacy, performance, and durability of newly available optical materials. Validate optical performance of field-selectable spectral bandpass filters to determine impacts to multiple tasks needed in a dynamic airborne environment. Mature optical lens material manufacturability of novel dual-band crystalline materials for use in advanced targeting applications. Conduct experiments to determine the range resolution achievable for day/night airborne active 3-D imaging.				
FY 2024 Plans: Will validate the new dual band infrared (IR) optical material in a relevant lens design; enabling lower size, weight, and power - cost (SWaP-C), improved durability, and dual-band flexibility. Will develop a compact and lightweight optical design, and novel optical components to support scalable long-range electro-optic infrared (EOIR) sensor payloads on current and future low-SWAP unmanned air platforms. Will determine applicable payload pointing and stabilization approaches to pair with the optical payload design to meet platform constraints. Will investigate feasibility of multi-spectral payload designs for small unmanned platforms.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		13.468	14.546	14.863
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AL2 / High Performance Computing for Rotorcraft App Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AL2: High Performance Computing for Rotorcraft App Tech</i>	-	1.126	-	-	-	-	-	-	-	-	0.000	1.126

A. Mission Description and Budget Item Justification

This Project investigates and validates aeromechanics modeling and simulation tools for Future Vertical Lift (FVL) platforms. Research efforts in this Project are also applicable to the family of FVL manned and unmanned platforms.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology Development).

The cited work is consistent with the Under 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 United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: High Performance Computing for Rotorcraft App Tech	1.126	-	-
Description: Investigate new high performance and parallel computing efforts in support of FVL platforms.			
Accomplishments/Planned Programs Subtotals	1.126	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) AL4 / High Speed and Efficient VTOL Vehicle Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AL4: High Speed and Efficient VTOL Vehicle Technology	-	1.412	-	-	-	-	-	-	-	-	0.000	1.412

A. Mission Description and Budget Item Justification

This Project establishes component technologies in the area of materials, design, and dynamic models to enable next generation capability for Future Vertical Lift (FVL) platforms. Objectives of this Project are focused on improving both performance (i.e. range, payload, endurance) and reliability/maintainability metrics, where outcomes from these efforts are applicable to the Family of Future Vertical Lift manned and unmanned platforms.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology Development).

The cited work is consistent with the Under 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 United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: High Speed & Efficient Vertical Take-off and Landing	1.412	-	-
Description: This research effort establishes concepts in vertical take-off and landing in the area of propulsion to enable improved, efficient hover and high-speed cruise at longer range without added weight.			
Accomplishments/Planned Programs Subtotals	1.412	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technology	Project (Number/Name) AL5 / Air Vehicle Structures and Dynamics Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AL5: Air Vehicle Structures and Dynamics Technology	-	2.696	-	-	-	-	-	-	-	-	0.000	2.696

A. Mission Description and Budget Item Justification

This Project establishes validated modeling tools needed to develop aeroelastically stable rotor technologies to enable high speed flight and longer flight envelopes in Future Vertical Lift (FVL) platforms. Efforts in this Project are also applicable to the family of FVL manned and unmanned platforms.

Research in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this effort is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Aeromechanics and Aeroelasticity of Future Air Vehicle Platforms	2.696	-	-
Description: Establish improved experimentally validated modeling tools and methodologies that can be used to understand the physics of aeroelastic stability and design in next generation rotorcraft platform configurations for FVL platforms. This involves the development of an experimental capability, (TRAST), which will be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort will inform FVL requirement definition and technology maturation. This effort also establishes low noise rotor concepts and investigates the intersection of artificial intelligence and classical mechanics to enable novel mechanics and new approaches in structural dynamics for FVL applications to enable higher Operating Tempo (OPTEMPO) operations.			
Accomplishments/Planned Programs Subtotals	2.696	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AL8 / Holistic Situational Awareness and Dec Making Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AL8: Holistic Situational Awareness and Dec Making Tech</i>	-	0.857	-	1.004	-	1.004	3.017	3.020	-	-	0.000	7.898

Note

In Fiscal Year (FY) 2024, funding for this project is realigned from Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / Project AL9 (Holistic Sit Awareness and Dec Making Adv Tech).

A. Mission Description and Budget Item Justification

This Project focuses on modeling and simulation of pilotage and decision aiding system technology that allows for care free operations in complex and hostile environments.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology Development).

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

Work in this effort is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Situational Awareness Radar for DVE mitigation	0.857	-	-
Description: This effort investigates technologies and algorithms for compact radars that will provide a hazard warning capability to airborne platforms in all environmental conditions, including those with zero visibility. This hazard warning capability will detect collision threats and specific projectile hazards around the entire aircraft using a suite of small form-factor radars. Algorithms are created to interpret the data produced by these radars and distinguish threats from benign clutter. Innovative radar architectures and device technologies are investigated and demonstrated to enhance and extend performance.			
Title: Holistic Mission Manager (HMM) Concepts	-	-	1.004
Description: Increase FVL (FARA, FLRAA) mission effectiveness by an order of magnitude by merging existing Mission Systems Division MOSA technologies (HSA-DM, SAINT, A-Team, IME) into a single, ownship-centric mission manager. Dynamically load-balance the ownship, optimizing actions within the mission-team space. Increase lethality through mission effectiveness achieved			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AL8 / <i>Holistic Situational Awareness and Dec Making Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
by better crew workload management and mission management that coordinates all aspects of ownship mission requirements. Interoperability with all MDO players.				
FY 2024 Plans: Will survey government, industry, and academia to identify gaps and report on the existing and emerging mission planning/ management tools; conduct stakeholder engagements and program planning activities; develop and coordinate a request for information.				
FY 2023 to FY 2024 Increase/Decrease Statement: This effort begins in FY24 with funding realigned from PE 0603465 (Future Vertical Lift Advanced Technology) / Project AL9 (Holistic Sit Awareness and Dec Making Adv Tech).				
Accomplishments/Planned Programs Subtotals		0.857	-	1.004
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) BP7 / Future Vertical Lift Air Platform Tech (CA)
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BP7: Future Vertical Lift Air Platform Tech (CA)	-	42.000	35.000	-	-	-	-	-	-	-	0.000	77.000

Note
Congressional Interest Item funding provided for Future Vertical Lift Air Platform Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Future Vertical Lift Platform Technology.

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

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

	FY 2022	FY 2023
Congressional Add: Program Increase - High Strength Functional Composites	5.000	5.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for High Strength Functional Composites		
FY 2023 Plans: Congressional Interest Item funding provided for High Strength Functional Composites		
Congressional Add: Program Increase: Adaptive Flight Control Technology	7.000	3.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Adaptive Flight Control Technology		
FY 2023 Plans: Congressional Interest Item funding provided for Adaptive Flight Control Technology		
Congressional Add: Program Increase - High Density eVTOL Power Source	15.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for High Density eVOTL Power Source		
Congressional Add: Program Increase - Individual Blade and Higher Harmonic Control	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Individual Blade and Higher Harmonic Control		
Congressional Add: Missile Technology Transfer and Innovation	5.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) BP7 / <i>Future Vertical Lift Air Platform Tech (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Missile Technology Transfer and Innovation		
Congressional Add: Rotor Blade Operational Readiness	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Rotor Blade Operational Readiness		
Congressional Add: Program Increase - DIGITAL TWIN PATHFINDER	-	17.000
FY 2023 Plans: Congressional Interest Item funding provided for Digital Twin Pathfinder		
Congressional Add: Program Increase - SEAT TRACK INTEGRATED REPLACEABLE/UPGRADABLE PROTECTION SYSTEM	-	10.000
FY 2023 Plans: Congressional Interest Item funding provided for SEAT TRACK INTEGRATED REPLACEABLE/UPGRADABLE PROTECTION SYSTEM		
Congressional Adds Subtotals	42.000	35.000

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) BZ7 / Future Vertical Lift Medical Technologies			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>BZ7: Future Vertical Lift Medical Technologies</i>	-	7.818	7.503	7.644	-	7.644	7.449	7.443	7.564	7.662	0.000	53.083

A. Mission Description and Budget Item Justification

This Project involves research to prevent injury and performance degradation in Aviators, Unmanned Arial System (UAS) Operators and other Warfighters in training and operations; refines risk assessment and performance models based on operational stressors, e.g., sleep deprivation, work load, fatigue; and delivers biomedical-based spinal injury criteria and assessment methodologies. This research provides medical information important to the design and operational use of future vertical lift aircraft, and when appropriate, ground vehicles.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Medical Standards to Support Future Vertical Lift (FVL)</p> <p>Description: This effort develops and delivers medical guidelines and strategies to assure optimal Soldier performance and protection on the future technologically-intensive battlefield. Key elements of the program include: 1) tailored medical selection and retention standards for FVL; 2) medical strategies to maintain and enhance human performance in Multi-domain operations (MDO); 3) human-centered technology design guidance to accommodate the range of aircrew; 4) improved protection standards to reduce FVL occupant injury; and 5) operator state monitoring tools to enable scalable autonomy in FVL aircraft.</p> <p>FY 2023 Plans: Will refine Army Regulation Update 40-501 to ensure medically fit aircrew. Will develop Health Hazard Assessment methods and criteria to protect FVL occupants from Head Supported Mass, impulsive noise/ shock, and repeated jolt. Will develop recommendations for multisensory cuing for Degraded Visual Environment (DVE) operations. Will develop recommended human variables for operator state assessment and a holistic aircrew workload/ performance stress model. Will refine spinal fracture thresholds and FVL aviator/crew seat requirements. Will improve standards for assessing flight helmet stability and crash retention; Will assess FVL flight envelope physiological effects and countermeasures. Will develop proposed responses of autonomous system to FVL aircrew. Will develop recommendation package for enhanced FVL crashworthiness.</p> <p>FY 2024 Plans: Will develop Health Hazard Assessment methods and criteria to protect FVL occupants from Head Supported Mass, impulsive noise/ shock, and repeated jolt. Will develop recommendations for maintaining orientation in Manned-Unmanned Teaming</p>	7.818	7.496	7.644

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technology</i>	Project (Number/Name) BZ7 / <i>Future Vertical Lift Medical Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
(MUM-T) and FVL operators. Will develop recommendations for multisensory cuing for Degraded Visual Environment (DVE) operations. Will develop recommendations for counter-measures for motion sickness in Soldiers transported by FVL. Will assess FVL flight envelope physiological effects and recommend countermeasures. Will assess FVL vibration effects on aircrew health and performance. Will recommend updated head supported mass (HSM) limits to prevent injury and maintain FVL aircrew performance. Will develop recommended human variables for operator state assessment and a holistic aircrew workload/performance stress model. Will develop input for human behavior and biomedical monitoring algorithms. Will develop medical aspects of FVL scalable autonomy system incorporating real-time biomedical monitoring inputs. Will develop recommendations for hearing protection of FVL aircrew, operators, and passengers. Will update recommended head supported mass (HSM) limits to prevent FVL aircrew injury. Will develop next-generation head protection strategies for FVL aircrew. Will develop recommendation package for enhanced FVL crashworthiness. Efforts in this task are further developed in Program Element 060465A, Project CJ5.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort..			
Title: SBIR/STTR Transfer	-	0.007	-
FY 2023 Plans: SBIR/STTR Transfer			
FY 2023 to FY 2024 Increase/Decrease Statement: SBIR/STTR Transfer			
Accomplishments/Planned Programs Subtotals	7.818	7.503	7.644

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CC3 / <i>FVL Radar Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CC3: FVL Radar Technologies</i>	-	0.428	-	-	-	-	5.188	3.593	3.596	3.635	0.000	16.440

A. Mission Description and Budget Item Justification

This Project develops underlying technologies applicable to next generation radar apertures used for detection, tracking and precision targeting, navigation and fire control for multiple modalities.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Battlefield Surveillance & Targeting Radar Technology	0.428	-	-
Description: Advanced Reconnaissance, Surveillance and Target Acquisition Waveform Designs for advanced multi-beam Ground Moving Target Indicator (GMTI) and Synthetic Aperture Radar (SAR) systems.			
Accomplishments/Planned Programs Subtotals	0.428	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) CG9 / Adapt & Resilnt Tact Autnmy Cont & Struct Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CG9: Adapt & Resilnt Tact Autnmy Cont & Struct Tech	-	6.270	-	-	-	-	-	-	-	-	0.000	6.270

A. Mission Description and Budget Item Justification

This Project develops methodologies for advanced flight dynamics models, robust flight controls for superior handling qualities, and improved survivability, redundancy management with reduced structural loads on the aircraft. Designs algorithms for autonomy, optionally piloted operations and manned-unmanned teaming. This Project directly supports Future Vertical Lift (FVL) modernization priority capabilities by investigating, maturing, and harmonizing leap-ahead autonomy, structures, and controls technologies, concepts, and capabilities which enable combat mission success across the family of manned/unmanned FVL platforms.

Work in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Adaptive and Resilient Engineered Structures (ARES) Technologies	1.501	-	-
Description: Develop structures technologies providing performance, survivability, and sustainment benefits with broad applicability across platform scale and role, enabling mission success for manned/unmanned FVL platforms in the contested environment of multi-domain operations.			
Title: Adaptive Tactical Autonomy and Control (ATAC) Technologies	4.769	-	-
Description: Develop vehicle management, flight control, and autonomy technologies that enable FVL aircraft to achieve superior maneuverability and agility at all speeds, effectively exploit extreme/degraded environmental conditions as a force multiplier, fight and win in presence of failure or damage, and operate on a cognitive-loading-spectrum from piloted to fully autonomous.			
Accomplishments/Planned Programs Subtotals	6.270	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CG9 / <i>Adapt & Resilnt Tact Autnmy Cont & Struct Tech</i>

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH2 / <i>Air Launched Effects Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CH2: <i>Air Launched Effects Technology</i>	-	7.291	4.168	4.312	-	4.312	3.483	3.383	3.280	-	0.000	25.917

A. Mission Description and Budget Item Justification

This Project utilizes improved analytic modeling to investigate the effects that potential unmanned system capabilities could have on air vehicle design considerations and operational concepts. This Project improves government capability to design and assess novel Unmanned Aircraft System (UAS) concepts. This Project also develops and investigates the ability to launch a UAS from a manned or unmanned future vertical lift aircraft at tactical altitudes and to control the same after launch from nearby Future Verticle Lift (FVL) aircraft, as well as development of the associated payloads (recon, battle damage assessment, targeting, comms, decoy). This Project will assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Systems Concepts Studies for Air Launched Effects</p> <p>Description: Investigates and models air vehicle concepts to understand the effects that potential operational Air Launched Effects capabilities will have on air vehicle properties.</p> <p>FY 2023 Plans: Conduct assessment of vehicle concepts and technology for Versatile Air Launched Effects. Develop UAS component models to improve propulsion architecture modeling, aircraft weight prediction, and improve performance and cost assessment.</p> <p>FY 2024 Plans: Will explore tradespace for air vehicle concepts with application to FUAS and ALE. Will develop models to estimate performance, improve methods for cost analysis, and incorporate improved propulsion models.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	7.291	4.065	4.312
<p>Title: SBIR/STTR Transfer</p>	-	0.103	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH2 / <i>Air Launched Effects Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	7.291	4.168	4.312

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) CH3 / <i>Holistic Team Survivability Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CH3: <i>Holistic Team Survivability Technology</i>	-	10.808	10.819	11.041	-	11.041	11.044	11.057	11.065	11.110	0.000	76.944

A. Mission Description and Budget Item Justification

This Project will investigate and design advanced survivability technologies to develop a holistic team-based solution that delivers advanced sensing and electronic warfare (EW) effects across a family of aircraft to optimally penetrate and survive in the anti-access/area denial (A2AD) environment. This Project will take an integrated team-based system of systems survivability approach through a purpose-driven mix of improved survivability situational awareness, signature management, vulnerability reduction, enhanced platform survivability against directed energy munitions, route and maneuver optimization, expendables, advanced sensors, and electro-optics (EO) & radio frequency (RF) jamming for existing and future air platforms. This Project will also provide advanced teaming algorithms for survivability. This Project develops and evaluates multi layered survivability concepts and supporting technologies for increased survivability of Future Vertical Lift (FVL) Family of Systems (FVL FoS) in an advanced and evolving integrated air defense systems environment.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Survivability Concepts	4.036	3.362	3.464
Description: This effort will provide analysis of the rapidly evolving and emerging threat environment and impacts to Future Vertical Lift Family of Systems FVL FoS platforms, developing and evaluating full spectrum survivability concept, collaborative team based survivability algorithms and behaviors			
FY 2023 Plans: Investigate damage prediction algorithms given a threat/ballistic impact. Investigate RF materials development for durability improvement and weight reduction. Continue development of algorithms, behaviors, and human machine interface for team-based survivability. Begin investigation and analysis of Electro Optical/ Infrared coatings for FVL applications, leveraging new coatings technologies.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH3 / <i>Holistic Team Survivability Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will initiate the development of damage prediction algorithms given a threat/ballistic impact. Will develop RF material coupons for durability improvement and weight reduction. Will continue development and maturation of algorithms, behaviors, and human machine interface for team-based survivability. Will continue the development and analysis of uniquely tailored Electro-Optical/ Infrared coatings for FVL and UAS applications, leveraging emergent coatings technologies. Will investigate microclimatology for survivability algorithm development. Will investigate emergent fuel cell vulnerability reduction technologies for next generation FVL platforms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Distributed Electronic Warfare Effects</p> <p>Description: This effort investigates and develops critical EW components and techniques to enable the FVL capability to operate and survive in A2/AD environments. It provides scalable low size, weight, power, and cost (SWaP-C) signal processing components and decision-making algorithms that adapt and counter the characteristics of advanced and emerging threats.</p> <p>FY 2023 Plans: Conduct single node bench experimentation of hardware performance and software algorithm functionality to inform further development and optimization. Validate software technology readiness level assessments. Optimize operational capability of a payload based on technology maturation and EW technical community inputs.</p> <p>FY 2024 Plans: Will mature algorithms and conduct multi-node experiment of hardware performance and software algorithm functionality. Will develop methods for distributed detection and geolocation of A2/AD threats with enhanced accuracy. Will investigate the impact of threat progression on measured performance of detection and countermeasure algorithms in both the single node and multi-node cases.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		6.772	7.329	7.577
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.128	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH3 / <i>Holistic Team Survivability Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	10.808	10.819	11.041

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) CH4 / <i>Power & Thermal Management for FVL Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CH4: <i>Power & Thermal Management for FVL Tech</i>	-	6.913	7.613	9.766	-	9.766	11.918	7.841	7.809	7.893	0.000	59.753

A. Mission Description and Budget Item Justification

This Project directly supports Future Vertical Lift (FVL) Modernization Priority capabilities by investigating and developing power and thermal management technologies to provide significantly higher electrical power capability to FVL aircraft while addressing consequential size, weight, and thermal issues. This Project provides power capability for advanced electric aeromechanical effectors, advanced mission systems algorithms for route planning and teaming, and advanced electronic warfare devices. This also Project investigates emerging electrical power generation and distribution, energy storage, and thermal management technologies needed for future Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) and survivability equipment for application to FVL and other Army platforms. Enables significantly increased aircraft electrical power capability for advanced electric aeromechanical effectors, advanced mission systems to include algorithms for route planning and teaming, and for advanced electronic warfare devices while minimizing size and weight.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Optimized Energy for C5ISR Platforms	4.726	5.058	5.270
Description: This effort investigates electrical power and thermal management associated with high power C5ISR capabilities on ground and air platforms enabling enhanced mobility and mission flexibility. This effort funds research to improve FVL aircraft and other Army platforms power efficiency through the use of on-demand hybrid electrical power architectures, while also researching ways to eliminate platform thermal constraints. This effort will also investigate safer battery chemistries which enable very high density electrical power sources and energy storage to be flight certified for high rate pulsed power, electrical power management, and thermal management for dynamic high rate pulsed power.			
FY 2023 Plans: Investigate intrinsically safe chemistries for energy storage components able to deliver light weight, high energy power to support aviation electronic warfare capabilities. Mature thermal management components to support rejection of waste heat generated by platform mission equipment. Conduct experiments on real world thermal management components in order to validate models. Investigate advanced cold plate designs for two-phase heat rejection to reduce size, weight, and power draw. Conduct			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH4 / <i>Power & Thermal Management for FVL Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>experiments on thermal energy storage using phase change materials to better manage waste heat from high heat flux loads. Investigate efficient power electronics which will further reduce the waste heat generated by the aircraft.</p> <p>FY 2024 Plans: Will mature safe silicon chemistry components to develop and enable light weight, high power aviation energy storage systems. Will validate thermal management components through real world assessment to drive rejection of waste heat generated by platform mission equipment. Will?mature?cold plate designs and conduct experiments on novel phase change materials capable of managing peak thermal loads. Will design and develop power management strategies and algorithms for vertical lift platforms to efficiently distribute electrical power.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Power & Thermal Management Components</p> <p>Description: This effort develops electrical power and thermal management component technologies to meet the power and thermal demands of Future Vertical Lift aircraft while minimizing system size and weight. Technology will be validated through component level test.</p> <p>FY 2023 Plans: Perform fabrication and validation testing of efficient, distributed, and adaptable cooling systems that enable increased electrical power capability while reducing weight and cost to Future Vertical Lift aircraft electrical power and thermal management systems. Perform design of power dense generator technology thereby reducing system weight and volume while improving system efficiency and reliability for future and enduring fleets.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This effort ends in FY23 and funding is realigned to Adaptive Power Component Technologies within this project.</p>		2.187	2.368	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.187	-
<p>Title: Adaptive Power Component Technologies</p>		-	-	2.486

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) CH4 / <i>Power & Thermal Management for FVL Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort develops adaptive propulsion and power system component technologies to provide highly efficient propulsion and power capability to FVL aircraft while addressing consequential SWAP & thermal issues. Technology will be validated through component level test.</p> <p>FY 2024 Plans: Will perform detailed design and system integration modeling and analysis of adaptive power technologies that can provide key capabilities for a future hybrid propulsion system.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This effort begins in FY24 with funding realigned from Power& Thermal Management Components within this project.</p>			
<p>Title: Hybrid Propulsion Conceptual Design Analysis</p> <p>Description: Explore design and development of hybrid-electric propulsion concepts / applications (conventional & non-conventional) for multiple manned-VTOL classes to achieve greatest operational benefit for FVL future Platforms. Analysis will include trade studies to identify metrics, best architectures/technologies/configurations, and demonstration path for improved FVL aircraft capability.</p> <p>FY 2024 Plans: Will conduct component and system modeling. Will perform down-select of initial hybrid electric propulsion concepts as applied to FVL/enduring aircraft configurations to be investigated and initiate trade-studies/benefit analysis (key metrics include weight, system complexity, fuel burn, and electrical efficiency).</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: This effort begins in FY24.</p>	-	-	2.010
Accomplishments/Planned Programs Subtotals	6.913	7.613	9.766

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) C14 / Adaptive Avionics Technologies			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CI4: Adaptive Avionics Technologies	-	-	-	1.005	-	1.005	3.611	3.615	3.618	3.657	0.000	15.506

Note

Adaptive Avionics Technologies is a new start within the Future Verticle Lift Technology program in FY 2024.

In Fiscal Year (FY) 2024, funding for this project is realigned from Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / Project AL9 (Holistic Sit Awareness and Dec Making Adv Tech).

A. Mission Description and Budget Item Justification

This Project will Build on Modular Open Systems Approach (MOSA) successes to enable future aviation mission systems to proactively exploit emerging innovation from multiple technological domains, employing continuous development and continuous deployment by researching and developing advanced avionics integration techniques and optimized processing management.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Future Avionics Implementation Research (FAIR)	-	-	1.005
Description: This effort will investigate evolving advanced avionics technologies and integration techniques in disparate environments for FVL mission systems, and will research complex computing environments, contextual resource management and ownship network technologies to implement on FVL air platforms.			
FY 2024 Plans: Will conduct trade studies and internal research to understand the state of the art with respect to computing resource management techniques using contextual based situational awareness, innovative and flexible data architectures, distributed data processing and advanced ship network technologies.			
FY 2023 to FY 2024 Increase/Decrease Statement: This effort begins in FY24 with funding realigned from PE 0603465A Future Vertical Lift Advanced Technology/ Project AJ9 Integ Mission Equip for Vert Lift Systems Adv Tech.			
Accomplishments/Planned Programs Subtotals	-	-	1.005

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) C14 / <i>Adaptive Avionics Technologies</i>

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy				Project (Number/Name) CI5 / High Speed Maneuverable Missile (HSMM) Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CI5: High Speed Maneuverable Missile (HSMM) Tech	-	8.215	23.463	24.209	-	24.209	-	0.837	19.154	14.005	0.000	89.883

A. Mission Description and Budget Item Justification

The Project investigates, designs, and evaluates missile component technologies compatible with Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) aviation platforms in a Multi-Domain Battle/Cross-domain Maneuver operational environment. Efforts provide technologies to support a smaller, faster, maneuverable missile capable of long range non-line-of-sight attack in contested/degraded environments. Technology development increases aviation lethality and platform survivability by increasing missile standoff range, speed, and maneuverability, a faster rate of fire, shorter times of flight, and multi-threat lethal effects. Enables cross domain applications for aviation and ground vehicle platforms, including handoff capability, to engage threats in dead zones, and to operate in contested environments.

Work in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: High Speed Maneuverable Missile (HSMM) Technology	8.215	22.607	24.209
Description: Efforts provide technology development to support a maneuverable missile capable of both short range direct attack and long range non-line-of-sight attack with reduced time to target; reduced size and weight for increased load-out; capable of air launched missions in degraded/contested environments.			
FY 2023 Plans: Continue component development and evolve critical component designs including navigation sensors, warheads, fire control, and digital missile datalinks. Advance the design and development of a missile test bed. Develop detailed design of the advanced propulsion system to increase range and speed with desired trajectory for effectiveness and survivability. Assess that detailed designs accurately reflect platform interfaces and requirements to include maneuverability, long range precision strike capability in degraded/contested environments, and reduced time to target.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) C15 / <i>High Speed Maneuverable Missile (HSMM) Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will conduct experiments to validate the critical component designs including navigation sensor, warheads, fire control, and digital missile datalinks. Will conduct experiments to validate the design and development of the missile test bed. Will use the missile test bed to investigate increases in maneuverability, aviation lethality, and platform survivability in degraded/contested environments. Will validate detailed design of the advanced propulsion system and technologies by optimizing increases in range and speed to support long range precision strike performance in degraded/contested environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.856	-
Accomplishments/Planned Programs Subtotals		8.215	23.463	24.209
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	92.926	88.768	33.301	-	33.301	31.432	32.574	42.236	42.836	0.000	364.073
AD2: <i>High Energy Laser (HEL) Enabling and Support Techn</i>	-	5.856	-	-	-	-	-	-	-	-	0.000	5.856
AD3: <i>Maneuver Air Defense Technology</i>	-	7.604	-	-	-	-	-	-	-	-	0.000	7.604
AD5: <i>Next Generation Fires Radar Technology</i>	-	1.433	-	-	-	-	-	-	-	-	0.000	1.433
AE2: <i>Unconventional Countermeasures-Survivability Tech</i>	-	3.783	3.947	3.384	-	3.384	2.766	3.769	3.772	3.363	0.000	24.784
BN6: <i>Advanced Weapons Components (CA)</i>	-	74.250	61.752	-	-	-	-	-	-	-	0.000	136.002
CV7: <i>High Energy Laser Direct Diode Apl Tech</i>	-	-	2.902	1.495	-	1.495	3.218	3.030	7.411	8.971	0.000	27.027
CV8: <i>Vulnerability Modules for Multi-Domain Operations</i>	-	-	8.083	8.987	-	8.987	7.734	7.952	8.691	8.786	0.000	50.233
DA9: <i>Radar Survivability through Dis Sensing Tech</i>	-	-	5.803	4.703	-	4.703	4.076	3.767	2.304	2.329	0.000	22.982
DC1: <i>Next Generation DE Concept Development & Analysis</i>	-	-	6.281	6.446	-	6.446	13.638	14.056	20.058	19.387	0.000	79.866
DE3: <i>Adv Beam Control Component Development for C-CM</i>	-	-	-	8.286	-	8.286	-	-	-	-	0.000	8.286

A. Mission Description and Budget Item Justification

This Program Element (PE) line is directly aligned with the Air & Missile Defense (AMD) Army Modernization Priority. Work in this PE investigates and develops AMD technologies to enable defense of ground forces and selected geopolitical assets from aerial attack, missile attack, and surveillance. Major focus areas for AMD Science and Technology include: Missiles, Directed Energy, Gun-Based Air Defense Technologies, and Battlefield Sensors and Supporting AMD Technologies. Missiles Applied Research investigates and develops a broad range of Missile technologies to enhance Army integrated AMD capabilities at extended range. Directed Energy

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>
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Applied Research investigates and develops critical High Energy Laser (HEL) technologies to explore performance against Air Defense threats and for other Directed Energy applications across Army Modernization Priorities. Gun-Based Air Defense Technologies Applied Research investigates and develops Combined Arms for Air Defense (CAFAD) technologies and components in a laboratory environment. Sensors and Supporting AMD Technologies Applied Research investigates and develops Battlefield Sensor and radar technologies required for detection, acquisition and tracking of air defense targets as well as supporting technologies that enhance AMD.

Work in this PE complements PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research is performed by the United States Army Futures Command (AFC), the United States Army Space and Missile Defense Command/Army Strategic Forces Command (SMDC/ARSTRAT), and the United States Army Rapid Capabilities and Critical Technologies Office (RCCTO).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	93.549	27.016	29.409	-	29.409
Current President's Budget	92.926	88.768	33.301	-	33.301
Total Adjustments	-0.623	61.752	3.892	-	3.892
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	61.752			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.623	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	3.892	-	3.892

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BN6: *Advanced Weapons Components (CA)*

Congressional Add: *Program Increase - BEAM CONTROL SYSTEMS AND INDUSTRY GRADE OPTICAL FIBER FABRICATION FOR ENERGY LASER*

Congressional Add: *Program Increase - COUNTER UAS CENTER FOR EXCELLENCE*

Congressional Add: *Program Increase: High Energy Laser Testing and Expansion*

Congressional Add: *Program Increase: HIGH ENERGY LASER AND OPTICAL TECHNOLOGY*

Congressional Add: *Program Increase: High Energy Laser Technology Integration*

Congressional Add: *Program Increase - ARMY MISSILE RISK-BASED MISSION ASSURANCE*

	FY 2022	FY 2023
Congressional Add: <i>Program Increase - BEAM CONTROL SYSTEMS AND INDUSTRY GRADE OPTICAL FIBER FABRICATION FOR ENERGY LASER</i>	12.000	9.000
Congressional Add: <i>Program Increase - COUNTER UAS CENTER FOR EXCELLENCE</i>	5.000	5.000
Congressional Add: <i>Program Increase: High Energy Laser Testing and Expansion</i>	10.000	-
Congressional Add: <i>Program Increase: HIGH ENERGY LASER AND OPTICAL TECHNOLOGY</i>	6.000	10.000
Congressional Add: <i>Program Increase: High Energy Laser Technology Integration</i>	10.000	-
Congressional Add: <i>Program Increase - ARMY MISSILE RISK-BASED MISSION ASSURANCE</i>	15.000	5.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2022	FY 2023
Congressional Add: <i>Kill Chain Automation</i>	8.000	-
Congressional Add: <i>Machine Learning Optimized Power Electronics</i>	3.000	-
Congressional Add: <i>Program Increase - Precision Long Range Integrated Strike (PLRIS)</i>	5.250	6.752
Congressional Add: <i>Program Increase - SMALL UAS TRACKING AND TARGETING DEVICES</i>	-	14.000
Congressional Add: <i>Program Increase - CYBER ELECTROMAGNETIC ACTIVITIES MISSILE DEFENDER</i>	-	2.000
Congressional Add: <i>Program Increase - MISSILE RISK-BASED MISSION ASSURANCE</i>	-	10.000
Congressional Add Subtotals for Project: BN6	74.250	61.752
Congressional Add Totals for all Projects	74.250	61.752

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) AD2 / High Energy Laser (HEL) Enabling and Support Techn			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD2: High Energy Laser (HEL) Enabling and Support Techn	-	5.856	-	-	-	-	-	-	-	-	0.000	5.856

A. Mission Description and Budget Item Justification

This Project conducts static and dynamic High Energy Laser (HEL) vulnerability and lethality analyses and investigates advanced component technologies to enhance performance of future HEL weapons systems against advanced threats. In addition, this Project includes laboratory efforts for HEL applied research as well as concepts analysis for Army core competencies in Directed Energy (DE). This Project investigates low cost, advanced laser technologies based on unconventional solid-state laser concepts, architectures, beam control and advanced beam control schemes for the development of improved size, weight, and power (SWaP) Army DE weapons and tactical laser developers.

Work in this effort compliments other Army DE efforts conducted under PE 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's 31+4 programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.

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

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser Enabling and Support Technology	5.856	-	-
Description: This effort provides the underlying data for future High Energy Laser weapons to effectively engage an array of threats. The data includes prioritized aim points on each threat as well as time to defeat the threats for each aim point. This activity includes the full spectrum of target lethality investigations and engagement of flying targets in relevant scenarios. This part of the activity is primarily executed at the Solid State Laser Testbed facility at White Sands Missile Range, New Mexico.			
This effort also focuses on developing core Army expertise through laser and beam control technology assessments, applied research, and other technical core competencies. This effort focuses on developing in-house expertise in Adaptive Optics, Beam Control, laser diodes, target illuminators lasers and beacon illuminator lasers, laser diagnostics, and new tracking algorithms. These technologies can be integrated into future laser systems to locate, identify, and engage critical targets. Results of this research will improve the size, weight and power requirements, and the efficacy of laser weapons systems on Army platforms in the future.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) AD2 / <i>High Energy Laser (HEL) Enabling and Support Techn</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Accomplishments/Planned Programs Subtotals	5.856	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AD3 / Maneuver Air Defense Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD3: <i>Maneuver Air Defense Technology</i>	-	7.604	-	-	-	-	-	-	-	-	0.000	7.604

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by investigating and developing critical missile technologies and components necessary for an affordable short range air defense interceptor capability to defeat Cruise Missile (CM), Rotary Wing (RW), Tactical / Lethal Unmanned Aerial System (UAS), and Fixed Wing (FW) threats. This Project also designs and develops technologies to provide reduced size weight and power and cost for Maneuver Short Range Air Defense (MSHORAD), Short Range Air Defense (SHORAD), and Lower Tier essential to maintain overmatch against mid-/far-term threats.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Maneuver Air Defense Technology	7.604	-	-
Description: Investigates and develops critical missile technologies and components necessary for an affordable short range air defense interceptor capability to defeat RW, Tactical / Lethal UAS, and FW threats.			
Accomplishments/Planned Programs Subtotals	7.604	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AD5 / Next Generation Fires Radar Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
AD5: Next Generation Fires Radar Technology	-	1.433	-	-	-	-	-	-	-	-	0.000	1.433

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by investigating and developing advanced radar technologies for insertion into Multi-Mission Army Radar systems. This Project addresses challenges facing simultaneously achieving high linearity and efficiency at high frequencies, accuracy in the underlying high frequency device and circuit models, integration of new material into Silicon complementary metal-oxide-semiconductor (CMOS) processing flows, and electronics reliability that appear as new semiconductor materials are developed and feature sizes shrink.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD6 (Next Generation Fires Radar Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Multi-Mode Air Defense Radar	1.433	-	-
Description: This research supports the technical challenges associated with air defense radar technology. In particular, this effort will analyze current and emerging radio frequency (RF) spoofing, RF jamming, and RF signature management technologies to determine their impact on the performance of air defense radars. Electromagnetic modeling, RF measurements, and experiments will be used to identify mitigation techniques for spoofing and jamming, and to identify useful signature management technologies. This will also include research in electronic devices, sub-assembly design, and laboratory experiments to advance the state-of-the-art of air defense radars operating in contested electronic environments.			
Accomplishments/Planned Programs Subtotals	1.433	-	-

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AE2 / Unconventional Countermeasures-Survivability Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>AE2: Unconventional Countermeasures-Survivability Tech</i>	-	3.783	3.947	3.384	-	3.384	2.766	3.769	3.772	3.363	0.000	24.784

A. Mission Description and Budget Item Justification

This Project designs and develops technologies to deter tactical surveillance and targeting by adversarial area denial systems and munitions. The Project investigates methods to increase survivability of critical assets against precision-guided near-peer advanced weapons threats, investigates and develops tonedown methods for signature management, and computationally develops novel countermeasures. This Project also develops a suite of high-fidelity, physics-based modeling and simulation tools for the design and development of unconventional countermeasures and survivability enhancers applicable to a wide range of operating environments.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Model-Based Assessment of Sensors and Countermeasures	2.309	1.878	-
Description: This effort develops a suite of high-fidelity, physics-based modeling and simulation tools for the design and development of unconventional countermeasures for a wide range of operating environments; develops tools for the evaluation of threat detection and object identification.			
FY 2023 Plans: Integrate and blend small high-fidelity models within larger low resolution domains to enable end-to-end modeling of environmental and unconventional countermeasure effects on terminal sensing modalities.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle conclusion of this effort with transition of technologies to PE 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).			
Title: Advanced Integrated Unconventional Countermeasures Applications	1.330	2.018	1.651

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AE2 / Unconventional Countermeasures-Survivability Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Description: This effort develops methods and materials to defeat peer advanced reconnaissance, surveillance, targeting methods through advancements in material science and computational prototyping to reduce targetable signatures and confuse targeting systems.</p> <p>FY 2023 Plans: Develop concepts for systems incorporating organic materials for targeting hyperspectral and multispectral sensor bands, and develop advanced thermal generation technologies for lightweight structural panels for integration into survivability enhancement systems.</p> <p>FY 2024 Plans: Will develop computational tools and validate material science solutions to aid in the optimization of signature management by coupling material science and computational simulations within a closed-loop computational architecture for targeted countermeasure applications.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort to transition technologies to PE 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech) for maturation and demonstration.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		0.144	0.051	-
<p>Title: Virtual Unconventional Countermeasure Environment</p> <p>Description: This effort develops physics-based modeling and simulation tools for rapid prototyping of novel unconventional countermeasures across multiple relevant operational environments and sensing modalities on an assortment of platforms.</p> <p>FY 2024 Plans: Will conduct studies to investigate effects on countermeasure development and effectiveness assessment under rapidly developed physics-based geo-typical scenes.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	-	1.733

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) AE2 / <i>Unconventional Countermeasures-Survivability Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase reflects the planned lifecycle initiation of this effort.			
Accomplishments/Planned Programs Subtotals	3.783	3.947	3.384

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

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BN6: <i>Advanced Weapons Components (CA)</i>	-	74.250	61.752	-	-	-	-	-	-	-	0.000	136.002

Note

Congressional Interest Item funding provided for Advanced Weapons Components.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Advanced Weapon Components.

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

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

	FY 2022	FY 2023
<p>Congressional Add: Program Increase - BEAM CONTROL SYSTEMS AND INDUSTRY GRADE OPTICAL FIBER FABRICATION FOR ENERGY LASER</p> <p>FY 2022 Accomplishments: Work in FY 2022 is a continuation of and furthers efforts executed under FY 2021.</p> <p>The effort will characterize and optimize a diverse set of fiber laser systems, optics, and photonics to support development, maturation, and suitability assessments for technology insertion for High Energy Laser weapon systems.</p> <p>Additionally, this effort will develop and mature next generation direct diode laser systems. Finally, this effort will research crystalline fiber lasers and techniques for high energy pulsed power applications for next generation High Energy Laser systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p> <p>FY 2023 Plans: Work in FY 2023 is a continuation of and furthers efforts executed under FY 2022.</p> <p>This effort will continue to characterize and optimize a diverse set of fiber laser systems, optics, and photonics to support development, maturation, and suitability assessments for technology insertion for High Energy Laser (HEL) weapon systems.</p>	12.000	9.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023	
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
<p>Additionally, this effort will continue development and mature the next generation direct diode laser systems. Finally, this effort will research crystalline fiber lasers and techniques for high energy pulsed power applications for next generation High Energy Laser systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>			
<p>Congressional Add: Program Increase - COUNTER UAS CENTER FOR EXCELLENCE</p> <p>FY 2022 Accomplishments: Congressional Interest Item funding provided for Counter UAS Center for Excellence</p> <p>FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components</p>	5.000	5.000	
<p>Congressional Add: Program Increase: High Energy Laser Testing and Expansion</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser lethality testing and expansion.</p> <p>This effort will develop and refine High Energy Laser (HEL) Lethality Testing using the Solid-State Laser Testbed (SSLT) at White Sands Missile Range (WSMR). Effort ensures upgrades to maintain relevancy and responsiveness to today's programs (cruise missiles, larger UAVs). Additionally, this effort will conduct HEL testing to support development of HEL atmospheric propagation codes to account for ground battlefield conditions, while providing traceability to current and future Army HEL systems. Defines lethality requirements for future and current Army HEL programs and acquisition Program of Records.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>	10.000	-	
<p>Congressional Add: Program Increase: HIGH ENERGY LASER AND OPTICAL TECHNOLOGY</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser optical technology.</p> <p>This effort will develop and mature power scalable laser subsystem optical technologies. Conduct laboratory and field experiments to validate performance of the technologies. Develop beam control technologies, e.g. adaptive optics for atmospheric compensation and advanced tracking sensors, to increase effectiveness of Army HEL</p>	6.000	10.000	

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023	
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	
<p>weapon systems against stressing threats. Finally, this effort will enable beam director subsystem refinement, development, and systematic maturation, while enhancing the industrial base critical materials and technologies.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p> <p>FY 2023 Plans: Work in FY 2023 is a continuation of and furthers efforts executed under FY 2022.</p> <p>This effort continues to develop and matures improvements in tracking, targeting, cueing, and battle damage assessment. Leverages previous development efforts to integrate and demonstrate an integrated laser ranger/ illuminator with time gated camera that provides improved targeting and engagement in complex and cluttered environments.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>			
<p>Congressional Add: Program Increase: High Energy Laser Technology Integration</p> <p>FY 2022 Accomplishments: Program increase supporting applied research in high energy laser technology integration.</p> <p>This effort supports increased Science and Technology (S&T) investment to improve High Energy Laser (HEL) capability for operational analysis and system development. Leverages increased model and simulation capability to support technical analysis, operational assessments and systems engineering in areas such as Direct Diode approaches for HEL. Finally, this effort will research and develop automated detection, tracking, identification and engagement algorithms to enable integration with higher echelon battle management systems.</p> <p>Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.</p>	10.000	-	
<p>Congressional Add: Program Increase - ARMY MISSILE RISK-BASED MISSION ASSURANCE</p> <p>FY 2022 Accomplishments: Congressional Interest Item funding provided for Army Missile Risk-Based Mission Assurance</p> <p>FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components</p>	15.000	5.000	
<p>Congressional Add: Kill Chain Automation</p>	8.000	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) BN6 / Advanced Weapons Components (CA)
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
FY 2022 Accomplishments: Congressional Interest Item funding provided for Kill Chain Automation		
Congressional Add: Machine Learning Optimized Power Electronics	3.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics		
Congressional Add: Program Increase - Precision Long Range Integrated Strike (PLRIS)	5.250	6.752
FY 2022 Accomplishments: Congressional Interest Item funding provided for Precision Long Range Integrated Strike		
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Add: Program Increase - SMALL UAS TRACKING AND TARGETING DEVICES	-	14.000
FY 2023 Plans: This effort will develop, build and demonstrate a small agile gimbal prototype incorporating enhanced lasers and servos for greater targeting range. The demonstration gimbal for High Energy Laser (HEL) beam direction will be based on requirements and designs for next generation lightweight HEL systems.		
Project expands U.S. manufactured compact stabilized tracking and targeting devices for Class I, II and III small Unmanned Air Systems (sUAS).		
Work performed in Huntsville, Alabama by the United States Army Space and Missile Defense Command (USASMDC), with the Rapid Capabilities and Critical Technologies Office (RCCTO) oversight.		
Congressional Add: Program Increase - CYBER ELECTROMAGNETIC ACTIVITIES MISSILE DEFENDER	-	2.000
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Add: Program Increase - MISSILE RISK-BASED MISSION ASSURANCE	-	10.000
FY 2023 Plans: Congressional Program Increase for Advanced Weapons Components		
Congressional Adds Subtotals	74.250	61.752

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) BN6 / <i>Advanced Weapons Components (CA)</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) CV7 / High Energy Laser Direct Diode Apl Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CV7: High Energy Laser Direct Diode Apl Tech</i>	-	-	2.902	1.495	-	1.495	3.218	3.030	7.411	8.971	0.000	27.027

A. Mission Description and Budget Item Justification

This Project designs and develops single mode diode emitters to increase output power to 100 Watts with >60% electrical-to-optical efficiency and packaging for an array of emitters. This Project will also develop and validate a 100 kW-class laser subsystem with 58% electrical-to-optical efficiency and 80% fractional power in bucket (PIB) in a lab setting. This Project will leverage industry and National Labs research to overcome gain limitations through implementing innovative techniques to control the current across the contact in the semi-conductor gain region. This Project also funds research to achieve higher power, 10s of watts, single mode emitters are necessary to make significant improvements to the size, weight, and power (SWaP) of laser subsystems.

Research in this Project complements other Army Directed Energy efforts conducted under Program Element (PE) 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's modernization programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) in coordination with RCCTO.

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

	FY 2022	FY 2023	FY 2024
Title: High Energy Laser Direct Diode Applied Technology	-	2.902	1.495
Description: This effort designs and develops single mode diode emitters to increase output power to 100 Watts with >60% electrical-to-optical efficiency and develop packaging for an array of emitters. This effort will also design and develop a 100 kW-class laser subsystem with 58% E-O efficiency and 80% fractional PIB; validated in a lab setting. This effort will leverage industry and National Labs research to overcome gain limitations through implementing innovative techniques to control the current across the contact in the semi-conductor gain region. Higher power 10s of watts single mode emitters are necessary to make significant improvements to the SWaP of laser subsystems.			
FY 2023 Plans: Will design and develop the Tapered Amplifier Array in order to fit into spectral locking assembly for laser system to improve Size, Weight and Power for High Energy Laser weapon systems. Will design and develop a 100 Watt, 60% Electrical to Optical Efficient			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) CV7 / High Energy Laser Direct Diode Appl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Single Mode Tapered Amplifier in order to improve power and efficiency out of single mode tapered amplifiers to improve Size, Weight and Power for a High Energy Laser weapon system.</p> <p>FY 2024 Plans: Complete development of single mode diode array and packaging. Evaluate spectral locking of array beam quality. Complete development of higher power and efficiency single mode diodes. Evaluate performance and optimize single mode diode designs based on findings.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Fiscal Year 24 decrease of \$1.400 million dollars aligns the program with Army modernization priorities in Advanced Beam Control in support of the National Defense Strategy.</p>			
Accomplishments/Planned Programs Subtotals	-	2.902	1.495

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) CV8 / Vulnerability Modules for Multi-Domain Operations			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CV8: Vulnerability Modules for Multi-Domain Operations	-	-	8.083	8.987	-	8.987	7.734	7.952	8.691	8.786	0.000	50.233

A. Mission Description and Budget Item Justification

This Project will design and develop High Energy Laser (HEL) Vulnerability Modules (VM), engagement tactics data and kill signatures for targeting Unmanned Aerial Systems, Cruise Missiles, and Rotary Wing threats for future HEL weapon systems. Developed smart VMs will enable real time threat feature detection and targeting, increasing the lethality of the HEL weapon systems through optimizing aimpoint selection. The Development of smart VMs will enable optimized targeting across a large range of current and future threat targets due to detection capabilities applied against threat features and not specific threats.

Research in this Project complements other Army Directed Energy efforts conducted under Program element (PE) 0602150A (Air and Missile Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology).

The cited research is consistent with the Army's modernization programs, the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and supports the Army's future capability opportunities for leap-ahead technology for Directed Energy.

Research is performed by the United States Army Space and Missile Defense Command - Technical Center (USASMDC-TC) in coordination with RCCTO.

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

	FY 2022	FY 2023	FY 2024
Title: Vulnerability Modules for Multi Domain Operations	-	8.083	8.987
Description: This effort will design and develop Vulnerability Modules for Multi Domain Operations against current and emerging high priority threats. Investigates and conducts experiments on High Energy Laser Lethality against Unmanned Aerial Systems, Cruise Missiles and Rotary Wing aircraft. The effort will fund research and conduct experiments to optimize aimpoints for rapid and effective High Energy Laser weapon systems fire control solutions.			
FY 2023 Plans: This effort will develop Vulnerability Modules on Group 2&3 Unmanned Aerial System (UAS), sub-sonic Cruise Missiles and Rotary Wing Aircraft by conducting vulnerability analysis and experiment activities. Will research Failure Mode Effects Analysis (FMEA), selecting aim points, developing models, and analyze data from intel sources and subject matter experts.			
FY 2024 Plans: This effort will advance Vulnerability Modules (VMs) on Group 2&3 Unmanned Aerial Systems (UASs), Rotary Wing (R-W), and Subsonic and Supersonic Cruise Missiles (CMs) through vulnerability analysis and experiments. Conduct Part Two of UAS and R-W initial coupon/material and specific aimpoint experiments utilizing data gained in Smart VM development to further increase			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) CV8 / <i>Vulnerability Modules for Multi-Domain Operations</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
VM Readiness Levels (RLs). Conduct Subsonic CM complete set of components and full-scale experiments. Conduct studies of Supersonic CM analytical/existing data, intel, and SME operations combined with DoD simulations.				
FY 2023 to FY 2024 Increase/Decrease Statement: Fiscal Year 24 increase of \$0.900 million dollars is for procurement of advanced threat represented targets in alignment with Army modernization priorities in Multi-Domain Operations in support of the National Military Strategy.				
Accomplishments/Planned Programs Subtotals		-	8.083	8.987
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) DA9 / Radar Survivability through Dis Sensing Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DA9: Radar Survivability through Dis Sensing Tech	-	-	5.803	4.703	-	4.703	4.076	3.767	2.304	2.329	0.000	22.982

A. Mission Description and Budget Item Justification

This project investigates and develops critical radar capability enhancements to defeat advanced Air and Missile threats and protect Army maneuver forces and critical assets. Radar enhancements are required for advanced Electronic Protection (EP) techniques against advanced jammers, electronic Combat Identification (CID), and resource optimization across the threat spectrum while retaining 360° coverage capability. Technology development includes providing capabilities for: dispersed multi-static operation, classifying/tracking emerging threats and high volume threats; adaptive digital beam forming to enable resource efficiency, performance in a dynamic clutter environment and enhanced survivability in a contested battlespace; and multi-modal tracking and additional discrimination models to support diverse and emerging threats, such as swarms and guided munitions. Enhanced development for the state-of-the-art scalable, digital array radar testbed to include advanced algorithms, transmitted power, antenna gain, detection range and angle accuracy/resolution upgrades to the existing/new radar front/back ends will allow greater performance characterization for Multi-mission Army Radar systems supporting the Multi-domain Operations (MDO).

This research is coordinated with Army Program Element (PE) 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts); PE 0602148A (Future Vertical Lift Technology / Project CC3 (FVL Radar Technology); PE 0602150A (Air and Missile Defense Tech)/Project AD5 (Next Generation Fires Radar Tech); and PE 0601102A (Defense Research Sciences)/ Project AA8 (Foundational Distributed Radar); Additionally this project leverages and works closely with Navy, Air Force, DARPA, and MDA radar research and development efforts.

This research complements Program Element (PE) 0602141A (Lethality Technology)//Project CJ7 (Future Air Defense Missile Enabling Technology) and PE 0603466A (Air and Missile Defense Advanced Technology)/ Project DB3 (Radar Survivability through Dis Sensing Adv Tech)The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Radar Survivability through Dis Sensing (RSDS) Tech	-	5.591	4.703
Description: Investigates and develops critical radar capability enhancements to defeat advanced Air and Missile threats and protect Army maneuver forces and critical assets			
FY 2023 Plans: Will design and develop RSDS software for radar survivability and explore concepts of operations for resource optimization architectures for dispersed multi-static operations implemented in current and future Army Air Defense radars. Will develop a tailored high-fidelity simulation environment to model and evaluate the optimum method of linking multiple radars. Will			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) DA9 / Radar Survivability through Distributed Sensing Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>leverage the new scalable, all-digital front-end antenna aperture Digital Array Radar Testbed (DART) to design and develop next generation capability, flexibility, and supportability to Army radars by increasing the number of digital elements and developing advanced algorithms and architectures to allow greater performance characterization.</p> <p>FY 2024 Plans: Will develop RSDS software technology and radar representative hardware to minimize risks associated with integration into Army Radar systems; continue modeling and simulation efforts to develop concepts in the areas of operations analysis, radar resource optimization, and radar communications; inform performance metrics of distributed sensing in a multi-static radar configuration; utilize the low-cost multi-static radar testbed and execute data collections in distributed sensing configurations in contested environments; perform data analysis to aid with modeling and simulation and the development of a software based RSDS capability for future and current air defense radar systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease due to completing the DART testbed upgrade in FY23. Modeling and simulation efforts to mature the technology will continue in FY24.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.212	-
Accomplishments/Planned Programs Subtotals	-	5.803	4.703

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) DC1 / Next Generation DE Concept Development & Analysis			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC1: Next Generation DE Concept Development & Analysis	-	-	6.281	6.446	-	6.446	13.638	14.056	20.058	19.387	0.000	79.866

A. Mission Description and Budget Item Justification

This Project researches and investigates lethality effectiveness, adaptive optics, beam control, laser sources, target and beacon illuminator lasers, new tracking algorithms, laser and beam control equipping for High Energy Laser experimentation to improve future High Energy Laser weapon system effectiveness. This Project determines critical activities to enable next generation directed energy technical innovations and funds core competencies in Lethality and Directed Energy.

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

	FY 2022	FY 2023	FY 2024
Title: Next Generation Direct Energy Concept Development and Analysis	-	6.281	6.446
Description: This effort funds foundational core competencies to develop and maintain a competent and skilled Directed Energy workforce as well as develop Science and Technology Labs to support future Directed Energy components, subsystems and system upgrades. This effort funds foundational research for future High Energy Laser weapons to effectively engage an array of threats. Research includes identifying and prioritizing aim points of identified threats by analyzing the time to kill for each aim point. In addition, this effort investigates the full spectrum of target lethality from material analysis, modeling engagement scenarios, and data collection of High Energy Laser engagements with dynamic targets. This effort also funds core in-house technical competencies for adaptive optics, beam control, laser diodes and laser illuminators.			
FY 2023 Plans: Investigates advanced adaptive optics concepts for use in deep turbulence environments. Investigates direct diode laser design concepts and pulsed illuminator / gate fine track sensor design concepts to develop improved size, weight, and power (SWaP) and improve the effective range of HEL weapon systems. System Characterization, Hardware in the Loop (HWIL) and Software in the Loop (SWIL) will increase efficiency in characterizing prototype(s) and HEL science and technology efforts, advancing future HEL weapon component and system effectiveness.			
FY 2024 Plans: Will research and investigate laser sources, beam control and advanced adaptive optics for increased high energy laser (HEL) system effectiveness against a range of threats. Conducts experiments to characterize high energy laser components and subsystem effectiveness. Continues to research and investigate laser source concepts to improve, size, weight, and power (SWaP) of HEL weapon systems. Determines critical activities to enable next generation DE technical innovations and core competencies.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) DC1 / <i>Next Generation DE Concept Development & Analysis</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Increase of \$0.096M in FY24 to support additional studies and analysis in Directed Energy Priority Research Areas in support of Army priorities and the National Defense Strategy.			
Accomplishments/Planned Programs Subtotals	-	6.281	6.446

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) DE3 / Adv Beam Control Component Development for C-CM
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DE3: Adv Beam Control Component Development for C-CM	-	-	-	8.286	-	8.286	-	-	-	-	0.000	8.286

Note
Adv Beam Control Component Development for C-CM is a new start within the Air and Missile Defense Technology program in FY 2024.

A. Mission Description and Budget Item Justification
Research and develop advanced Beam Control technology to create new sensors, illuminators, deformable mirrors, wave front sensors (WFS), other optical components, and acquisition and tracking concepts and to create Digital Twins of those new elements. Integrate a 60-cm off-axis telescope into the Mobile Beam Control Testbed gimbal and build a 50 kW Phased Array Laser Adaptive Optics Compensator. Develop algorithms for WFS and phased array sensors and integrate a 1-meter class segmented Beam Director with Phased Array High Energy Laser. In order to increase the effective range of the Indirect Fire Protection Capability High Energy Laser weapon system.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Title: Advanced Beam Control Component Developments for C-CM	-	-	8.286
Description: Support Advanced Beam Control Phase I (extend effective range of the Indirect Fire Protection Capability High Energy Laser weapon system). Support Advanced Beam Control Phase II (extend effective range of the Indirect Fire Protection Capability High Energy Laser weapon system). Develop New Technologies for Beam Director Assemblies. Support the Space and Missile Defense Commands efforts in developing Counter Cruise Missile Components/Subsystems.			
FY 2024 Plans: Research and develop advanced beam control technology to improve weapon system effectiveness and extend the effective range. Investigate optimal algorithms and hardware configuration for multiple wavefront sensor architectures.			
FY 2023 to FY 2024 Increase/Decrease Statement: Increase of \$8.250M in FY24 for a New Start Effort (Advanced Beam Control Component Developments for C-CM) in support of Army priorities and the National Defense Strategy.			
Accomplishments/Planned Programs Subtotals	-	-	8.286

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) DE3 / Adv Beam Control Component Development for C-CM

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	14.486	16.068	24.142	-	24.142	23.975	22.158	22.520	22.273	0.000	145.622
CL2: <i>AI Enhanced Intel Operations Technologies</i>	-	3.589	2.076	2.546	-	2.546	2.963	3.069	3.373	3.328	0.000	20.944
CL7: <i>ATR Using Multiple Cooperative Sensors App Tech</i>	-	7.366	6.388	10.895	-	10.895	11.401	9.356	9.368	9.488	0.000	64.262
CN7: <i>Predictive Maintenance Applied Research</i>	-	3.531	4.694	6.030	-	6.030	6.093	6.201	6.225	6.398	0.000	39.172
DA5: <i>AI Enabled Talent Management Applied Research</i>	-	-	0.319	-	-	-	-	-	-	-	0.000	0.319
DA6: <i>AI-Enabled Command and Coordination Apl Research</i>	-	-	2.591	3.265	-	3.265	3.518	3.532	3.554	3.059	0.000	19.519
DE8: <i>AI Development Environment Applied Research</i>	-	-	-	1.406	-	1.406	-	-	-	-	0.000	1.406

Note

In Fiscal Year 2024 (FY24), Project DE8 (AI Development Environment Applied Research) is a New Start.

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates artificial intelligence (AI) and machine learning (ML) to support an AI-enabled Multi-Domain Operations (MDO) Force to mature target recognition/detection using multiple cooperative autonomous sensors (MCAS), leader decision-making, replication of tactical behaviors to enable autonomous capabilities for maneuver, predictive maintenance, and intelligence support for operations in support of long-range precision fires. The Army's Artificial Integration Center (AI2C) will provide strategic guidance and coordination of these applied research efforts in AI/ML across the Army Modernization enterprise.

Work in this PE contributes to the Army Science and Technology (S&T) portfolio and is fully coordinated with efforts in PE 0601601A (Artificial Intelligence Basic Research) and PE 0603040A (Artificial Intelligence Advanced Technologies).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering S&T focus areas, the Army Modernization Strategy and the Chief Digital and Artificial Intelligence Office (CDAO).

Research in this PE is performed by the United States Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	15.034	16.454	17.906	-	17.906
Current President's Budget	14.486	16.068	24.142	-	24.142
Total Adjustments	-0.548	-0.386	6.236	-	6.236
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.548	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	6.236	-	6.236
• FFRDC Transfer	-	-0.386	-	-	-

Change Summary Explanation

Increased funding to support higher priorities in the Science & Technology (S&T) portfolio to include the initiation of new efforts related to artificial intelligence.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL2 / <i>AI Enhanced Intel Operations Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CL2: AI Enhanced Intel Operations Technologies</i>	-	3.589	2.076	2.546	-	2.546	2.963	3.069	3.373	3.328	0.000	20.944

A. Mission Description and Budget Item Justification

This Project will design and develop various technologies to augment human intelligence analysts with artificial intelligence (AI) and machine learning (ML)-enabled decision support, workflow automation, and recommendation tools to modernize how the Intelligence Warfighting Function supports Multi-Domain Operations and Joint All Domain Command and Control (JADC2). This Project will mature technologies that will enable interoperable intelligence organizations capable of conducting synchronized, proactive intelligence operations to optimize individual efficiencies and team performance.

The Capstone Concept for Joint Operations: Joint Force 2020 and the Force 2025 and Beyond (F2025B) strategy calls for the integration of terrestrial sensing and exploitation capabilities to accelerate the data to decision cycle across the Range of Military Operations (ROMO). The Army Operating Concept and the Army Functional Concepts identifies the need for interoperable intelligence organizations capable of conducting synchronized proactive intelligence operations that optimize individual efficiencies and team performance. These concepts are driven by a threat that has studied United States (US) advancements during the Global War on Terror and taken notes.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

This research is supported and coordinated with the Army Intel Community, Army Futures Command, and the Army Intelligence, Surveillance, Reconnaissance (ISR) Task Force.

Work in this Project supports the Army Science and Technology Ground Portfolio and the Chief Digital and Artificial Intelligence Office (CDAO)

Work in this Project is performed by the US Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Synthetics and Low Level Detection	0.936	-	-
Description: This effort will design and develop AI and ML technologies for low level object generation, detection and recognition that address the significant variation in object imagery and limited amounts of available training data for AI / ML algorithms.			
Title: AI Enhancements for Prometheus	1.153	0.500	-
Description: AI Enabled Intelligence Fusion for Targeting will address a "multi-INT" fusion problem and demonstrate how AI algorithms can fuse data from various military intelligence systems to support sensor to shooter automation for the strategic,			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL2 / <i>AI Enhanced Intel Operations Technologies</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
operational, and tactical levels. This effort will design and develop AI capabilities for support of Long Range Precision Fires, Mission Command, and Maneuver Commanders by leveraging Intelligence Community enterprise investments in sensing, data transport, and Machine Learning / AI frameworks.				
<p>FY 2023 Plans: Prometheus is a system that utilizes AI technologies to identify targets of interest from overhead satellite images. This effort will mature algorithms developed under the umbrella of Prometheus to predict representation for novel object classes from a small number of novel class samples, improving the AI algorithm learning capability and reducing the need for manual data input. Will investigate the use of visual information and semantic relationships to learn new objects and validate knowledge transfer from base classes to novel classes in order to reduce the time it takes to train AI algorithms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease due to planned completion of effort in Fiscal Year (FY) 2023.</p>				
<p>Title: AI-Enabled Intelligence Decision Support</p> <p>Description: This effort will investigate the augmentation of Military Intelligence and Operations (Intel/Ops) with artificial intelligence capabilities to leverage Mission, Enemy, Terrain and Weather, Troops, Time Available, and Civilian Considerations (METT-TC) information available to Commanders in support of Intelligence Preparation of the Battlefield (IPB) and the Military Decision Making Process (MDMP). The effort will mature techniques to visualize and animate threat models to support automated AI-enabled enemy courses of action analysis.</p>		1.100	1.000	1.000
<p>FY 2023 Plans: Design and develop AI agents to employ METT-TC information available to Commanders to generate courses of action for threat formations as well as conduct AI-war gaming in support of Intelligence Preparation of the Battlefield and the Military Decision Making Process. This effort will conduct experiments of automated real-time strategy war gaming between synthetic agents representing friendly and adversary forces at the Division echelon.</p> <p>FY 2024 Plans: Design and develop AI agents to employ METT-TC information available to Commanders to generate courses of action for threat formations as well as conduct AI-war gaming in support of Intelligence Preparation of the Battlefield and the Military Decision Making Process. This effort will conduct experiments of automated real-time strategy war gaming between synthetic agents representing friendly and adversary forces at the Division echelon.</p>				
Title: Foundation for AI Intelligence Support to Operations (ARCANE SERIES)		0.400	0.500	0.500

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL2 / <i>AI Enhanced Intel Operations Technologies</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Description: Design and develop an AI infrastructure/pipeline for training, integrating, and sustaining AI across multiple AI domains to inform requirements for enterprise production systems and edge systems for the Army Military Intelligence and Operations (Intel/Ops) community.</p> <p>FY 2023 Plans: Will investigate data frameworks for algorithmic fusion of information from multiple intelligence collection systems and multi-modal machine learning and scenery construction to compare and apply lessons learned.</p> <p>FY 2024 Plans: Will mature data frameworks and data pipelines for fusion of intelligence data from multiple military intelligence systems. Will develop and conduct experiments with infrastructure components that can implement machine learning algorithms across multiple AI domains.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.076	-
<p>Title: Rare Object Generation and Detection</p> <p>Description: This effort will design and develop AI and machine learning (ML) technology to generate and detect objects that are rarely detected and have limited training data sets (rare object generation and detection). Rare object generation and detection is a key ML challenge due to limited amounts of available training data that make it difficult to build high performing AI models to address these challenges.</p> <p>FY 2024 Plans: This effort will design and develop AI and machine learning (ML) algorithms for rare object generation, detection and recognition. Research will investigate technical approaches to address object image variations and limited amounts of available training data such as the use of synthetic data.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase to expand efforts to develop AI/ML technologies for rare object generation, detection and recognition.</p>		-	-	0.511
<p>Title: AI-Enabled Intelligence Fusion for Targeting</p>		-	-	0.535

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL2 / <i>AI Enhanced Intel Operations Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: AI Enabled Intelligence Fusion for Targeting will investigate the fusion of different type of intelligence data (multi-INT fusion) and validate AI algorithms that can fuse data from various military intelligence systems to support sensor to shooter automation for the strategic, operational, and tactical levels. This effort will design and develop AI capabilities for support of Long Range Precision Fires, Mission Command, and Maneuver Commanders by leveraging Intelligence Community enterprise investments in sensing, data transport, and Machine Learning / AI frameworks.</p> <p>FY 2024 Plans: Will develop a system of applications that utilize AI technologies to identify targets of interest and develop algorithms that use multiple data sources to predict representation for novel object classes from a small number of novel class samples. Will investigate the fusion of visual, language, signal, and event-based information and semantic relationships to learn new objects and relationships and validate knowledge transfer from base classes to novel classes in order to reduce the time it takes to train AI algorithms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase to expand efforts to develop AI technologies from multiple AI domains to identify targets of interest.</p>			
Accomplishments/Planned Programs Subtotals	3.589	2.076	2.546

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL7 / <i>ATR Using Multiple Cooperative Sensors App Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CL7: ATR Using Multiple Cooperative Sensors App Tech</i>	-	7.366	6.388	10.895	-	10.895	11.401	9.356	9.368	9.488	0.000	64.262

A. Mission Description and Budget Item Justification

This Project will design and develop Artificial Intelligence (AI) and Machine Learning (ML) algorithms that leverage a team of air and ground sensors to autonomously navigate and collaborate through shared perception of the optical, thermal, and electromagnetic spectrums to find, identify, geo-locate, and track targets during reconnaissance missions.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project supports the Army Science and Technology Lethality Portfolio and the Chief Digital and Artificial Intelligence Office (CDAO).

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Collaborative Target Detection and Tracking	5.416	4.370	4.695
Description: This effort will design and develop the AI / ML technologies to automatically detect and track targets using electro-optical, thermal, and electromagnetic sensors and constrained computing hardware onboard the air and ground vehicles and share threat perception across the unmanned team.			
FY 2023 Plans: Design and develop a cloud-native data pipeline that allows for AI model fine-tuning at the edge in a Denied-Degraded-Intermittent-Limited (DDIL) communications environment. Investigate radio frequency (RF) signature fingerprinting and classification, cross-queueing between platforms for different vantage point, and probability aggregation to improve classification confidence. Design and develop algorithms that enable platforms to collaborate on target searches and fuse target information to avoid erroneous tracks.			
FY 2024 Plans: Will develop algorithms that enable autonomous air and ground vehicles to track and maintain custody of targets after detection to aid in the subsequent stages of the targeting cycle including engagement and assessment. Develop algorithms that share the attributes of targets detected by a single platform to the entire team of autonomous sensors.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL7 / <i>ATR Using Multiple Cooperative Sensors App Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding change reflects planned life cycle of effort.				
<p>Title: Autonomous and Collaborative Mobility</p> <p>Description: This effort will design and develop mobility algorithms using AI and ML techniques that allow autonomous ground and air vehicles to passively perceive the terrain and self-navigate without active and detectable sensing. Design and develop collaborative teaming techniques for autonomous air and ground vehicles to work together on reconnaissance missions.</p> <p>FY 2023 Plans: Design and develop AI algorithms that enable autonomous and collaborative maneuver of air and ground platforms at night or Global Positioning System (GPS) -denied environments.</p> <p>FY 2024 Plans: Design and develop AI algorithms that enable autonomous air and ground platforms to maneuver more tactically and collaboratively during reconnaissance missions. Develop a simulation environment that will allow for reinforcement learning to be leveraged in the development of tactical and collaborative behaviors for the air and ground platforms based on terrain, anticipated enemy locations, view shed, and other factors. Develop autonomy algorithms for more complex terrain and conditions, including nighttime and Global Positioning System (GPS)-denied environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Increased funding for additional efforts to support simulation environments to allow for reinforcement learning and developing autonomy algorithms for more complex terrain and conditions.</p>		1.000	1.000	4.700
<p>Title: Intuitive Mission Command Interfaces</p> <p>Description: Design and develop the capability for warfighters to quickly and intuitively convey reconnaissance guidance, confirm or deny detected targets, and take recommended action through common mission command tools, including Tactical Assault Kit (TAK) and Integrated Visual Augmentation System (IVAS).</p> <p>FY 2023 Plans: Investigate AI algorithms that recommend courses of action for mission activities of the autonomous sensors.</p> <p>FY 2024 Plans: Develop software for the Integrated Visual Augmentation System (IVAS) that enables soldiers to intuitively relay reconnaissance intent to a team of autonomous sensors and quickly interpret feedback from the systems and make targeting decisions. Explore various algorithms that use voice commands, eye movements, and hand gestures to interact with the system for relaying intent</p>		0.950	0.470	1.500

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CL7 / <i>ATR Using Multiple Cooperative Sensors App Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
and closing the targeting cycle more effectively. Develop feedback mechanisms in Android Tactical Assault Kit (ATAK) and IVAS to improve the AI algorithms once soldiers recognize mistakes by the autonomous sensors. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of effort.				
Title: Coeus Description: This effort investigates cloud and cloud-native architectures, orchestration technologies, and collaboration techniques to support current and future AI model development and machine learning operations (MLOps) tasks across a globally distributed workforce. Research will increase efficiency of development platforms, decrease model development costs, and reduce the time required to integrate new AI capabilities into software products. FY 2023 Plans: Will conduct data science and engineering in support of ATR-MCAS (Aided Target Recognition - Mobile Cooperative and Autonomous Sensors) through the use of Coeus, a modular software platform (cloud native). FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of effort.		-	0.315	-
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.233	-
Accomplishments/Planned Programs Subtotals		7.366	6.388	10.895
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>				Project (Number/Name) CN7 / <i>Predictive Maintenance Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN7: <i>Predictive Maintenance Applied Research</i>	-	3.531	4.694	6.030	-	6.030	6.093	6.201	6.225	6.398	0.000	39.172

A. Mission Description and Budget Item Justification

This Project designs and develops artificial intelligence (AI) and machine learning (ML) tools and capabilities to predict and analyze maintenance status for emerging and legacy aviation and ground platforms. Investigates techniques to extract data from maintenance databases and platform sensors and make inferences of missing data via virtual simulations. Will investigate maintenance concepts that employ AI data capture and integrate AI tools into enterprise resource planning for military aviation and ground vehicles. Will determine platforms of focus and prioritize by cost and value to Army missions. Each platform will be sequentially investigated at the appropriate component (i.e. engine health) and fleet level. Will determine appropriate technologies and capabilities needed to construct a robust Army-wide predicative maintenance platform that will accelerate the pace of innovation for this problem set. Will validate and inform requirements and technical architectures for modernization efforts of next generation aviation and ground systems both manned and unmanned.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project supports the Army Science and Technology Ground Portfolio and the Joint Artificial Intelligence Center (JAIC).

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Predictive Maintenance	3.531	4.523	6.030
<p>Description: This Project designs and develops artificial intelligence (AI) and machine learning (ML) tools and capabilities to predict and analyze maintenance status for emerging and legacy aviation and ground platforms. Investigates techniques to extract data from maintenance databases and platform sensors and make inferences of missing data via virtual simulations. Will investigate maintenance concepts that employ AI data capture and integrate AI tools into enterprise resource planning for military aviation and ground vehicles. Will determine platforms of focus and prioritize by cost and value to Army missions. Each platform will be sequentially investigated at the appropriate component (i.e. engine health) and fleet level. Will determine appropriate technologies and capabilities needed to construct a robust Army-wide predicative maintenance platform that will accelerate the pace of innovation for this problem set. Will validate and inform requirements and technical architectures for modernization efforts of next generation aviation and ground systems both manned and unmanned.</p> <p>The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CN7 / <i>Predictive Maintenance Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Research in this Project supports the Army Science and Technology Ground Portfolio and the Joint Artificial Intelligence Center (JAIC).</p> <p>Research in this Project is performed by the United States (US) Army Futures Command.</p> <p>FY 2023 Plans: Will investigate data collection/aggregation techniques and data architectures, and design and develop data pipelines to a cloud-based environment. Will design and develop a scalable, cloud-based data management environment that serves as a data lake repository for incoming data pipelines from the physical data management platforms established at the point of the maintenance activity. Design and develop techniques to aggregate data at the point of the maintenance activity and establish a single pipeline to transition the aggregated data to a scalable, cloud-based data management environment. Design and develop a scalable cloud-based data management architecture accessible via Coeus on an Army-based and owned system.</p> <p>FY 2024 Plans: Will validate AI models addressing high-priority maintenance and supply concerns relevant to tactically-orientated formations. Will explore the pairing these AI models with the foundational components of a scalable hybrid edge/cloud data management environment able to maneuver with Army units in Multi-Domain Operations. Investigations will validate the appropriate balance of edge/cloud data storage, curation, movement, and automation. These features will be determined in reference to operations when the connection to the Department of Defense Information Network (DODIN) is disrupted and when it is connected.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.</p>	-	0.171	-
Accomplishments/Planned Programs Subtotals	3.531	4.694	6.030

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

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) CN7 / <i>Predictive Maintenance Applied Research</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DA5 / <i>AI Enabled Talent Management Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>DA5: AI Enabled Talent Management Applied Research</i>	-	-	0.319	-	-	-	-	-	-	-	0.000	0.319

A. Mission Description and Budget Item Justification

This Project designs, develops, and validates applied behavioral and social science research to enhance the Soldier Lifecycle (e.g., selection, assignment, training, and leader development) and human relations (e.g., unit cohesion). This Project will design and develop new personnel measures and methods that more fully assess potential and predict performance, behavior, attitudes, and resilience. These technologies also provide innovative and effective Force Integration methods to optimize individual and team performance to ensure the Army can meet mission requirements in uncertain and complex environments. This Project designs and develops new performance measures and metrics for individuals and units, designs innovative training methods, and conducts scientific assessments to inform Human Capital policy and programs. This Project will also investigate non-materiel solutions to help the Army adjust to changes in force size and structure, a variety of mission demands and contexts, challenges in human relations, and budgetary constraints.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project supports the Army Science and Technology Ground Portfolio and the Joint Artificial Intelligence Center (JAIC).

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Artificial Intelligence (AI)-Enabled Skill Identification for Job Matching and Team Building</p> <p>Description: This effort will develop AI techniques to create an analytical suite that can measure skills required by job postings and skills possessed by soldiers and officers. This will permit the Army to "put the right person in the right job" and determine how to combine individuals to optimize team performance.</p> <p>FY 2023 Plans: Will investigate the difference between the skill pairings of successful vs. unsuccessful teams using natural language processing. This effort will determine how teams can become 'more than the sum of their parts' and use neural networks to predict successful team outcomes from these individuals' skill sets. This project will design and develop algorithms to identify complementary team members and recommend individual substitutions to improve team performance.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work on this project will finish in FY 2023.</p>	-	0.307	-
<p>Title: SBIR/STTR</p>	-	0.012	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DA5 / <i>AI Enabled Talent Management Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	0.319	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>				Project (Number/Name) DA6 / <i>AI-Enabled Command and Coordination Apl Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DA6: <i>AI-Enabled Command and Coordination Apl Research</i>	-	-	2.591	3.265	-	3.265	3.518	3.532	3.554	3.059	0.000	19.519

A. Mission Description and Budget Item Justification

This Project designs and develops solutions that enable Artificial Intelligence (AI)-Enabled Command and Coordination. Additionally, project investigates and matures technologies required to enable commanders and their staff to synchronize and converge all elements of available combat power to achieve multi-domain effects. Technology maturation includes the development and testing of algorithms, models, software, hardware, and interfaces required to support the command of Army forces, coordination of Army operations, execution of the operations process, and establishing necessary C2 systems.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Course of Action (COA) Analysis for Optimal Operations</p> <p>Description: Design and develop a game theory based algorithm to create optimal or near-optimal COA for red and blue forces based on available data or user inputs.</p> <p>FY 2023 Plans: Will design and develop a game theory algorithm and integrate with an available simulation framework to create COAs at various echelons. Will investigate and determine scenario criteria need for the algorithm to function, design and develop learning strategies and utility functions, and integrate the AI system into an available simulation suite to enable model training. Design and develop a cloud-native data pipeline that allows for distributed decision making at the tactical edge in a Denied-Degraded-Intermittent-Limited (DDIL) environment.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Planned effort will be completed in FY 2023.</p>	-	1.500	-
<p>Title: AI-Enhanced Battle Damage Assessment</p> <p>Description: Design and develop algorithms to optimize the relationships between known friendly force sensors and shooters and assign them to available targets.</p> <p>FY 2023 Plans:</p>	-	0.996	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DA6 / <i>AI-Enabled Command and Coordination Apl Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Will design and develop a game theory-based algorithm for a platoon level engagement to provide optimizations between known blue sensors and shooters and the assignment to available targets. FY 2023 to FY 2024 Increase/Decrease Statement: Planned effort will be completed in FY 2023.				
Title: AI-Enhanced Planning for Optimal Operations Description: Designs and develops AI-enabled systems that link people, processes, networks, and command posts in support of command and control. Develops and trains models that analyze, understand, and optimize AI-operations across Army Battle Command Systems and data fabrics. Develops platforms to access AI-enabled C2 tools from austere environments. Establishes pipelines that assess, train, retrain, store, and disseminate AI models and tools. Establishes access to fused multitudinous data sources in support of AI-based analytics capabilities. FY 2024 Plans: Will design and develop game theory and multi-agent reinforcement learning algorithms and integrate with an available simulation framework to create COAs at various echelons. Will investigate and determine scenario criteria need for the algorithm to function, design and develop learning strategies and utility functions, and integrate the AI system into an available simulation suite to enable model training. FY 2023 to FY 2024 Increase/Decrease Statement: Increase in funding to support planned initiation of this effort.		-	-	2.000
Title: AI Command and Coordination Environment Description: Designs and develops AI-enabled systems that link people, processes, networks, and command posts in support of command and coordination. Develops and trains models that analyze, understand, and optimize AI-operations across Army Battle Command Systems and data fabrics. Develops platforms to access AI-enabled C2 tools from austere environments. Establishes pipelines that assess, train, retrain, store, and disseminate AI models and tools. Establishes access to fused multitudinous data sources in support of AI-based analytics capabilities. FY 2024 Plans: Design and demonstrate a cloud native C2 environment for access to AI-tools at the edge in degraded communications environments. Incorporate tactical data fabric concepts with AI enabled decision dominance hardware and software requirements. FY 2023 to FY 2024 Increase/Decrease Statement: Increase in funding to support planned initiation of this effort.		-	-	1.265
Title: SBIR/STTR		-	0.095	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DA6 / <i>AI-Enabled Command and Coordination Apl Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	2.591	3.265

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DE8 / <i>AI Development Environment Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>DE8: AI Development Environment Applied Research</i>	-	-	-	1.406	-	1.406	-	-	-	-	0.000	1.406

Note

AI Development Environment Applied Research is a new start within the Artificial Intelligence and Machine Learning Technologies program in FY 2024.

A. Mission Description and Budget Item Justification

The Army lacks a common platform to develop AI/ML. This results in siloed and duplicative work that is inefficient. Many current solutions have narrow application and are proprietary, requiring additional funding, time, and labor for even minor modifications. The AI-enabled Army of the future will require low cost, rapid AI/ML solutions at the edge. This project will design and develop a set of platform(s), and infrastructure optimized for Army use and ready for rapid employment in enterprise, multi, and hybrid cloud environments to support modular software (cloud native) intended to continuously develop and integrate AI/ML models. It will design and develop hardware and software technologies, including cloud native applications and infrastructure for globally dispersed AI/ML development collaboration, artifact sharing, automated resource provisioning, and continuous ML Operations. The AI Development Environment will provide the AI-enabled Army of the future with low cost, rapid AI/ML solutions at the edge and accelerated algorithm development for faster delivery to the field as well as less expensive AI/ML development by leveraging shared resources.

The cited research is consistent with Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project supports the Army Science and Technology Network Portfolio and the Chief Digital and Artificial Intelligence Office (CDAO).

Work in this Project is performed by the US Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Artificial Intelligence Environment Applied Research	-	-	1.406
Description: This effort investigates cloud and cloud-native architectures, orchestration technologies, and collaboration techniques to support current and future AI model development and machine learning operations (MLOps) tasks across a globally distributed workforce. Research will increase efficiency of development platforms, decrease model development costs, and reduce the time required to integrate new AI capabilities into software products.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602180A / <i>Artificial Intelligence and Machine Learning Technologies</i>	Project (Number/Name) DE8 / <i>AI Development Environment Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will investigate hybrid cloud architectures to support MLOps from the cloud to the tactical edge. Design and develop techniques to optimize cloud operations in a hybrid or multi-cloud environments. Will investigate the integration of additional software tools with the development environment to increase options of Artificial intelligence (AI) algorithm development and testing. <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> This project is a FY24 New Start.			
Accomplishments/Planned Programs Subtotals	-	-	1.406

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence Applied Research
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	25.019	27.360	14.297	-	14.297	22.613	20.651	17.232	9.988	0.000	137.160
CM1: <i>Collab Battlefield Networked Leth Sys App Tech*</i>	-	-	-	-	-	-	8.569	10.516	7.358	-	0.000	26.443
CM7: <i>Collaborative Convergence Applied Research</i>	-	25.019	27.360	14.297	-	14.297	14.044	10.135	9.874	9.988	0.000	110.717

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2024

A. Mission Description and Budget Item Justification

The Program Element (PE) executes research as part of a campaign of learning to assess feasibility of technologies in an operational environment, learning from early failure and re-scope research to improve speed of response, scalability, interoperability and range of engagement. This program element will deliver integration of technologies from sensor to shooter in near real-time, from tactical to strategic level, taking a system design approach in support of All Domain Situational Awareness (CJADC2). It will enable optimal lethal and non-lethal effects across all domains using artificial intelligence and machine learning to improve how we recognize threats, augment and enhance leader decision-making, replicate tactical behaviors to enable autonomous capabilities, and design system engineering architectures to validate interoperability of technologies.

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering Priority focus areas and the Army Modernization Strategy.

Work is performed by the United States Army Futures Command.

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	25.967	27.399	25.884	-	25.884
Current President's Budget	25.019	27.360	14.297	-	14.297
Total Adjustments	-0.948	-0.039	-11.587	-	-11.587
• Congressional General Reductions	-	-	-	-	-
• Congressional Directed Reductions	-	-	-	-	-
• Congressional Rescissions	-	-	-	-	-
• Congressional Adds	-	-	-	-	-
• Congressional Directed Transfers	-	-	-	-	-
• Reprogrammings	-0.948	-	-	-	-
• SBIR/STTR Transfer	-	-	-	-	-
• Adjustments to Budget Years	-	-	-11.587	-	-11.587

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity	R-1 Program Element (Number/Name)
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602181A / <i>All Domain Convergence Applied Research</i>

• FFRDC Transfer	-	-0.039	-	-	-
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Change Summary Explanation

Funding decrease is due to realignment of funding to Program Element 0602141A (Lethality Technology) / Project CIB (Sensor to Shooter (STS) Applied Research) for designing and developing advanced algorithms for sensor to shooter decision aids.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence A plied Research				Project (Number/Name) CM7 / Collaborative Convergence Applied Research			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CM7: Collaborative Convergence Applied Research	-	25.019	27.360	14.297	-	14.297	14.044	10.135	9.874	9.988	0.000	110.717

A. Mission Description and Budget Item Justification

This Project supports research required to oppose adversary technologies in the threat based early operational environment. Focus is on those technologies that will aid in reducing the sensors to shooters timelines. This is accomplished using Artificial Intelligence (AI) algorithm decision agent design architectures, advanced methods for processing data, and improved AI performance. Additionally, this Project will research technologies and solutions necessary to enable mission command in multi-domain operations. The project will accelerate emerging research to achieve sensor to shooter dominance.

Work in this Project compliments Program Element (PE) 0603041A (All Domain Convergence Advanced Technology).

Work in this Project supports Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: AI-Enabled Decision Support in Distributed Networks	5.390	3.488	3.641
Description: This effort researches techniques to understand and model complex multi-platform tactical networks in Multi-Domain Operational environments to develop training data sets for AI-enabled tactical decision support capabilities. This effort leverages Army research informed by Army Doctrine on data value, consensus, uncertainty, human-agent teaming and network science to optimize decision support training data production. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.			
FY 2023 Plans: Increase complexity and number of elements in tactical network engagement models and integrate synthetic training data with ongoing real-world engagement data (imagery, quantitative confidence, speed, etc) from training centers and exercises; develop cost and reward functions that collectively approximate doctrine and mission success for basic fire and maneuver missions; assess generalized performance and adaptability of decision models			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence A Applied Research	Project (Number/Name) CM7 / Collaborative Convergence Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will research real-time human-in-the-loop (HITL) feedback process to improve target detection and decision support for multi-platform networks; explore techniques to modify in real-time HITL for improved accuracy and efficiency; conduct experiments to assess performance improvements from hardware-software co-design; investigate multi-agent reinforcement learning (MARL) on Capability Graph Networks (CGN) for basic fire and maneuver missions.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Synthetic Data for AI-Enabled Decision Support</p> <p>Description: This effort researches approaches to incorporate synthetic data to augment Army training data sets and optimize AI performance for uncommon Multi-Domain Operations (MDO) targets and environments. This effort investigates efficacy and optimal application of synthetic training data developed using multiple technical methods, including physics-based models and generative adversarial techniques. This effort will experiment with artificially augmented data sets to enable classification of rare targets and cost-effective enterprise-level training data generation. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.</p> <p>FY 2023 Plans: Research techniques to develop and characterize synthetic data sets that include novel synthetic objects and backgrounds; experiment with larger and more varied synthetic augmentations to traditional training data sets; identify and correlate effects of synthetic training data augmentation to trained object classifier performance; develop methodologies to enhance classification performance against uncommon targets with synthetic training data augmentation.</p> <p>FY 2024 Plans: Will mature synthetic data generation pipelines in both the electro-optical/visible and infrared spectral bands, consisting of physics based and generative adversarial based data-driven approaches, for both target signatures and background scenes to optimize machine learning detection/classification accuracy on targets while reducing false alarms in the background; develop synthetic environments/simulation testbeds for assessment of deep reinforcement learning based course of action generation as a command and control decision aid; conduct experiments in Army-relevant environments and field assessments to validate synthetic data methodology.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>		6.065	5.125	5.974
<p>Title: Data Characterization for AI-Enabled Decision Support</p> <p>Description: This effort will investigate techniques for data management, characterization, curation, labeling, and classification to enable repeatable, robust performance of trained AI-enabled decision support capabilities for complex, multi-platform tactical</p>		5.193	4.486	4.682

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence Applied Research	Project (Number/Name) CM7 / Collaborative Convergence Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
networks in varied tactical Multi-Domain Operations (MDO) environments. Supports AI-enabled decision support capabilities for Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.				
<p>FY 2023 Plans: Research training data assessment techniques that correlate statistical content of training data selected with performance and adaptability of resulting trained algorithms; revise and improve training data sets to accommodate findings and improve generalized algorithm performance; deploy training data set characterization and algorithm performance tools on Army development platform to support collaborative object classifier, AI-enabled decision support tool, and autonomy training.</p> <p>FY 2024 Plans: Will support systematic data collection and curation for continuous AI algorithm development; research and implement techniques for ingesting large, diverse data sets relevant to broad AI algorithm development across the Army; formalize methods for including synthetic data to augment real data.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort</p>				
<p>Title: Lethality Architecture</p> <p>Description: Designs networked lethality role-based architecture to support automated decision aids and target handoff capability for combined arms operations. Designs a hybrid distributed architecture that will ingest real-time, prioritized data for decision agents to support scalable operations with reduced processing time.</p> <p>FY 2023 Plans: Validate time and space synchronization of fires and distributed lethality capabilities in role-based architecture. Continue to develop architecture to interface with additional Joint and international partner systems. Conduct experiments to validate de-confliction between various sensors and weapons systems to achieve reduced sensor to shooter timelines. Mature methods and algorithms for decision aids to operate in degraded environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>		6.022	7.782	-
<p>Title: Algorithms and Environment</p> <p>Description: Designs and develops a data model for commander decision aided algorithms to support integrated direct & indirect fires; defines the process and data structure to automate decision aids and target handoff for simultaneous engagements to air/</p>		0.482	1.992	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602181A / All Domain Convergence A plied Research	Project (Number/Name) CM7 / Collaborative Convergence Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
ground platforms; and designs decentralized data structures and hybrid databases that can scale to echelons and user selectable input.				
<p>FY 2023 Plans: Design simulation capability for integrated direct and indirect fires decision aids, including coordinating decentralized operations. Conduct experiments for automated decision aids and target handoff capability for simultaneous engagement to air/ground platforms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>				
<p>Title: Fires Coordination</p> <p>Description: Designs and develops integrated direct/indirect effects coordination and execution. Investigates autonomous cooperative engagement methods by modeling adversary behavior to determine the optimal shooter(s) for a large number of targets to achieve tactical overmatch. Design learning behaviors capable of incorporating commander's guidance and based on enemy data and historic performance.</p> <p>FY 2023 Plans: Design and develop Fires coordination measures integrated at the platform level for both air and ground platforms. Design and develop enhanced decision aids and effects coordination algorithms capability to execute Fires synchronization. Conduct experiments for course of action analysis integrated capability using enemy intel data. Design and develop enhanced algorithms for predicting adversary behaviors to optimize recommendations to the commander.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Work has been administratively realigned in FY24 to Program Element 0602141 Lethality Technology / Project CIB (Sensor to Shooter (STS) Applied Research).</p>		1.867	3.488	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.999	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602181A / <i>All Domain Convergence Applied Research</i>	Project (Number/Name) CM7 / <i>Collaborative Convergence Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	25.019	27.360	14.297

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research							
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	11.954	27.868	30.659	-	30.659	23.868	30.334	31.328	32.417	0.000	188.428
CM9: Convergent CEMA Deception	-	5.421	-	-	-	-	-	-	-	-	0.000	5.421
CN4: Network Enabling University Applied Research	-	2.484	2.655	2.675	-	2.675	2.521	2.269	2.270	2.295	0.000	17.169
CN5: Network Vuln/ Effectiveness Assess Methods (N-VEAM)	-	4.049	4.418	4.478	-	4.478	4.478	4.484	4.487	4.537	0.000	30.931
CW2: Exploitation of Atmospheric Impacts across Domains	-	-	3.051	1.514	-	1.514	-	-	-	-	0.000	4.565
CX3: Intelligent Env Battlefield Awareness Apl Tech	-	-	3.141	2.201	-	2.201	0.616	4.188	5.231	4.969	0.000	20.346
CX4: Persistent Geophysical Sensing-Infrasound Apl Tech	-	-	2.761	2.576	-	2.576	2.081	3.136	2.614	2.290	0.000	15.458
CX5: Sensing in Contested Environments Technologies	-	-	1.007	1.028	-	1.028	-	1.116	2.078	1.597	0.000	6.826
CX6: Subterranean Detection and Monitoring Apl Tech	-	-	1.587	1.688	-	1.688	1.533	1.534	0.644	2.220	0.000	9.206
CZ6: Assured PNT Enabling Applied Technology	-	-	3.661	3.347	-	3.347	2.319	2.272	2.137	2.160	0.000	15.896
CZ7: Convergent CEMA Technical Effects	-	-	5.587	5.472	-	5.472	5.573	5.580	5.584	5.645	0.000	33.441
DA8: Quantum PNT & Radio Frequency Sensing	-	-	-	2.612	-	2.612	3.657	5.232	5.236	5.293	0.000	22.030
DB4: Enabling Long Standoff 3D (ELS3D) Tech	-	-	-	2.058	-	2.058	1.090	0.523	1.047	1.411	0.000	6.129
DE6: Understanding Environment as a Threat Tech	-	-	-	1.010	-	1.010	-	-	-	-	0.000	1.010

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research
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A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs, validates, and conducts experimentation to establish technical solutions for creating integrated future equipment and systems that improve resiliency, survivability, operational effectiveness, mobility, sustainability, and readiness of ground forces. This PE provides mid-to-long term tactical Command, Control, Communications and Intelligence (C3I) capabilities (e.g. networking, cyber, electronic warfare, Positioning, Navigation and Timing (PNT), space, persistent surveillance) based upon promising technologies that address emerging and future threats, and includes research critical and unique to the Army and DoD (e.g., atmospheric modeling and meteorological technologies). Applied research investments focus on the design and investigation of materials, processes, technologies, methodologies, and models to establish architectures, systems, and interfaces that enhance and optimize performance on the future battlefield. The outputs of these efforts inform and transition to advanced research efforts that demonstrate improved C3I capabilities.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024 Base</u>	<u>FY 2024 OCO</u>	<u>FY 2024 Total</u>
Previous President's Budget	12.406	27.892	29.518	-	29.518
Current President's Budget	11.954	27.868	30.659	-	30.659
Total Adjustments	-0.452	-0.024	1.141	-	1.141
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.452	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	1.141	-	1.141
• FFRDC Transfer	-	-0.024	-	-	-

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CM9 / Convergent CEMA Deception			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CM9: <i>Convergent CEMA Deception</i>	-	5.421	-	-	-	-	-	-	-	-	0.000	5.421

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops hardware and software to enable cyber and radio frequency (RF) technical effects electronic spoofing and cyber deception along with inconspicuous Cyber Electromagnetic Activity (CEMA) and network operations of Army platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This research is critical to counter near-peer ability to geo-locate and put indirect fires onto our positions.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Radio Frequency/Cyber Sensing and Effects	3.017	-	-
Description: This effort develops technologies to avoid geolocation of blue force RF emissions by peer/near- peer adversaries. Research will focus on developing low probability of detection (LPD) communications and RF transceivers to increase freedom of maneuver while maintaining effective communications.			
Title: Dynamic Intelligent Networks and Cyber Technical Effects for CEMA	2.404	-	-
Description: This effort investigates techniques and develops methods for combining the physical (Radio Frequency) and network (cyber) layers for enhanced effects when coupled with electromagnetic technical effects.			
Accomplishments/Planned Programs Subtotals	5.421	-	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CN4 / Network Enabling University Applied Research			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN4: <i>Network Enabling University Applied Research</i>	-	2.484	2.655	2.675	-	2.675	2.521	2.269	2.270	2.295	0.000	17.169

A. Mission Description and Budget Item Justification

The Project leverages applied research from academia, in the focus areas of intelligent networks, self-sensing/self-healing networks, network security, air and ground vehicle teaming and alternatives to Global Positioning System (GPS). This Project will focus on research that supports mid-to-long term tactical Command, Control, Communications and Intelligence (C3I) capabilities (e.g. networking, cyber, electronic warfare, Positioning, Navigation and Timing (PNT), space, persistent surveillance). This Project also focuses on bringing competitively selected Universities with research and development teams into Technical Alliances that will investigate and develop technologies originating from applied research in academia pertaining to intelligent networks, self-sensing/self-healing networks, and network security and artificial intelligence/machine learning as applied to C3I, and other innovative communication as well as alternatives to GPS, leading to potential emerging technologies in areas of strategic importance to the Army in secure and intelligent communication and networking.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CN3 (Network Enabling University Adv Development).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Intelligent, Secure and Self-Sensing/Self-Healing Networks Applied Technology	1.179	1.227	1.291
Description: Investigate and design fused networks and decision-making architecture into intelligent networks to provide the actionable autonomous intelligence while denying corruption, and/or attack and to execute operational missions securely and reliably.			
FY 2023 Plans: Will continue research in AI/ML software for Network technologies, predictive analytics software, intelligent data integration software, edge computer processing platforms, edge sensing systems, and other technologies; will continue to research in distributed learning under privacy and resource constraints, and the communication between computing nodes and edge computing AI/ML solutions for network-driven intelligence; will design intelligent multi-modal communication and more reliable, efficient, and effective use of available communication technologies; and will continue to investigate wireless networking and biosensor solutions for intelligent networks.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CN4 / Network Enabling University Applied Research		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will continue to investigate AI/ML emerging technologies for Network solutions, distributed hybrid ML at various scales, adaptable network systems, unified framework for joint sensing, RF-based deceptive tactical networks, improve cyber defense systems through secure and reliable ML, and network localization.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Real-Time Tactical Networks Applied Research</p> <p>Description: Investigate and design resilient and adaptable network communications to support intelligent systems in challenged environments with denied and constrained resources.</p> <p>FY 2023 Plans: Will continue to investigate methods and techniques that support a resilient network capable of delivering reliable information pathways with caching, value-based prioritization, and information optimization; will improve time and reliability of information/data over secure tactical networks; and will continue to investigate decentralized networks with knowledge bases, reasoning, planning, sensing, self-healing and control capabilities for advanced teaming and collaborative operations.</p> <p>FY 2024 Plans: Design and develop an information network that will resiliently support information pathways for sensing, computing, and control in cyber-physical systems, such as autonomous vehicle teams over unreliable communication networks. Design an information network that responds dynamically to changes in operating conditions through real-time adaptation and evolution to enable continuity of the core services that it provides to the networked system.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>		0.569	0.585	0.614
<p>Title: Alternatives to GPS Applied Research</p> <p>Description: Research performance and assurance improvements against both electronic and kinetic attacks relative to current state-of-the-art GPS, and that can provide PNT technology to users in disrupted, degraded or denied GPS environments.</p> <p>FY 2023 Plans: Will continue to investigate direct use of signals from satellite constellations in LEO for APNT; will investigate autonomous vision-based navigation solutions to address the critical need for reliable operability within GPS denied and contested environments; will develop fusing approaches for vision, radar, inertial, and other sensors technologies for GPS denied/degraded environments; and</p>		0.736	0.746	0.770

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CN4 / Network Enabling University Applied Research

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
will research a GNSS independent navigation solution that is computationally lightweight enough to be implemented on low-cost, physically lightweight platforms. FY 2024 Plans: Investigates and designs GNSS global and tactical sensors, exploitation of LEO satellites for jam-resistant PNT extraction, and create a sensor fusion framework that high integrity PNT. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.097	-
Accomplishments/Planned Programs Subtotals	2.484	2.655	2.675

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CN5 / Network Vuln/Effectiveness Assess Methods (N-VEAM)			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN5: Network Vuln/Effectiveness Assess Methods (N-VEAM)	-	4.049	4.418	4.478	-	4.478	4.478	4.484	4.487	4.537	0.000	30.931

A. Mission Description and Budget Item Justification

This Project develops analytical methodology and capabilities to characterize hardware and software that enable Electromagnetic Warfare (EW) and Cyber capabilities to assess operations of Army Network and communication platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This Project also develops a holistic cross-domain analysis and assessment methodology for network and communication technologies faced with advanced Cyber Electromagnetic Activity (CEMA). These investigations are critical to identifying vulnerabilities of United States systems and technologies so that network and network-enabled systems can be hardened as early in development as possible.

Work in this Project complements Program Element (PE) 0602146 (Network C3I Technology) / Project AN3 (Non- Traditional Waveforms Technology), PE 0602213 (C3I Applied Cyber) / Project 2CY (Information Trust Technology), PE 0602213 (C3I Applied Cyber) / Project CY6 (Autonomous Cyber Technology), PE, 0602146 (Network C3I Technology) / Project CI3 (Mobile and Survivable Command Post (MASCP) Tech), PE 0603457 (C3I Cyber Advanced Development) / Project 8CY (Information Trust Advanced Technology), PE 0603463 (Network C3I Advanced Technology) / Project AN4 (Non-Traditional Waveforms Advanced Technology), PE 0603457 (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology), PE 0603463 (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology), and PE 0603463 (Network C3I Advanced Technology) / Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Understanding, Protecting, and Enabling CEMA Effects	2.064	2.183	2.241
Description: This effort develops and continually improves methodology and approaches for estimating and predicting CEMA effects on networks and network-enabled systems during complex multi-domain operations when significant cross-domain effects can be expected. Methods include drawing upon past research concerning the interaction of cyber and Electromagnetic Warfare threats on operational networks; laboratory operations, over-the-air anechoic chamber experimentation, and open-air field experimentation; and first principles Modeling and Simulation (M&S) and engineering analysis. Abstracting, generalizing, and automating multi-domain CEMA operations will enable the development of analysis and assessment of capabilities to anticipate			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CN5 / Network Vuln/Effectiveness Assess Methods (N-VEAM)		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>the impact of future threats. Live, virtual, and simulated environments will be developed to estimate the potential operational impact of threat CEMA technologies on friendly systems.</p> <p>FY 2023 Plans: Investigate EW and cyber techniques for converged assessment of EW and Cyber effects on network systems addressing network technology for Integrated Tactical Network Capability Set 23 production and fielded equipment. Investigate EW and cyber techniques for assessment of EW and Cyber effects on network systems through component development and in support of Capability Set 25.</p> <p>FY 2024 Plans: Will conduct research to assess network technologies using EW and Cyber effects at the component and system level designated for Capability Set 25 and investigate EW and Cyber techniques for converged assessment of EW and Cyber effects on network system at the component level in support of Capability Set 27 (Automation and intelligence for next generation, secure communications and network data transport)</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Vulnerability Analysis Methodology for CEMA Threats</p> <p>Description: This effort investigates threat/target interactions to develop experimental and analytical methodology for separate and cross-domain cyber and electromagnetic threat attack so that assessed vulnerabilities in a multi-domain complex environment can be reduced or eliminated before fielding new networks and network-enabled systems. Experimental and analysis methodologies will be developed to investigate vulnerabilities of specific configurations of complex future networks with multiple communications modalities, advanced deception techniques in the cyber and electromagnetic areas, and advanced Positioning, Navigation, and Timing (PNT) systems.</p> <p>FY 2023 Plans: Verify and validate assessment tools, methodologies and metrics (e.g. path loss, scattering in contested/congested electromagnetic environments, Low Probability of Detect, Low Probability of Intercept, UV & optical communication performance) for Integrated Tactical Network technology; design and develop cyber tool stimulus for maturation of tactical network autonomous decision-making engines; continue to develop the contested/congested electromagnetic environment to reflect emerging threats; and determine threat environments for technology experimentation and technology exploration activities to inform them on vulnerability mitigations that improve critical technologies.</p> <p>FY 2024 Plans:</p>		1.985	2.137	2.237

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CN5 / Network Vuln/Effectiveness Assess Methods (N-VEAM)

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Will develop assessment methodologies, tools, and metrics (e.g. LPD/LPI Angle of Arrival, UV line-of-sight (LOS)/beyond-line-of-sight (BLOS), inertial aided PNT) for evaluation of UV and millimeter-Wave dispersed communications in threat representative contested/congested environments; investigate and exploit Cyber vulnerabilities of Artificial Intelligence (AI)/Machine Learning (M/L) based intrusion detection systems (IDS); conduct research to develop and mature contested/congested Cyber and electromagnetic environment threat representation capabilities (e.g. adversary signal detection and identification); conduct research on emerging cloud and Elastic Compute Cloud through creation of use cases to mature methodologies and tools for evaluation of tactical and enterprise systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.098	-
Accomplishments/Planned Programs Subtotals	4.049	4.418	4.478

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p> <p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CW2 / Exploitation of Atmospheric Impacts across Domains			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW2: <i>Exploitation of Atmospheric Impacts across Domains</i>	-	-	3.051	1.514	-	1.514	-	-	-	-	0.000	4.565

A. Mission Description and Budget Item Justification

This Project enables identification and exploitation of how atmospheric phenomena impact windows of superiority for Army capabilities by developing technologies that characterize, predict, and efficiently express atmospheric impacts in future operating environments. New sensing technologies and algorithms enable heterogeneous sensor networks to extract critical environmental information optimizing performance and reducing the need for dedicated meteorological sensors. Novel physics-based models, empirical parameterizations, and machine learning applications extrapolate this environmental information both spatially and temporally. Uncertainty-aware decision support tools leverage this situational awareness to efficiently express atmospheric effects on friendly and threat weapons systems, sensors, and operations at the point of need and across multiple domains. This information can be exploited by autonomous and human decision makers for mission planning and execution; battlefield visualization; reconnaissance, surveillance, and target acquisition; route planning to maximize stealth and efficiency; long-range precision fires; and modeling of environmental impacts for combat simulations and war games.

This work provides technologies for evaluation by and/or transitions to the Department of Defense weather and operations community including: Program Executive Office (PEO) Ammunition-Program Manager (PM) Combat Ammunition Systems (CAS) and Marine Corps Systems Command (MCSC) for meteorological message input to field artillery targeting systems, PM Intelligence Systems and Analytics (DCGS-A), and the US Air Force 557th Weather Wing to improve their operational weather support to the Army.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Atmospheric Impacts	-	2.940	1.514
Description: This effort develops environmental exploitation capabilities though coupled sensing, numerical prediction, and decision support technologies for data-sparse, computationally-limited, and network-constrained domains.			
FY 2023 Plans:			
Mature combined multi-modal sensing capabilities for detection, classification, and localization of small Unmanned Aerial Systems (sUAS); develop new machine-learning-based algorithms to support tactical adaptability of software-defined, portable radar; mature capabilities for rapid optical characterization of hazardous, biological and non-biological aerosols; validate methods to predict bulk atmospheric impacts on directed energy from multi-modal sensor data; mature dispersion calculations of Atmospheric			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CW2 / Exploitation of Atmospheric Impacts across Domains

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Boundary Layer Environment Lattice-Boltzmann Method (ABLE-LBM) in urban domains; validate uncertainty propagation algorithms in tactical, urban models when assimilating non-traditional, environmental observations. FY 2024 Plans: Will conclude the combination of multi-modal small Unmanned Aerial Systems (sUAS) detection, classification, and localization sensing capabilities; finalize and transition capabilities for rapid optical characterization of hazardous, biological, and non-biological aerosols. FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned conclusion of this effort in FY2024.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.111	-
Accomplishments/Planned Programs Subtotals	-	3.051	1.514

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CX3 / Intelligent Env Battlefield Awareness Apl Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CX3: Intelligent Env Battlefield Awareness Apl Tech</i>	-	-	3.141	2.201	-	2.201	0.616	4.188	5.231	4.969	0.000	20.346

A. Mission Description and Budget Item Justification

This Project investigates, develops, and designs technologies to allow Soldiers to maneuver faster in dynamic environments as informed by physical, geological, and biological constraints. This Project enhances visualization tools for mission planning through delivering web modules/software tools which contain crucial geochemical resources and advanced knowledge of geo-environmental infrastructure for mission planners.

This Project supports the Common Operating Environment Army Modernization Priority. These technologies provide situational awareness for multi-source intelligence, particularly in anti-access/area denied (A2/AD) operational environments.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).

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

Work in this Project is performed at the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Hydrology Mapping	-	0.991	0.679
Description: This effort provides data tools and models to support high-fidelity battlefield overlay maps that accurately show hydrologic/soil moisture threats (soil, hydrology, and snow/ice) not captured by current terrain mapping capabilities.			
FY 2023 Plans: Identify data, models, and techniques to measure, simulate, and forecast hydrologic conditions in the field with a focus on knowledge gaps and develop integration plans to create global coverage in existing tools.			
FY 2024 Plans: Will develop Machine Learning (ML) methodologies to derive parameters for a stochastically based hydrologic model using high-resolution hydrologic and remotely sensed data.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort as work transitions to PE 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).			
Title: Predictive Geographic Information System (GIS) Mapping (physical)	-	1.254	1.010

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CX3 / Intelligent Env Battlefield Awareness Apl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort develops a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions in Outside Continental United States (OCONUS) dark sites from the statistical analysis of known datasets and the application of geophysical principles.</p> <p>FY 2023 Plans: Identify geophysical model component gaps in temporal and static feature capture sections of planned GIS Mapping capability.</p> <p>FY 2024 Plans: Will complete development of foundational data layers in a comprehensive GIS tool that integrates predictive models of soil, vegetation, hydrology, and permafrost conditions.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort as work transitions to PE 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).</p>			
<p>Title: Vegetation Property Mapping Tech</p> <p>Description: This effort investigates and develops the required data to build geospatial overlays that describe forest type and structure as it relates to maneuver and concealment.</p> <p>FY 2023 Plans: Identify existing tools and data to describe forest type and structure as it relates to maneuver and concealment for integration onto geospatial overlays.</p> <p>FY 2024 Plans: Will characterize non-forested (single-strata) vegetation attributes at multiple vegetation analog sites relevant for open terrain mobility and proxies in threat area terrain attributes.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>	-	0.199	0.261
<p>Title: Extreme Environments Environmental Effects on Operations Tech</p> <p>Description: This effort designs and develops modeling of natural terrain following extreme disturbances that impact operational environments such as wildfires, flash floods, earthquakes and landscape changes induced by high intensity military conflict.</p> <p>FY 2023 Plans:</p>	-	0.582	0.251

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CX3 I Intelligent Env Battlefield Awareness Apl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Identify critical environmental parameters for baseline adaptations, select study and analog sites, and collect pre- and post-disturbance event data. FY 2024 Plans: Will investigate existing data algorithms ability to predict extreme events and will identify which events cause anomalies in model accuracy. FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned life cycle for this effort to develop viable algorithms for model accuracy.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.115	-
Accomplishments/Planned Programs Subtotals	-	3.141	2.201

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CX4 / Persistent Geophysical Sensing-Infrasound Apl Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CX4: Persistent Geophysical Sensing-Infrasound Apl Tech	-	-	2.761	2.576	-	2.576	2.081	3.136	2.614	2.290	0.000	15.458

A. Mission Description and Budget Item Justification

This Project designs and develops algorithms, hardware, and software components to provide passive, persistent, non-line-of-sight, multi-modal sensing capable of providing fused battlefield intelligence for increased situational awareness in a dynamic operational environment. These technologies provide near-real-time data collection, processing, and alerting on evolving cross-domain threats including strategic and tactical fires, air and ground platforms, as well as critical transportation infrastructure (bridges) and explosive events with applications for deep sensing.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX8 (Persistent Geophysical Sensing-Infrasound Adv Tech).

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

Work is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	-	2.660	2.576
Description: This effort develops a suite of geophysical and geo-sensing technologies to persistently assess battlefield elements to include infrastructure and additional sources of interest such as explosive and fires events and various air platforms; refines terrain, topography, and meteorological models related to acoustic propagation detected by the employed sensor suite as well as detection and classification signal processing algorithms for a broader range of sources and/or threats.			
FY 2023 Plans: Investigate and validate classification algorithms for additional sources of interest as determined by stakeholders and provide software updates. Will utilize a military user assessment to evaluate alternate array geometry for feedback loop.			
FY 2024 Plans: Will mature algorithm components utilizing multiple laboratory and field experiments in conjunction with various array configurations and will design and develop a sensor placement tool with capabilities to account for terrain/topography and meteorological effects.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.101	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CX4 / Persistent Geophysical Sensing- Infrasound Apl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	2.761	2.576

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CX5 / Sensing in Contested Environments Technologies			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CX5: Sensing in Contested Environments Technologies	-	-	1.007	1.028	-	1.028	-	1.116	2.078	1.597	0.000	6.826

A. Mission Description and Budget Item Justification

This Project characterizes through direct or inferential methods the identification of non-weaponized biological hazards posed to Soldiers in operational environments by advancing sensor technologies and software modules that will detect and characterize hazards within confined environments. This research provides Soldiers the capability to understand biological hazards present in subterranean environments and take necessary steps to mitigate or avoid these threats.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX9 (Sensing in Contested Environments Adv Technologies).

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

Work in this Project is performed at the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Non-traditional Threat Detection in Contested Environments Tech</p> <p>Description: This effort identifies, examines and prioritizes previously developed sensor packages as well as commercial of the shelf (COTS) capabilities from multiple sources that can accurately detect biological hazards relevant to operations in subterranean environments from point of ingress/egress to evaluate exposure potential and affects.</p> <p>FY 2023 Plans: Develop additional detection algorithms for macroscopic threats and create additional zoonotic threat assays.</p> <p>FY 2024 Plans: Will develop alternative zoonotic assays and antibody/antigen methods; and will assess potential sample techniques for standoff collection and select most appropriate for modification.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>	-	0.970	1.028
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans:</p>	-	0.037	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CX5 / Sensing in Contested Environments Technologies

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i>			
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.007	1.028

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CX6 / Subterranean Detection and Monitoring Apl Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CX6: Subterranean Detection and Monitoring Apl Tech	-	-	1.587	1.688	-	1.688	1.533	1.534	0.644	2.220	0.000	9.206

A. Mission Description and Budget Item Justification

This Project designs and develops an integrated suite of tunnel detection, subterranean monitoring solutions, and vulnerability assessment technologies to detect, identify, and monitor subterranean threat activities in urban environments through advanced sensing and rapid analysis capabilities. This Project also develops and investigates enhanced technologies to detect tunnels and tunneling activity in complex and varied environments. This research is critical to provide greater situational awareness of the subterranean domain and enhanced survivability for the Soldier.

Work in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CZ5 (Subterranean Detection and Monitoring Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Cavity Assessment in Variable Environments-Subterranean (CAVES)	-	1.529	1.688
Description: This effort will extend current tunnel detection and perimeter security systems beyond austere environments for application in variable terrain, and complex geologic environments, such as mountains, and hard rock geology common in the western pacific. Extended current tunnel detection and perimeter security systems beyond austere environments for application in variable terrain, and complex geologic environments, such as mountains, and hard rock geology common in the western pacific.			
FY 2023 Plans: Conduct experiments to determine the feasibility of legacy tunnel detection and perimeter security technologies in variable terrain, and complex geologic environments, such as mountains, and hard rock geology common in the western pacific.			
FY 2024 Plans: Will conduct hardware assessment of tunnel detection and perimeter security technologies proven feasible in variable and complex geologic environments, such as mountains, and hard rock geology common in the United States Pacific Command area of responsibility.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.058	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CX6 / Subterranean Detection and Monitoring Apl Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		-	1.587	1.688
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CZ6 / Assured PNT Enabling Applied Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CZ6: Assured PNT Enabling Applied Technology</i>	-	-	3.661	3.347	-	3.347	2.319	2.272	2.137	2.160	0.000	15.896

A. Mission Description and Budget Item Justification

Assured Positioning Navigation and Timing (APNT) Enabling Technologies project investigates and matures technologies for Space-Based and High Altitude applications for Army tactical ground forces. Efforts include the development of sensors and electronic components for communications, signal and information processing, target acquisition, quantum based communications and sensing, and threat warning for small spacecraft and high altitude applications. Investigations leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development.

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CJ8 (Assured PNT Communications Advanced Tech).

The research cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the United States Army Space and Missile Defense.

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

	FY 2022	FY 2023	FY 2024
Title: Assured PNT Enabling Applied Technology	-	3.527	3.347
Description: This effort supports validation of hardware and software components and models to further Space/HA sensor or Deep Sensing capabilities, payload design and development.			
FY 2023 Plans: Will continue to design, develop, and implement an advanced laboratory testbed that will be utilized to mature payloads for APNT, ground launched assets and optical/quantum secure communications on multiple simulated platforms simultaneously with hardware and software in the loop. The testbed will be applicable to high altitude (HA), space based, and ground based platforms utilizing quantum secured communications. Hardware will be developed to optimize transmission of data across multi-domain environments and optimized for Army Program Executive Office (PEO) requirements.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CZ6 / Assured PNT Enabling Applied Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Will continue to develop, and validate an advanced laboratory testbed that will be utilized to mature payloads for APNT, ground launched assets and optical/quantum secure communications on multiple simulated platforms simultaneously with hardware and software in the loop. Testbed will be applicable for Quantum Entanglement (QE) and HA applications.				
FY 2023 to FY 2024 Increase/Decrease Statement: Decrease due to planned lifecycle of this effort.				
Title: SBIR/STTR		-	0.134	-
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		-	3.661	3.347
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) CZ7 / Convergent CEMA Technical Effects			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CZ7: Convergent CEMA Technical Effects	-	-	5.587	5.472	-	5.472	5.573	5.580	5.584	5.645	0.000	33.441

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops hardware and software to enable cyber and radio frequency (RF) technical effects along with inconspicuous Cyber Electromagnetic Activity (CEMA) and network operations of Army platforms and dismounts, while maintaining freedom to maneuver, communicate, and sense. This research will investigate and develop methods to protect blue platforms from adversarial detection and attack. This research is critical to counter near-peer adversary ability to geo-locate and put indirect fires onto blue force positions.

Work in this Project complements Program Element (PE) 0602146A (Network C3I Technology) / Project AM6 (Non Modular RF Communications Technology) and Project AN3 (Non Traditional Waveforms Technology), Program Element (PE) 0602213A (C3I Applied Cyber) / Project CI6 (Network Obscuration and Deception Tech) and Project CY6 (Autonomous Cyber Technology), Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology), and Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM7 (Modular RF Communications Advanced Technology) and Project AN4 (Non Traditional Waveforms Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: RF-Enabled CEMA Sensing and Technical Effects	-	3.168	3.335
Description: This effort develops technologies to avoid geolocation of blue force RF emissions by peer/near- peer adversaries. Research will focus on developing low probability of detection (LPD) communications and RF transceivers to increase freedom of maneuver while maintaining effective communications.			
FY 2023 Plans: Develop techniques for heterogeneous and distributed signal transmission; develop signals and waveforms for RF emissions on wideband reconfigurable transceivers and perform proof-of-concept validation; design and implement wideband reconfigurable RF transceiver hardware interoperable with compact antennas, RF frontend hardware, and data converters; develop non-RF integrated breadboard communication demonstrator and assess general capabilities of this system external to the laboratory environment.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CZ7 I Convergent CEMA Technical Effects		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will validate RF emulator techniques in relevant outdoor environment; investigate antenna architecture to enhance performance in accordance with RF emulator requirements; validate effectiveness of converged cyber and RF emulation effects in relevant environment; validate performance of non-RF integrated breadboard communication demonstrator.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p>				
<p>Title: Convergent Networking and CEMA Effects</p> <p>Description: This effort investigates techniques and develops methods for combining the physical (Radio Frequency) and network (cyber) layers for enhanced effects when coupled with electromagnetic technical effects. Research also investigates methods of adaptive networking using unconventional communication channels and active tactical cyber defense methods to anticipate adversarial activities and effective responses.</p> <p>FY 2023 Plans: Develop intelligent networking protocols for controlling novel methods for covert communication; conduct experiments on the use of unconventional spectrum and techniques for covert communications; explore the integration of developed covert networking techniques with multi-domain technical effects; investigate the use of game theory approaches to achieve cyber misrepresentation on tactical networks; build attack graphs to comprehend the interdependencies among vulnerabilities and to analyze the attacker's potential course of action; use game theory for an optimum decoy allocation framework that causes network reconnaissance to be difficult, allows detection of an attacker, and detains the attacker.</p> <p>FY 2024 Plans: Will investigate radio-frequency low-probability-of-detection techniques and network-level metrics for hybrid coding and diversity approaches to covert communications; develop protocols for and conduct experiments on hybrid radio-frequency/ultraviolet communications networks; develop methods that build asymmetric advantages for defenders over intelligent, near-peer adversaries, to deal with dynamic environments and fast changing mission context that results in uncertainties and partial information; continue to build attack graphs to understand the interdependencies among all known target vulnerabilities and analyze attacker's potential courses of action; develop an architecture of a cyber misrepresentation decision making system in a tactical environment that incorporates graph-based friendly network representation and game theory approaches.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort.</p>		-	2.215	2.137
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>		-	0.204	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CZ7 / Convergent CEMA Technical Effects
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	5.587	5.472

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) DA8 / Quantum PNT & Radio Frequency Sensing			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DA8: Quantum PNT & Radio Frequency Sensing	-	-	-	2.612	-	2.612	3.657	5.232	5.236	5.293	0.000	22.030

Note

Quantum PNT & Radio Frequency Sensing is a new start within the C3I Applied Research program in FY 2024.

A. Mission Description and Budget Item Justification

This Project will investigate quantum sensing approaches for positioning, navigation, and timing (PNT) to improve the accuracy and resilience of Army PNT capabilities independent of Global Positioning System (GPS).

Work in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW6 (Modular GPS Independent Sensors Advanced Tech) and Program Element (PE) 0602146A (Network C3I Technology) / Project AW5 (Modular GPS Independent Sensors Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Quantum-Enhanced Sensing and PNT	-	-	2.612
Description: This effort will investigate quantum sensing approaches for positioning, navigation, and timing (PNT) to improve the accuracy and resilience of Army PNT capabilities independent of Global Positioning System (GPS).			
FY 2024 Plans: Will model, design, and assess solid-state sensors for low-size, weight, and power (SWaP) magnetometry and PNT sensing applications; model, design, and develop Rydberg electric field sensors for comparison with conventional receiver antennas.			
FY 2023 to FY 2024 Increase/Decrease Statement: This is a new start in FY24			
Accomplishments/Planned Programs Subtotals	-	-	2.612

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) DA8 / Quantum PNT & Radio Frequency Sensing

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) DB4 / Enabling Long Standoff 3D (ELS3D) Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DB4: <i>Enabling Long Standoff 3D (ELS3D) Tech</i>	-	-	-	2.058	-	2.058	1.090	0.523	1.047	1.411	0.000	6.129

Note

Enabling Long Standoff 3D (ELS3D) Tech is a new start within the C3I Applied Research program in FY 2024.

A. Mission Description and Budget Item Justification

This Project investigates and develops a low-SWAP laser transmitter, processing algorithms and calibration models tailored for higher resolution 3D data collections over larger areas from longer stand-off for mapping, Intelligence Surveillance and Reconnaissance (ISR) and targeting.

Work in this Project compliments Program Element (PE) 0603042A (C3I Advanced Technology) / Project DB5 (Enabling Long Standoff 3D Adv Tech).

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

Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Signal Processing for Forward Looking Mapping Systems	-	-	2.058
Description: This effort will design and develop hardware and software to enable long standoff airborne collection of high-resolution quick turnaround 3-Dimensional Data.			
FY 2024 Plans: Will investigate advanced signal processing and calibration models for new configurations for high quality 3D data coverage for standoff airborne collection.			
FY 2023 to FY 2024 Increase/Decrease Statement: This is a new start in FY2024.			
Accomplishments/Planned Programs Subtotals	-	-	2.058

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) DB4 / Enabling Long Standoff 3D (ELS3D) Tech

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research				Project (Number/Name) DE6 / Understanding Environment as a Threat Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DE6: <i>Understanding Environment as a Threat Tech</i>	-	-	-	1.010	-	1.010	-	-	-	-	0.000	1.010

Note

Understanding Environment as a Threat Tech is a new start within the C3I Applied Research program in FY 2024.

A. Mission Description and Budget Item Justification

This Project designs and advances mission planning software enabling the Soldier to identify, track, and plan for industrial or commercial chemical/environmental threats. Software modules will increase capability of mission based planning technologies providing new operational routing options for mission execution with environmental threat overlays.

Work in this Project complements Program element (PE) 0603042A (C3I Advanced Technology) / Project DE7 (Understanding the Environment as a Threat Adv Tech).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Work in this Project is performed by the United States Army Engineer Research and Development Center.

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

	FY 2022	FY 2023	FY 2024
Title: Subsurface Forensics	-	-	1.010
Description: This effort will prepare Soldiers for the risks of deliberate or accidental release of toxic industrial chemicals and materials by investigating and developing methods to collect data to characterize and predict the fate and transport of hazards of concern.			
FY 2024 Plans: Will develop new techniques to achieve ultra-low detection levels of explosive constituents, non-weaponized hazards for reverse point sourcing threats increasingly wet, protein rich environments.			
FY 2023 to FY 2024 Increase/Decrease Statement: This is a new start in FY2024			
Accomplishments/Planned Programs Subtotals	-	-	1.010

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) DE6 / Understanding Environment as a Threat Tech

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	6.356	41.588	48.163	-	48.163	42.393	46.675	45.428	45.899	0.000	276.502
CL5: Air Platform Enabling University Applied Research	-	0.673	0.905	0.526	-	0.526	0.957	1.291	1.293	1.307	0.000	6.952
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	3.801	4.168	4.249	-	4.249	4.378	4.383	4.386	4.435	0.000	29.800
CN1: Disruptive Countermeasure Concepts for Aviation	-	1.882	7.387	7.546	-	7.546	7.653	7.231	7.235	7.314	0.000	46.248
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	4.485	4.796	-	4.796	5.411	6.633	5.539	5.589	0.000	32.453
CU8: Structures Tech for Enduring Efficient Resilience	-	-	1.648	1.682	-	1.682	1.046	1.048	1.048	1.059	0.000	7.531
CU9: Systems Design Technology	-	-	3.109	3.135	-	3.135	3.026	5.227	5.335	5.394	0.000	25.226
CW3: Advanced Rotors Applied Technology	-	-	2.589	2.614	-	2.614	2.011	2.013	2.645	2.673	0.000	14.545
CW4: Air Vehicle Structures and Dynamics Tech	-	-	2.985	3.042	-	3.042	3.072	3.077	3.079	3.113	0.000	18.368
CW5: Experimental and Computational Aeromechanics Tech	-	-	6.600	6.835	-	6.835	6.904	6.913	6.917	6.993	0.000	41.162
CW6: Future UAS Propulsion Technology	-	-	3.414	3.560	-	3.560	3.595	3.598	3.601	3.640	0.000	21.408
CW7: High Speed and Efficient VTOL Vehicle Tech	-	-	1.549	1.580	-	1.580	1.580	1.582	1.584	1.601	0.000	9.476
CW8: Next Generation Aviation Transmission Apl Tech	-	-	1.482	1.511	-	1.511	1.454	2.371	1.457	1.458	0.000	9.733

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602183A / Air Platform Applied Research											
DC2: <i>High Performance Computing for Rotorcraft Apl Tech</i>	-	-	1.267	1.293	-	1.293	1.306	1.308	1.309	1.323	0.000	7.806
DE2: <i>Airborne Threat Defeat</i>	-	-	-	5.794	-	5.794	-	-	-	-	0.000	5.794

A. Mission Description and Budget Item Justification

This Program Element (PE) undertakes applied research efforts that support and enable the overall Army Aviation portfolio in general, and the Army's modernization priority for future vertical lift (FVL). Vital and enduring applied research is conducted in the air portfolio that supports mid-to-long term requirements in contested operational environments and technologies that have broad application to FVL modernization, as well as overall Army and specific Department of Defense (DoD) aviation needs.

Research in this PE contributes to the Army Science and Technology (S&T) air systems portfolio and is fully coordinated with efforts in PE 0602148A (Future Vertical Lift Technology), PE 0603465A (Future Vertical Lift Advanced Technology) and PE 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy.

Research in this PE is performed by the United States Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)

	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024 Base</u>	<u>FY 2024 OCO</u>	<u>FY 2024 Total</u>
Previous President's Budget	6.597	41.588	41.582	-	41.582
Current President's Budget	6.356	41.588	48.163	-	48.163
Total Adjustments	-0.241	0.000	6.581	-	6.581
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.241	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	6.581	-	6.581

Change Summary Explanation

Increase funding to support new start effort in project DE2 (Airborne Threat Defeat) which will address the need to engage and disorient guided threats.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CL5 / Air Platform Enabling University Applied Research
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CL5: Air Platform Enabling University Applied Research	-	0.673	0.905	0.526	-	0.526	0.957	1.291	1.293	1.307	0.000	6.952

A. Mission Description and Budget Item Justification

This Project focuses on applied research originating from extramural applied research in academia pertaining to navigation/routing, autonomous robotic vehicles, artificial intelligence and machine learning as applied to aerial mobility and maneuver, holistic survivability, teaming, integrated mission systems, air-launched effects, and other innovative air enabling applied research technologies that will accelerate the Army modernization in next generation aerial vehicles. This Project will perform discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies fundamental to the modernization priorities. This Project conducts applied research and development leading to all the potential emerging technologies in areas of strategic importance to Army Aviation in artificial intelligence / machine learning (AI/ML), autonomous teaming systems, survivability, aeromechanics, advanced vertical take-off and landing (VTOL) design & concepts, flight dynamics, vibration & noise control, propulsion, human factor engineering and structures & materials, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances. The Project will also continuously experiment with methods to identify, demonstrate and transition novel technology from entities that might not otherwise collaborate with the Department of Defense (DoD), with the end goal of accelerating the adoption of cutting-edge applied research technology for the warfighter in the Army aviation portfolio.

Work in this Project complements Program Element (PE) 0602148A (Future Vertical Lift Technology), PE 0603465A (Future Vertical Lift Advanced Technology Development), PE 0603043A (Air Platform Advanced Technology) and PE 0602144A (Ground Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Advanced Teaming Description: Develop capabilities to self-organize and coordinate large teams of unmanned vehicles participating in long-term reconnaissance operation using distributed command/control architectures despite communication delays and/or failures and showcasing resilience to wide-area jamming.	0.321	-	-
Title: Coordinated Air-Ground Vehicle Maneuvering Description: Develop the technology for a fleet of ground and air vehicles to have the capabilities required to perform an autonomous reconnaissance mission in a relevant environment.	0.352	-	-
Title: Vertical Lift Applied Research	-	0.872	0.526

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CL5 / Air Platform Enabling University Applied Research

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: Conduct applied research in academia to elevate Vertical Lift research and continue to investigate promising and emerging technologies</p> <p>FY 2023 Plans: Will conduct applied research in emerging technologies in areas of autonomous teaming systems, survivability, aeromechanics, advanced VTOL design & concepts, flight dynamics, vibration & noise control, propulsion, human factor engineering and structures & materials.</p> <p>FY 2024 Plans: Will continue to conduct applied research in rotorcraft emerging technologies through autonomous teaming systems, aeromechanics, advanced VTOL design & concepts, flight dynamics models to extend reach, and agility.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.033	-
Accomplishments/Planned Programs Subtotals	0.673	0.905	0.526

<p>C. Other Program Funding Summary (\$ in Millions) N/A</p> <p>Remarks</p> <p>D. Acquisition Strategy N/A</p>

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CL8 / Aviation Teaming Autonomy Concepts & Technologies
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	3.801	4.168	4.249	-	4.249	4.378	4.383	4.386	4.435	0.000	29.800

A. Mission Description and Budget Item Justification

This Project establishes multi-level simulations, physics-based models, and artificial intelligence/machine learning (AI/ML) algorithms and methods to inform and advance capabilities for heterogeneous advanced teaming concepts to support operations in complex and peer contested environments. Innovative solutions, knowledge, and understanding generated from this effort informs Program Element (PE) 0602148A Future Vertical Lift Technology / Project AK9 (Adv Teaming for Tactical Aviation Operations Tech).

Research in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology) and PE 0603465A (Future Vertical Lift Advanced Technology Development).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Intelligent Unmanned Aerial System Teaming Technologies	3.801	4.093	4.249
Description: Enables the establishment of component technologies to support resilient, multi-modal, survivable Unmanned Aircraft System (UAS) teams that can plan and act on time-scales beyond human capability and have a robust shared understanding of contested and dynamic environments to support effective tactical engagement. Specific topics include 1) novel artificial-intelligence algorithms and methods for adaptive team composition and control, 2) increased team knowledge base and understanding of local and global world models, 3) hierarchical, composable, and adaptive learning methods for increased mission resilience, and 4) understanding interaction and scalability between, amongst, and across heterogeneous team members and the environment.			
FY 2023 Plans: Develop methods and technologies to enable teams of unmanned air vehicles to autonomously detect, identify, locate, and report radio frequency (RF) signals of opportunity; develop physics based models for Air-Launched Effects (ALE) simulation and advanced ALE/ Future Attack Reconnaissance Aircraft (FARA) teaming simulation; simulate ALE multi-agent tactics for RF homing and will assess multi-operator, multi-agent simulation with real human operators replacing simulated operators; investigate			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CL8 / Aviation Teaming Autonomy Concepts & Technologies

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>algorithms for detection, localization, and navigation on a s-UAS; create control algorithms for high speed obstacle avoidance, GPS-denied localization, and cooperative tactical teaming behaviors; examine efficacy of wireless power transfer hardware and battery management electronics for s-UAS; determine power requirements for s-UAS and examine effects of platform design variables, control methodologies, and autonomous functions on performance; investigate s-UAS endurance with optimized mission planning logistics under fixed energy constraints.</p> <p>FY 2024 Plans: Will develop multi-agent tactics for autonomous teams of unmanned air vehicles to autonomously detect, identify, locate, and report radio frequency (RF) signals of opportunity. Will develop multi-agent tactics, path planning, and controls for tethered UAS teams. Will develop multi-agent behaviors for executing cooperative localized tasks. Will implement machine learning on the battery management system to achieve improved performance over multiple charging/discharging cycles. Will investigate novel UAS vertical take-off and landing (VTOL) design for increased endurance and effects on optimization algorithms for mission planning under fixed energy constraints.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.075	-
Accomplishments/Planned Programs Subtotals	3.801	4.168	4.249

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CN1 / Disruptive Countermeasure Concepts for Aviation			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN1: <i>Disruptive Countermeasure Concepts for Aviation</i>	-	1.882	7.387	7.546	-	7.546	7.653	7.231	7.235	7.314	0.000	46.248

A. Mission Description and Budget Item Justification

This Project investigates advanced technologies to reduce Future Vertical Lift (FVL) platform susceptibility and vulnerability to damage from guided and unguided threats, as well as technologies to defeat small arms, rocket, and missile threats. This Project performs research and develops innovative detect and defeat technologies against next-generation threats to the FVL. Areas of research include new laser materials and designs for in-band, low size, weight, power, and cost (SWaP-C) precision laser soft-kill countermeasures operating in the mid- and long-wave infrared, lethality effects of ultrashort pulsed lasers, and sensitive radio frequency (SeRF) detection modality for use as aircraft survivability equipment (ASE). In addition, this Project will also perform research and development on the use of remotely-deployed, passive multi-modal sensors to localize threat ground vehicles and discriminate decoys.

Research in this Project is fully coordinated with Program Element (PE) 0602148A (Future Vertical Lift Technology) and PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Cognitive Countermeasures Technology Development	1.882	2.064	2.095
Description: This effort investigates and matures novel materials, components, and techniques to counter legacy and emerging threats to FVL platforms. Emphasis will be placed on technologies and approaches to enable a robust, holistic countermeasure capability for target defeat, regardless of threat characteristics or guidance mode.			
FY 2023 Plans:			
Investigate a range of rare earth-doped laser materials based on low-phonon hosts; conduct comprehensive spectroscopic research aiming at directly diode-pumped, in-band MWIR laser source; conduct laser material selection among the studied materials aimed at avoidance of two-photon pump absorption by hosts - thus ensuring laser device longevity for military use; investigate temperature dependence of device laser parameters aiming at drastic efficiency improvements; investigate USPL optical effects against realistic surrogate target system and validate sensor Disrupt/Damage/Defeat using non-optical USPL			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CN1 / Disruptive Countermeasure Concepts for Aviation

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>effects; develop and validate sensor hardware with algorithms for detection of specific targets and perform breadboard validation and assessments against select targets.</p> <p>FY 2024 Plans: Will investigate optimal approaches to multi-band sensitive radio frequency (SeRF) novel detection modalities and integrate multi-band components for system assessments. Will investigate the feasibility of realizing state-of-the-art Microelectromechanical (MEMS) Radio Frequency (RF) power and phase detection for augmented range and signals intelligence capabilities of related SeRF systems. Will design and develop optimized pulsed laser sources based on selected best Midwave Infrared (MWIR) approach. Will mature Q-switching and cooling design components. Will conduct experiments to identify best pathways toward pulsed Longwave Infrared (LWIR) sources. Will improve experimental techniques in LWIR region using Ultra-Short Pulse Lasers (USPL) to further study optical and non-optical RF effects.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: Deep Autonomous Sensing</p> <p>Description: This effort investigates the ability to localize and recognize the formation of threat ground vehicles deep in the battlefield in support of the FVL platform. Emphasis will be placed on developing novel, passive multi-modal sensors on aerial, ground, and re-locatable platforms to enable high fidelity, low false alarm target recognition and counter concealment and camouflage with decoy discrimination.</p> <p>FY 2023 Plans: Generate processing and algorithms for layered hybrid networks of multi-modal, multi-component aerial and ground sensors that can autonomously deploy, localize, and track near-peer ground threat vehicles and explore techniques for discriminating decoys; develop low size, weight, and power (SWaP) electric- and magnetic-field, acoustic, seismic, and infrasonic sensing capabilities to capture target signatures insensitive to obscurant, camouflage, and jamming; explore sensor performance characteristics with metrics, fusing distributed data to enable efficient processing at the edge and information dissemination over low SWaP optical communication systems with the ability to operate in several data conditions including high rate burst; investigate technologies and capabilities for emplacement and retrieval of ground sensors in challenging operational environments such as rugged terrain or mega-cities. Advance approaches to remotely emplace sensors in optimal locations to maximize coverage and increase the likelihood of detection of threats and decoy discrimination.</p> <p>FY 2024 Plans: Will conduct experiments to validate approaches to teaming between multi-modal ground-based sensor constellations with FVL airborne platforms (manned and/or unmanned) by integrating prototype sensor constellations with Army aviation prototype and surrogate platforms. Will investigate and conduct experiments with air-deployed sensor concepts and methodologies to</p>	-	5.278	5.451

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CN1 / Disruptive Countermeasure Concepts for Aviation		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
ensure low-cost mechanical designs. Will investigate and experiment with implementations of cost effective Position, Navigation, and Timing (PNT) techniques in the ground constellation of fixed and relocatable sensors in support of position and attitude determination for cost effective geolocation of threats. Will enhance methods of multi-modal sensor fusion, classification, and tracking of threat vehicles insensitive to obscurant, camouflage, and jamming.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: SBIR/STTR Transfer				
Description: Funding transferred in accordance with Title 15 USC §638				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638				
Accomplishments/Planned Programs Subtotals		-	0.045	-
		1.882	7.387	7.546
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CU7 / Control & Autonomy for Tactical Superiority Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	4.485	4.796	-	4.796	5.411	6.633	5.539	5.589	0.000	32.453

A. Mission Description and Budget Item Justification

This Project will develop and flight-validate new approaches and tools applicable to advanced high-speed configurations being considered for Future Vertical Lift (FVL) and transition to industry to ensure that FVL aircraft meet Army requirements. Work in this Project may also address and be applied to the needs of other Army and specific Department of Defense (DoD) aviation systems.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Adaptive Tactical Autonomy and Control (ATAC) Tech</p> <p>Description: Develop advanced vehicle management, flight control, and autonomy technologies that enable FVL aircraft to achieve superior maneuverability and agility at all speeds, effectively exploit extreme/degraded environmental conditions as a force multiplier, fight and win in presence of failure or damage, and operate on a cognitive-loading-spectrum from piloted to fully autonomous.</p> <p>FY 2023 Plans: Collaborate with Original Equipment Manufacturers (OEMs) to use available flight data to compare, validate, and improve Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) models. Mature and evaluate, in piloted simulation, algorithms for automatic reallocation of redundant controls to compensate for failure or battle damage. Start enhancing Army-developed autonomy algorithms through the application of Machine Learning and Artificial Intelligence concepts.</p> <p>FY 2024 Plans: Will develop flight control concepts that intelligently adjust aircraft response characteristics based on configuration, mission, and pilot input. Will mature concepts for transition of control between pilot and autonomous system and back to normalize pilots' utilization of autonomous functions. Will develop an architecture for the interface between autonomy algorithms and flight controls</p>	-	4.321	4.796

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CU7 / Control & Autonomy for Tactical Superiority Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
for over-actuated FVL-relevant configurations that enable control re-allocation schemes developed to enhance survivability and damage tolerance to be extended to autonomous flight. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase in FY24 supports the development of metrics and performance requirements that guide the design and testing of autonomy algorithms.				
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.164	-
Accomplishments/Planned Programs Subtotals		-	4.485	4.796
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CU8 / Structures Tech for Enduring Efficient Resilience
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU8: Structures Tech for Enduring Efficient Resilience	-	-	1.648	1.682	-	1.682	1.046	1.048	1.048	1.059	0.000	7.531

A. Mission Description and Budget Item Justification

This Project will ensure critical structures technologies providing improved weight efficiency, fatigue tolerance, parasitic weight avoidance, and integration / synergy opportunities will transition to Advanced Technology Development tasks to later provide Future Vertical Lift (FVL) Project Management Offices and Original Equipment Manufacturers mission performance benefit in terms of range/payload, survivability, sustainment, and operational availability. Research in this Project may also address and be applied to the needs of other Army and specific DoD aviation systems.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Multifunctional Advanced Structural Concepts (MASC)</p> <p>Description: Develop innovative, critical, highly weight-optimized, durable, fatigue-resistant, damage-tolerant structural concepts exploiting multifunctionality for weight savings and broad multi-scale FVL benefit impact.</p> <p>FY 2023 Plans: Develop innovative concepts enhancing structural weight efficiency applicable to FVL across size classes. Develop structural concepts using multifunctionality for parasitic weight avoidance. Apply integration methodology in guiding development of technologies to optimize benefits of reduced weight, increased resilience, and reduced maintenance.</p> <p>FY 2024 Plans: Will apply advanced composite material forms and titanium additive manufacturing to develop innovative concepts enhancing structural weight efficiency applicable to FVL across size classes. Will develop enhanced analysis of structural composites. Will continue to apply integration methodology in guiding development of technologies to optimize benefits of reduced weight, increased resilience, and reduced maintenance.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	1.588	1.682
<p>Title: SBIR/STTR Transfer</p>	-	0.060	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CU8 / Structures Tech for Enduring Efficient Resilience

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<i>FY 2023 Plans:</i> Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.648	1.682

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CU9 / Systems Design Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU9: <i>Systems Design Technology</i>	-	-	3.109	3.135	-	3.135	3.026	5.227	5.335	5.394	0.000	25.226

A. Mission Description and Budget Item Justification

This Project will leverage large datasets and advances in multi-disciplinary optimization techniques, incorporate higher fidelity analysis, and machine learning techniques to improve predictions of emerging aviation requirements and system complexity.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Concept Design and Optimization Methods</p> <p>Description: Expand scope of design and assessment support across Future Vertical Lift (FVL) lines of effort (LOEs) and the science and technology portfolio. Incorporate method enhancements to improve timeliness, accuracy, and detail of conceptual design (performance, weight, and cost).</p> <p>FY 2023 Plans: Develop tools and methods to improve rotorcraft design and optimization with advanced component models. Apply tools to design and analyze Future Vertical Lift and other manned/unmanned air vehicle concepts.</p> <p>FY 2024 Plans: Will further develop tools and methods to improve rotorcraft design and optimization with advanced component models and improved modeling framework. Will apply tools to trade studies to explore aircraft concepts for Future Vertical Lift (FVL) as well as electric and hybrid rotorcraft concepts.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	2.996	3.135
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans:</p>	-	0.113	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / <i>Air Platform Applied Research</i>	Project (Number/Name) CU9 / <i>Systems Design Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
<i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	3.109	3.135

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW3 / Advanced Rotors Applied Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW3: Advanced Rotors Applied Technology	-	-	2.589	2.614	-	2.614	2.011	2.013	2.645	2.673	0.000	14.545

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) and other Army and Department of Defense (DoD) aviation systems technologies that mature high speed and highly efficient rotor and hub system designs.

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Advanced Hubs Tech</p> <p>Description: Investigate advanced rotor system and hub technologies to support goals of increased speed and lift by developing configurations and technologies that reduce drag and enable more efficient rotor system performance.</p> <p>FY 2023 Plans: Complete advanced rotor hub conceptual design studies. Commence hub component testing.</p> <p>FY 2024 Plans: Will refine advanced rotor hub conceptual designs. Will conduct detailed analysis on hub to determine performance benefits.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	2.495	2.614
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.094	-
Accomplishments/Planned Programs Subtotals	-	2.589	2.614

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / <i>Air Platform Applied Research</i>	Project (Number/Name) CW3 / <i>Advanced Rotors Applied Technology</i>

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW4 / Air Vehicle Structures and Dynamics Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW4: Air Vehicle Structures and Dynamics Tech	-	-	2.985	3.042	-	3.042	3.072	3.077	3.079	3.113	0.000	18.368

A. Mission Description and Budget Item Justification

This Project develops modeling tools and methodologies needed to research low noise and aeroelastically stable rotor technologies. Research in this Project enables high speed flight, longer flight envelopes, and lower noise signatures in Future Vertical Lift (FVL) platforms and is also applicable to the family of FVL manned and unmanned platforms.

Research in this Project is fully coordinated with Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology Development).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Air Vehicle Structures and Dynamics Technologies	-	2.876	3.042
<p>Description: Establish improved experimentally validated modeling tools and methodologies that can be used to understand the physics of aeroelastic stability and design in next generation rotorcraft platform configurations for FVL platforms. This involves the development of an experimental capability, the Tiltrotor Aeroelastic Stability Test (TRAST), which will be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort will inform FVL requirement definition and technology maturation. This effort also establishes low noise rotor concepts and investigates the intersection of artificial intelligence and classical mechanics to enable novel mechanics and new approaches in structural dynamics for FVL applications to enable higher Operating Tempo (OPTEMPO) operations.</p> <p>FY 2023 Plans: Experimentally and analytically explore active control technologies for tiltrotor aeroelastic stability augmentation and performance improvement to enable lighter, higher speed, and higher range tiltrotor aircraft. Investigate aerodynamic interactions between closely spaced airfoil elements and their potential to reduce boundary layer height and separation, thus reducing broadband noise. Validate a rotor using this effect to achieve a reduced noise signature through high fidelity simulations and experiments. Develop</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CW4 / Air Vehicle Structures and Dynamics Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
analysis tools to design internal structures capable of exhibiting adaptive reconfiguration. Identify an algorithmic code to prescribe a topological optimization of the structure of an adaptive Unmanned Aerial System (UAS) platform. FY 2024 Plans: Will conduct Tiltrotor Aeroelastic Stability Test (TRAST) in NASA's Langley Transonic Dynamics Tunnel (TDT) to explore effects of the rotor and control system parameters on tiltrotor aircraft whirl flutter boundaries. Will explore experimentally and analytically, the active control technology-Generalized Predictive Control (GPC) on tiltrotor stability augmentation. Will explore analytically, winglet and wing extension for tiltrotor aircraft performance and stability improvement. Will investigate aeroelastic stability and vibratory loads of lift-offset coaxial rotor at high flight speed. Will develop a tool chain to analyze the boundary layer noise from rotor airfoils, including multi element airfoils and use the tools to find low noise rotor blade designs; assess the low noise designs experimentally. Will develop crashworthy navigation and flight controls algorithms to adapt to congested environments. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.109	-
Accomplishments/Planned Programs Subtotals	-	2.985	3.042

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW5 / Experimental and Computational Aeromechanics Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW5: <i>Experimental and Computational Aeromechanics Tech</i>	-	-	6.600	6.835	-	6.835	6.904	6.913	6.917	6.993	0.000	41.162

A. Mission Description and Budget Item Justification

This Project investigates new high fidelity computational methods to simulate aerodynamic effects and test methods of emerging rotorcraft lift technologies that could be incorporated into Future Vertical Lift (FVL) designs and other Army and Department of Defense (DoD) aviation systems.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Experimental Aeromechanics</p> <p>Description: Develop and explore new methods to simulate aerodynamic effects for aircraft and other future FVL configurations.</p> <p>FY 2023 Plans: Conduct test of winged compound rotorcraft configurations through expanded high speed flight envelope with rotor revolutions per minute (RPM) variation and auxiliary propulsion to provide fundamental understanding and validation data for computational tools; Investigate state of the art of measurement & diagnostics techniques for rotorcraft; Test rotor blade structural deformation and boundary layer transition using embedded sensor networks; Investigate methods for rotorcraft hub drag reduction.</p> <p>FY 2024 Plans: Will develop a powered tail rotor test stand for more accurate physical modeling of winged compound rotorcraft interactional aeromechanics to provide fundamental understanding and validation data for computational tools. Will investigate advanced high speed compound rotorcraft wing designs to provide improved hover and forward flight performance. Will investigate state of the art measurement & data analysis techniques for rotorcraft to provide new or improved data sets for computational tool validation. Will conduct tests to investigate methods of rotorcraft hub drag reduction on FVL relevant configurations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	4.044	4.366
<p>Title: Computational Aeromechanics</p> <p>Description: Verify, validate and apply high-fidelity modeling and simulation software tools for rotorcraft aeromechanics.</p>	-	2.315	2.469

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CW5 / Experimental and Computational Aeromechanics Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>FY 2023 Plans: Test and validate computational models for interactional aerodynamics applications including fast-running reduced-order computational fluid dynamics (CFD) models. Test and validate computational models for rotorcraft air launched effects (ALE) deployment simulations.</p> <p>FY 2024 Plans: Will verify and validate reduced-order and surrogate computational aeromechanics models for Future Vertical Lift (FVL) aircraft that provide high accuracy while running fast enough for use in rotorcraft design applications. Will demonstrate and test these new design-oriented computational models by addressing engineering problems for relevant FVL aircraft configurations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.241	-
Accomplishments/Planned Programs Subtotals	-	6.600	6.835

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW6 / Future UAS Propulsion Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW6: Future UAS Propulsion Technology	-	-	3.414	3.560	-	3.560	3.595	3.598	3.601	3.640	0.000	21.408

A. Mission Description and Budget Item Justification

This Project designs and assesses advanced engine and power system component technologies to support the goals of multi-fuel capability, reduced fuel consumption, and reduced engine size, weight, and cost in current and Future Unmanned Aircraft Systems (FUAS).

Research in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Multi-Fuel Capable Hybrid Electric Propulsion	-	3.289	3.560
Description: Applied research to enable intelligent and robust propulsion performance and noise signature reduction via multi-fuel and optimized hybrid electric capability for small engines (20kW to 150kW) powering future aircraft systems. The research focuses on the establishment of concepts to enable reduced fuel consumption, engine size, weight, and cost as well as improved group three and four FUAS reliability, survivability, and maintainability.			
FY 2023 Plans: Assess robust ignition for low quality fuels utilizing advanced ignition assistants and ignition sensing and control; complete models for oil-free bearings relevant to aviation turbochargers; validate bearingless motor design and optimization tool with experimental data; enhance hybrid-electric optimization tool to include design optimization and uncertainty analysis.			
FY 2024 Plans: Will integrate combustion and fuel property sensing, explore control strategy for varied ignition quality fuels to enable multi-fuel capability, and assess novel ignition assistant in relevant engine environment. Will validate oil-free bearing analysis tool and turbocharger aeroelasticity tool. Will extend validation of motor design tools to higher rotational speeds. Will validate and verify system level hybrid-electric architectures. Will continue augmenting hybrid-electric optimization and integration tool capabilities by introducing new higher fidelity models.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CW6 / Future UAS Propulsion Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding change reflects planned lifecycle of this effort.			
Title: SBIR/STTR Transfer	-	0.125	-
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	3.414	3.560

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW7 / High Speed and Efficient VTOL Vehicle Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW7: High Speed and Efficient VTOL Vehicle Tech	-	-	1.549	1.580	-	1.580	1.580	1.582	1.584	1.601	0.000	9.476

A. Mission Description and Budget Item Justification

This Project designs and develops material component technologies and dynamic models to enable future generation capabilities for Future Vertical Lift (FVL) platforms. This Project is focused on improving range, payload, and endurance performance as well as reliability and maintainability metrics. The outcomes from the efforts within this Project will be applicable to the Family of Future Vertical Lift manned and unmanned platforms.

Research in this Project is fully coordinated with PE 0603465A (Future Vertical Lift Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States (US) Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: High Speed Efficient Vertical Take-Off and Landing (VTOL) Vehicle Technologies	-	1.492	1.580
Description: This effort establishes propulsion concepts for vertical take-off and landing to enable improved, efficient hover and high-speed cruise at longer range without added weight.			
FY 2023 Plans: Validate dynamic models for hybrid composite gears with integrated shafts in the VIPER facility; determine hybrid gear's capability to deliver continuous power at 525 HorsePower (HP); develop experimental techniques to access hybrid gear failure modes and develop a dynamic model of a non-conventional transmission topology; perform oil-out experiments of hybrid composite gear components; quantify effectiveness of data-driven condition indicators for gears, bearings, and lubrication; investigate using simulated dynamic responses to train data-drive condition indicators.			
FY 2024 Plans: Will continue to develop experimental techniques to assess hybrid gear failure modes. Will continue to develop a dynamic model of a transmission topology that is non-conventional for rotorcraft. Will prepare the Vehicle Innovative Powertrain Experimental Research (VIPER) facility to perform hybrid-electric propulsion transmission experiments. Will assess tribological performance			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CW7 / High Speed and Efficient VTOL Vehicle Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
of functionally-graded ceramic/metal materials at the coupon level. Will expand the machine learning (ML) toolbox for investigating failure modes of electric rotating machinery. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: SBIR/STTR Transfer FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638		-	0.057	-
Accomplishments/Planned Programs Subtotals		-	1.549	1.580
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research				Project (Number/Name) CW8 / Next Generation Aviation Transmission Apl Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW8: Next Generation Aviation Transmission Apl Tech	-	-	1.482	1.511	-	1.511	1.454	2.371	1.457	1.458	0.000	9.733

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) and other Army and Department of Defense (DoD) advanced drive train technologies that increase performance and double current drivetrain life cycles while improving their reliability and maintainability.

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: High Reduction Ratio Transmission (HRT) Components</p> <p>Description: Effort investigates advanced materials and component designs that allow a 60:1 reduction ratio two-stage gearbox design that provides significant weight and volume reduction for extended range and component life for manned and unmanned applications.</p> <p>FY 2023 Plans: Test new corrosion resistant steel components for physical material properties such as tensile strength, surface hardness, bending strength, and surface fatigue. Develop improved manufacturing techniques based on the physical material properties data as well as develop and test new seal materials and seal configurations.</p> <p>FY 2024 Plans: Will perform tribology testing and analysis of advanced gear/bearing materials using in-house testing facilities.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	1.428	1.511
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.054	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) CW8 / Next Generation Aviation Transmission Apl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.482	1.511

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) DC2 / High Performance Computing for Rotorcraft Appl Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DC2: High Performance Computing for Rotorcraft Appl Tech	-	-	1.267	1.293	-	1.293	1.306	1.308	1.309	1.323	0.000	7.806

A. Mission Description and Budget Item Justification

This Project investigates and validates aeromechanics modeling and simulation tools for Future Vertical Lift (FVL) and other Army and DoD aviation systems and platforms. Research efforts in this Project are also applicable to the family of FVL manned and unmanned platforms.

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: High Performance Computing for Aviation Applications</p> <p>Description: Develop automated, high-fidelity computational tools for rotorcraft analysis and design.</p> <p>FY 2023 Plans: Develop new high-order accurate computational fluid dynamics models for rotorcraft aerodynamic analysis. Develop accurate and fast-running surrogate models suitable for use in rotorcraft design.</p> <p>FY 2024 Plans: Will develop and demonstrate new high-fidelity aeromechanics modeling and simulation tools to address relevant rotorcraft design problems for FVL-relevant aircraft. Will ensure that these new aeromechanics modeling and simulation tools run efficiently and effectively on state-of-the-art new heterogeneous high-performance computing systems.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	1.221	1.293
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.046	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Resea rch	Project (Number/Name) DC2 / High Performance Computing for Rotorcraft Apl Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	-	1.267	1.293

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Research	Project (Number/Name) DE2 / Airborne Threat Defeat
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DE2: Airborne Threat Defeat	-	-	-	5.794	-	5.794	-	-	-	-	0.000	5.794

Note
Airborne Threat Defeat is a new start within the Air Platform Applied Research program in FY 2024.

A. Mission Description and Budget Item Justification

Airborne Threat Defeat is a new start effort in FY2024 to address the need to engage and disorient guided threats.

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Airborne Threat Defeat Tech	-	-	5.794
Description: This effort develops novel weapon, munition and fire control system technology required to increase standoff distance and engagement time to decoy or defeat guided threats.			
FY 2024 Plans: Will investigate concepts to decoy and defeat advanced, agile, and guided aerial threats with novel weapon, munition, and fire control system technologies. Will develop modeling and simulation tools to evaluate potential decoy and defeat techniques. Will investigate miniaturized electro-chemical-mechanical payloads for advanced threat decoy or threat.			
FY 2023 to FY 2024 Increase/Decrease Statement: This is a New Start in FY2024			
Accomplishments/Planned Programs Subtotals	-	-	5.794

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	10.660	15.716	18.986	-	18.986	21.027	29.173	30.082	30.432	0.000	156.076
CK9: <i>Advancing Concepts and Technology Forecasting Tech</i>	-	2.206	2.529	2.586	-	2.586	2.572	2.576	2.577	2.606	0.000	17.652
CN2: <i>Intelligent Weapons Concepts and Technologies</i>	-	2.098	3.335	4.474	-	4.474	4.475	4.481	4.484	4.524	0.000	27.871
CN9: <i>Soldier Enabling University Applied Research</i>	-	0.905	0.396	0.457	-	0.457	2.171	2.777	2.779	2.809	0.000	12.294
CO1: <i>Soldier Power And Energy Concepts and Technologies</i>	-	1.195	2.387	4.442	-	4.442	4.483	8.132	9.447	10.084	0.000	40.170
CO2: <i>Soldier-Intelligent Technology Research</i>	-	4.256	1.543	-	-	-	-	-	-	-	0.000	5.799
CV9: <i>Technical-SAVVY Soldier Applied Research</i>	-	-	2.331	3.396	-	3.396	3.657	3.767	3.350	2.883	0.000	19.384
CW9: <i>Syn Bio for Reactive-Resp Mats-Soldiers & Sys</i>	-	-	3.195	3.631	-	3.631	3.669	7.440	7.445	7.526	0.000	32.906

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs, and performs research focused on technologies necessary for capability enhancements for the Soldier and Squad over the long-term well beyond those technologies planned within the Soldier Lethality Cross- Functional Team. Applied research projects investigate nascent and enduring science and technology areas that are applicable to the individual Soldier and Squads of Soldiers needs with emphasis on maximizing Soldier and Squad performance, lethality, mobility and survivability. This PE also designs and validates technologies that are necessary and foundational for future capabilities with far-reaching impact on mission success. The outputs of these efforts transition to advanced research efforts that mature and demonstrate potential opportunities to realize improved Soldier performance and inform technical requirements for future Soldier systems.

The PE will fund civilian salaries for in-house researchers/scientists and program managers collaborating with external subject matter experts in academia and industry who are leaders in these technology research areas. This PE is coordinated with PE 0602143A (Soldier Lethality Technology), 0602785A (Manpower, Personnel and Training Technology), 0603007A (Manpower, Personnel and Training Advanced Tech), 0603044A (Soldier Advanced Technology), and 0603118A (Soldier Lethality Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>
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Research in this PE is performed by the United States (US) Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	11.064	15.716	16.059	-	16.059
Current President's Budget	10.660	15.716	18.986	-	18.986
Total Adjustments	-0.404	0.000	2.927	-	2.927
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.404	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	2.927	-	2.927

Change Summary Explanation

Funding increase in FY2024 supports additional research for Army in alternative power sources efforts.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CK9 / <i>Advancing Concepts and Technology Forecasting Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CK9: <i>Advancing Concepts and Technology Forecasting Tech</i>	-	2.206	2.529	2.586	-	2.586	2.572	2.576	2.577	2.606	0.000	17.652

A. Mission Description and Budget Item Justification

This Project works across the Army Futures Command Combat Capabilities Development Command (AFC CCDC) and with the Futures & Concepts Center (FCC) to explore current and future emerging and disruptive applied scientific research in order to translate, integrate, and ingrain applied research outcomes with Army Warfighting Concepts to describe how the Army will fight in the mid and far-term future. Applied research outcomes describe the projected future operational effects of science in the context of Army concepts to mitigate risk for future Army capabilities and enable informed decision making across the Army Modernization Enterprise. This Project ensures Army Concepts are grounded by recent discoveries in applied scientific research, Army applied research is capability use-inspired to deliver the right future capability identified in the Army Concepts, and learning opportunities are created to advance Army Concepts and operationalize science for transformational overmatch.

This Project also performs long-range technology forecasts and trend analysis, informed by the threat and the predicted future state of technology, of Army-relevant applied research topics to enable informed decision making for the near-, mid-, and far-terms.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Advancing Concepts and Technology Forecasting	2.206	2.521	2.586
Description: Advancing Concepts and Technology Forecasting identifies and translates emerging and disruptive applied scientific research current and future outcomes in order to integrate and ingrain applied scientific data and knowledge with Army Warfighting Concepts which describe how the Army will fight in the mid- and far-term future. This effort also provides long-range, scientifically grounded technology forecasts and trend analysis, informed by the threat and future predicted state of technology, of applied research topics to enable informed decision-making for the near-, mid-, and far-terms.			
FY 2023 Plans: Integrate applied scientific research outcomes into emerging Army Warfighting Concept priorities for mid- and far-term decision dominance, sustained operations, and maximizing human potential; determine objective estimates of anticipated technology advances, across the Army Priority Research Areas, for Army decision-makers to aid in applied research program formulation.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CK9 / <i>Advancing Concepts and Technology Forecasting Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will provide objective estimates of anticipated applied research advances of emerging scientific areas with high relevance to the Army. Broad technology areas include extensions to the Army Priority Research Areas and other topics such as Army-unique autonomous behaviors, cross-domain sensor modalities, and agile manufacturing technologies; integrate outcomes of mid- and far-term Army Warfighting Concept priorities for decision advantage into emerging applied scientific research programs in distributed sensing and artificial intelligence for agile command and control, and for sustained operations into emerging applied scientific research programs in energy sciences.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.008	-
Accomplishments/Planned Programs Subtotals		2.206	2.529	2.586
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CN2 / <i>Intelligent Weapons Concepts and Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN2: <i>Intelligent Weapons Concepts and Technologies</i>	-	2.098	3.335	4.474	-	4.474	4.475	4.481	4.484	4.524	0.000	27.871

A. Mission Description and Budget Item Justification

This Project focuses on far-term, overarching lethality technologies by investigating techniques for Soldiers to guide the in-field adaptation of intelligent small arms technologies to respond to changing mission requirements, novel environments, and adversarial actions. Research areas include cognition-centric displays to ensure Soldiers maintain appropriate situational awareness in augmented reality (AR) environments, opportunistic shooter sensing, and interactive machine learning techniques to ensure small arms technologies can adapt to changing situations quickly and with reduced data requirements as compared to non-human guided machine learning and Artificial Intelligence (AI). The results of this Project will enhance operational performance of individuals and teams of Soldiers in the future operational environment through novel weapon and human-agent interaction technologies.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Human-Agent Interactions for Intelligent Squad Weapons	2.098	3.312	4.474
Description: This effort investigates enhanced target acquisition, situational awareness, and shooting performance through Soldier-centered integration of intelligent technologies and distributed information in augmented squad weapons. Enhances operational performance of individuals and teams of Soldiers through novel weapon and human-agent interaction technologies.			
FY 2023 Plans: Will determine methods for expanding prior opportunistic sensing approaches to increasingly realistic scenarios; investigate capabilities derived from fusion of opportunistically sensed data from small arms and small unmanned aerial systems; design and develop enhanced approaches for small arms fire control based on aim augmentation.			
FY 2024 Plans: Will mature algorithms for fusion of opportunistically sensed data from intelligent weapons and small unmanned aerial systems; develop adaptive small arms fire control capabilities using integrated opportunistic sensing within artificial intelligence (AI)-enhanced small arms ecosystems; develop methods for using opportunistic sensing to quantify emergent behaviors from dismounted, heterogenous human-autonomy squads during realistic scenarios; investigate approaches for providing contextualized Soldier-weapon-squad state data for enhanced squad-level task prioritization and command-level decision making.			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CN2 / <i>Intelligent Weapons Concepts and Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding realigned from PE 0602143A Project BE8 Synthetic Training Environment (STE) Technology to increase research in the areas of opportunistic sensing and squad level decision making.			
Title: SBIR/STTR Transfer	-	0.023	-
Description: Funding transferred in accordance with Title 15 USC §638			
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638			
Accomplishments/Planned Programs Subtotals	2.098	3.335	4.474

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CN9 / <i>Soldier Enabling University Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CN9: <i>Soldier Enabling University Applied Research</i>	-	0.905	0.396	0.457	-	0.457	2.171	2.777	2.779	2.809	0.000	12.294

A. Mission Description and Budget Item Justification

This Project investigates technologies from academia that will improve capabilities and systems to advance Soldier and Squad lethality-overmatch and Soldier performance. This Project funds collaborative, enduring applied extramural university-based research and brings together competitively selected universities with Army research teams into Technical Alliances. This Project will determine discovery solutions and inform capabilities development for mid- to far-term Army modernization priorities while also maintaining delivery of near-term technologies fundamental to the modernization priorities. The technical scope of this Project includes the investigation and design of overarching Soldier-centric technologies including, human systems integration, robotics, synthetic environments for training, advanced materials, power management, energy, Warfighter endurance, and computational technologies. This Project conducts applied research for potential emerging technologies in areas of strategic importance to the Army in Soldier capabilities related to increased protection, performance, agility, situational awareness, and lethality. This Project will also continuously strive to engage and collaborate with entities that might not otherwise collaborate with the Department of Defense (DoD) to identify and determine novel Soldier-centric technologies for accelerating the adoption of emerging technologies for the Warfighter in the Army Soldier portfolio.

Work in this Project complements Program Element 0603044A (Soldier Advanced Technology)/Project CN8 (Soldier Enabling University Advanced Development)

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Soldier Training and Performance	0.622	0.382	0.457
Description: Collaboratively investigate technologies for Soldier capabilities related to increased protection, performance, agility, situational awareness, training, and lethality.			
FY 2023 Plans: Will expand investigation in common software platform the automated testing framework to guarantee that synthetic training environments are highly trustworthy, reliable, and usable, to ensure that Soldiers are efficiently trained; investigate cognitive state and readiness of Warfighters through digital biomarkers and biosensors.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CN9 / <i>Soldier Enabling University Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Collect, label, warehouse, and analyze training data for the development of synthetic training environment. Continue to investigate technologies to monitor health, cognitive state and readiness of Warfighters through digital biosensor/biomarkers and their wireless charging capabilities. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle increase to expand the technology investigation and user feedback.				
Title: Soldier Electronics for the Integrated Combat Platform Description: Design and determine advanced materials and electronics that are standardized to the Soldier and their equipment through integrated combat platform.		0.283	-	-
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638. FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638. FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.		-	0.014	-
Accomplishments/Planned Programs Subtotals		0.905	0.396	0.457
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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CO1 / <i>Soldier Power And Energy Concepts and Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CO1: <i>Soldier Power And Energy Concepts and Technologies</i>	-	1.195	2.387	4.442	-	4.442	4.483	8.132	9.447	10.084	0.000	40.170

A. Mission Description and Budget Item Justification

This Project conducts applied research to improve safe, compact, efficient, rugged, lightweight, and energy dense power sources for increased capabilities for the mounted and dismounted force. This Project also investigates materials, processes, and component level energy storage and conversion technologies that enable tactical overmatch and reduce the physical and cognitive burden on Soldiers. Research will focus on safe electrochemical energy storage, high specific energy storage and conversion, novel materials and processing for energy and power, and new cell designs that address the power needs of future capabilities including advanced sensors, communications systems, and electronic Warfighting capabilities. Enabling and emerging technologies are supported in this Project to address future Soldier power needs necessary for increased lethality, increased mobility, and longer mission durations at reduced physical burden to the Soldier in the future operating environment.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Tactical Energy Sources and Energy Materials	1.195	2.384	2.442
Description: This effort conducts overarching power and energy research to determine and design alternative energy capabilities to replace current energy systems. Research focuses on new materials and processing techniques as well as energy storage technologies that support advanced sensors, communications systems, and electronic Warfighting capabilities.			
FY 2023 Plans: Investigate anode protection schemes for high capacity and high charge rate anode materials to enable high energy, safe, non-flammable aqueous electrolyte batteries; identify processes and methods to scale materials and component fabrication to larger format and multilayer pouch cells; investigate high energy cathodes including halide intercalation and conversion cathodes; develop protective interphases at the electrode/electrolyte interfaces to enable selective transport in aqueous electrolytes for reversible lithium (Li), zinc (Zn), and multivalent rechargeable batteries; validate and asses key metrics related to energy density, cycle life, columbic and cycle efficiency, rate capability, and safety of rechargeable batteries; design and generate catalysts and perform modelling with atomic precision to gain an accurate understanding of the fundamental factors dictating carbon dioxide reduction reaction mechanisms and conversion product selectivity; determine the most impactful fuels for synthesis from carbon			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CO1 / <i>Soldier Power And Energy Concepts and Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>dioxide; investigate the use of stretchable power devices with textile-woven conductors for a full body power management system with integrated data communication.</p> <p>FY 2024 Plans: Will characterize nickel and nickel-based alloy catalyst parameters for ethanol partial oxidation; investigate alumina and ceria-based materials as support substrate for ethanol partial oxidation catalysts; design and develop baseline characterization methods to explore catalyst and catalyst support combinations for the reduction of ethanol reformation temperature; design and develop large area, high capacity rechargeable batteries utilizing aqueous, hybrid, and inorganic electrolytes and additives; determine temperature driven phase and transport behavior in aqueous, hybrid, and inorganic electrolytes and investigate conductivity, transference number, capacity, recharge rate, and cycle life at high and low temperatures; investigate incorporation of high energy anodes for rechargeable aqueous batteries including silicon, metal, and alloy chemistries; identify routes to synthetically protect and passivate from electrolyte decomposition at high energy anodes; design and develop binders and methods for scalable processing and integration of battery material; mature high capacity halide-based cathode and supporting electrolyte interface.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.003	-
<p>Title: Materials and Technologies for Electrochemical Alternative Power</p> <p>Description: This effort investigates materials for electrolyzers and alternative power sources for small unit energy and power needs. Research is focused on materials and technologies that will reduce the dependence on fossil fuels while diversifying the energy sources for soldier platforms.</p> <p>FY 2024 Plans: Will investigate electrocatalysts and membranes for open cell electrolysis; perform analysis on candidate fuel products and associated production rates constrained by size, weight, and power and reduced carbon footprint; design and develop the button cell fabrication process for electrochemical alternative power sources.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	-	2.000

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CO1 / <i>Soldier Power And Energy Concepts and Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding increase supports additional research in alternative power sources.			
Accomplishments/Planned Programs Subtotals	1.195	2.387	4.442

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CO2 I <i>Soldier-Intelligent Technology Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CO2: <i>Soldier-Intelligent Technology Research</i>	-	4.256	1.543	-	-	-	-	-	-	-	0.000	5.799

A. Mission Description and Budget Item Justification

This Project investigates research gaps related to human and intelligent systems to enhance decision making in response to changing conditions. Applied research is conducted on novel and emerging visualization technologies as well as methodologies for intelligent systems and Soldier to co-adapt for the real-time quantification, prediction, and enhancement of squad-level shared situational awareness (SA) and situational understanding (SU) across dynamic, complex, and uncertain operating environments, leading to demonstrated increases in mission effectiveness. The result of this Project will inform various efforts that rely on human and intelligent system interactions including systems that adapt the behavior of autonomous assets and intelligent Soldier tools, based on dynamic needs of the Soldier/squad, using real-time opportunistic measures of Soldier SA and changing mission environment. In addition, this Project will design novel approaches to represent uncertain and dynamically changing information, to increase Soldier comprehension and enhanced mission effectiveness, with reduced Soldier/squad burden and training requirements.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Soldier Performance in Sociotechnical Environments	2.872	1.504	-
Description: Technologies for squad-level situational awareness assessment (information visualization) that provide command-level decision support with communication and intervention capabilities. Research focuses on algorithms for the quantification and visualization of collective uncertainty at the squad level for mission command decision making. This effort also supports the monitoring and assessing of Soldier tactical readiness and effectiveness through technologies and approaches for opportunistic human sensing.			
FY 2023 Plans: Will develop algorithms for autonomous systems to use opportunistically sensed data from groups in dismount virtual environments to adapt a learned behavior, or set of behaviors, for improved squad-autonomy performance.			
FY 2023 to FY 2024 Increase/Decrease Statement: Decreased funding due to effort being completed in FY23			
Title: Algorithms for Sensing Soldiers in Mission Context	1.384	-	-
Description: This effort investigates novel and emerging visualization technologies representing complex, time-sensitive information in the dynamic operating environment as well as technologies for human and artificial intelligence (AI) situational			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CO2 / <i>Soldier-Intelligent Technology Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
understanding for enhanced operational performance and decision making under conditions of time sensitive and dynamically changing information.			
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638 FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638 FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638	-	0.039	-
Accomplishments/Planned Programs Subtotals	4.256	1.543	-

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CV9 / <i>Technical-SAVVY Soldier Applied Research</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CV9: Technical-SAVVY Soldier Applied Research</i>	-	-	2.331	3.396	-	3.396	3.657	3.767	3.350	2.883	0.000	19.384

A. Mission Description and Budget Item Justification

This Project conducts applied research to provide critical breakthroughs in developing a "technologically" fluent force. This research will develop models of technological fluency(TF) (TF Modeling), methods and measures to assess and develop the technological fluency of Soldiers across a career (TF Personnel Assessments), and technologies to maximize technological fluency resilience and performance in Soldiers and units (Maximizing TF). TF is defined as the ability of Soldiers and units to use and rapidly adapt new and intelligent technologies without formal training on these technologies, and it will be a decisive factor in a future operating environment in which Soldiers and squads are teamed with increasingly sophisticated and evolving technologies. Soldiers and leaders in specialty areas (e.g., Cyber and Emerging Tech) and General Purpose Forces will require increased technological aptitudes and skills to adapt emerging technologies to evolving mission sets and avoid being overmatched by Artificial Intelligence (AI)-enabled "smart" technologies.

This Project supports key Army needs and will coordinate with and/or leverage findings of several Program Elements (PEs) to include PE 0602785A (Manpower, Personnel and Training Technology), 0602143A (Soldier Lethality Technology), and 0602145A (Next Generation Combat Vehicle Technology).

This research will be performed collaboratively by the Combat Capability Development Command - Army Research Laboratory (ARL) and the United States (U.S.) Army Research Institute (ARI) for Behavioral and Social Sciences.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Modernization Strategy, and the Army People Strategy.

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

	FY 2022	FY 2023	FY 2024
Title: Soldier Technical Enhancement Applied Research - ARL	-	1.497	2.096
Description: This effort enables TF through three areas of focus: TF Modeling through the creation and utilization of novel future-focused experimental test-beds; TF Personnel Assessments through methodologies and technologies for "opportunistic" (no Soldier burden) sensing and TF interpretation; and Maximizing TF through creating TF training approaches and in-field performance aids.			
FY 2023 Plans: Design the first of its kind future human-system interaction experimental environment containing multiple research grade test-beds; design and pilot initial experimental methodologies in support of TF Modeling.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CV9 / <i>Technical-SAVVY Soldier Applied Research</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will mature human-system interaction experimental environment to include prototype adaptive intelligent system interactions and initial technology integration for opportunistic sensing capability; conduct validation experiments on initial TF models using human-system interaction test-beds.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned increase in test bed development research.</p>				
<p>Title: Soldier Technical Enhancement Applied Research - ARI</p> <p>Description: This effort enables TF through three areas of focus: TF Modeling by identifying and understanding the critical human knowledge, skills, abilities, and characteristics that enable TF in Soldiers and teams; TF Personnel Assessments by developing and validating personnel tests to assess knowledge, skills, and abilities, and characteristics to promote TF for talent management; and Maximizing TF by creating and validating TF training approaches to improve TF at both the individual and team levels of performance.</p> <p>FY 2023 Plans: Develop a competency model of Technological Fluency (TF) that identifies the critical knowledge, skills, abilities, and characteristics that enable TF and related elements of job performance.</p> <p>FY 2024 Plans: Will continue to develop a competency model of Technological Fluency (TF) that identifies the critical knowledge, skills, abilities, and characteristics that enable TF; will initiate development of proof-of-concept training methods for maximizing TF competencies; will develop and define the individual personnel testing requirements needed to measure TF model competencies.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports planned lifecycle of the effort.</p>		-	0.749	1.300
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>		-	0.085	-
Accomplishments/Planned Programs Subtotals		-	2.331	3.396
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CV9 / <i>Technical-SAVVY Soldier Applied Research</i>

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

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>				Project (Number/Name) CW9 / <i>Syn Bio for Reactive-Resp Matls-Soldiers & Sys</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW9: <i>Syn Bio for Reactive-Resp Matls-Soldiers & Sys</i>	-	-	3.195	3.631	-	3.631	3.669	7.440	7.445	7.526	0.000	32.906

A. Mission Description and Budget Item Justification

This Project designs and investigates materials through the application of biotechnology and synthetic biology advances to develop material capabilities that respond and/or can adapt to a wide range of external stimuli and biological processes. Research into innovative materials that are capable of sensing, responding, and adapting to a broad spectrum of environmental variables will be conducted. This Project will explore new biology-based methods for controlled synthesis and assembly to create multi-functional materials and advanced composites as well as develop materials that are able to self-monitor, self-heal, and self-sustain. This Project also focuses on developing models, materials characterization techniques, non-destructive testing methods, and advanced fabrication and processing methodologies as well as the identification of unique material properties.

The cited research is consistent with the Undersecretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Futures Command (AFC).

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

	FY 2022	FY 2023	FY 2024
Title: Biological Bio-Composite Materials and Processes	-	3.078	3.631
Description: This effort conducts applied research through the application of biotechnology advances to develop materials with capabilities to respond and adapt to a wide range of external stimuli and biological processes. Research will explore new biology-based methods for controlled synthesis and assembly to create materials with precise chemistries, microstructures, properties, and responsive functionalities through controlled molecular placement, spatial architectures, and interfacial structures. Investment in bio-enabled materials research allows for the design of materials that are capable of sensing and responding, as well as adapting to a broad spectrum of environmental variables with the ability to self-monitor, self-heal, self-sustain, and self-degrade. Investments in this area could lead to future applications in Soldier performance, situational awareness, protection, and sustainment.			
FY 2023 Plans:			
Design and develop biological building blocks to interface with sensor platforms and investigate signal transfer to platform; develop a library of tunable and modular biological building blocks for advance sensing (e.g., Soldier performance, situational awareness, and target tracking and locating); develop hybrid experimental and computational tools to inform design of novel biomaterials for control in the electro-optical/electromagnetic (EO/EM); assess novel adhesive molecules and structural composites for scale and integration for down-stream processing (e.g. energetics, protective coatings); determine utility of novel biomaterials for advanced composites and protective coatings; investigate rate of degradation of high value targets and validate			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602184A / <i>Soldier Applied Research</i>	Project (Number/Name) CW9 / <i>Syn Bio for Reactive-Resp Matls-Soldiers & Sys</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>down-selected models of accelerated degradation using laboratory experiments; design biological counter measures to prevent or mitigate material degradation and investigate dynamic range of degradation processes.</p> <p>FY 2024 Plans: Will design and develop biological building blocks to interface with military equipment, electronics, and platforms (i.e. coatings, textiles, metals) for advance sensing, protection, and deception, and investigate signal output for sensors; investigate and tune novel biomaterials for control in electro-optical/electromagnetic (EO/EM) and determine shielding for protection; continue to tune and assess novel structural composites for scale and integration for down-stream processing (e.g. energetics, protective coatings); investigate strategies to integrate biomaterials into composites for protection, situational awareness, and communication to determine utility of novel biomaterials for advanced composites and protective coatings; understand biodegradation mechanisms of protective coatings and identify strategies to tune effects and delivery mechanisms.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports additional research into novel biomaterials.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p>	-	0.117	-
Accomplishments/Planned Programs Subtotals	-	3.195	3.631

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602213A / <i>C3I Applied Cyber</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	12.119	13.605	22.714	-	22.714	32.949	25.591	22.414	16.672	0.000	146.064
2CY: <i>Information Trust Technology</i>	-	0.601	0.858	3.054	-	3.054	-	-	-	-	0.000	4.513
3CY: <i>Network Access and Effects Technology</i>	-	6.479	7.798	10.588	-	10.588	12.525	12.225	12.233	12.366	0.000	74.214
5CY: <i>Offensive Cyber Operations (OCO) Mirror Technology</i>	-	0.987	1.022	-	-	-	-	-	-	-	0.000	2.009
CY1: <i>Information Assurance and Network Resiliency Tech</i>	-	3.397	3.927	-	-	-	-	-	-	-	0.000	7.324
CY6: <i>Autonomous Cyber Technology</i>	-	0.655	-	9.072	-	9.072	20.424	13.366	10.181	4.306	0.000	58.004

A. Mission Description and Budget Item Justification

This Program element (PE) investigates, designs, and develops cyber architectures, software, tools, and techniques to enable Cyber Electromagnetic Activities (CEMA) to counter adversary communications and harden the Army's tactical communications networks against cyber attacks. For offensive cyber effort against adversary communications, efforts investigate capabilities to identify and capture data traversing targeted networks for detection, identification, exploitation, direction finding, geolocation, and denial of service. Defensive cyber efforts in this PE focus on hardening the Army's tactical network by investigating and applying robust cyber security technologies and techniques to advance software, algorithms and protocols utilized within tactical networks, to protect against nation state level cyber-attacks and maintain Warfighter confidence in network information by hardening the blue force attack surface.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Priorities.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602213A / <i>C3I Applied Cyber</i>
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B. Program Change Summary (\$ in Millions)	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024 Base</u>	<u>FY 2024 OCO</u>	<u>FY 2024 Total</u>
Previous President's Budget	12.119	13.605	25.231	-	25.231
Current President's Budget	12.119	13.605	22.714	-	22.714
Total Adjustments	0.000	0.000	-2.517	-	-2.517
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-2.517	-	-2.517

Change Summary Explanation

Decreased funding to support higher Army priorities.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber				Project (Number/Name) 2CY / Information Trust Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
2CY: Information Trust Technology	-	0.601	0.858	3.054	-	3.054	-	-	-	-	0.000	4.513

A. Mission Description and Budget Item Justification

This Project develops defensive cyber technology to ensure that data traversing the network remains verified and has not been modified through unauthorized means.

Work in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 8CY (Information Trust Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Information Trust Technology</p> <p>Description: This effort develops defensive cyber technology to ensure that data traversing the network remains verified and has not been modified through unauthorized means.</p>	0.601	-	-
<p>Title: PKI-Modernization & Dynamic Access Control for Tactical (DAC-T) Technology</p> <p>Description: This effort will investigate cryptographic algorithms that address Program Manager (PM) Mission Command gap of native ability to support PKI digital signature and Online Certificate Status Protocol (OCSP) certificate validation for the Variable Message Format (VMF) standard MIL-STD-2045-47001D in Disconnected, Interrupted, and Low-bandwidth (DIL) Networks.</p> <p>Furthermore, this effort will investigate methods to enhance, speed up and automate account provisioning and access for people and Non-Person entities (NPE) (e.g. sensors, devices, web services, etc.). This will significantly reduce the workload/ burden for the soldier and improve the networks security posture by enforcing least privilege & just-in-time network access.</p> <p>FY 2023 Plans: Investigate modern PKI algorithms as well as OCSP stapling; investigate different courses of action for changes to the current MIL-STD-2045-47001E; update cryptographic libraries and software stack to support modern cryptographic algorithms and capabilities as well as OCSP Stapling; establish an Identity Credential & Access Management (ICAM) test infrastructure to test/ Integrate merging and synchronizing of ICAM data from data sources across the Department of Defense (DOD), Army and tactical levels in accordance with the Army ICAM Strategy, Army ICAM Attribute Specification and DoD ICAM Reference Design.</p> <p>FY 2024 Plans:</p>	-	0.858	3.054

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) 2CY I Information Trust Technology
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Will validate OCSP stapling techniques and certificate validation methods that can be integrated with the PM MC variable message format (VMF) parser; design and develop the DAC-T Provisioning functions and conduct experiments on merging and synchronizing of ICAM data from data sources across the DOD, Army and tactical levels in accordance with the Army ICAM Requirements Definition Package (RDP), Army ICAM Strategy, Army ICAM Attribute Specification and DoD ICAM Reference Design. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase enables the development of the DAC-T account provisioning capability and mature the cryptographic libraries.			
Accomplishments/Planned Programs Subtotals	0.601	0.858	3.054

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber				Project (Number/Name) 3CY / Network Access and Effects Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
3CY: Network Access and Effects Technology	-	6.479	7.798	10.588	-	10.588	12.525	12.225	12.233	12.366	0.000	74.214

A. Mission Description and Budget Item Justification

This Project investigates the application of machine learning technologies to assist in capability development and mission execution processes with respect to Offensive Cyber Operations (OCO)/Radio Frequency (RF) Enabled capabilities.

Work in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 9CY (Network Access and Effects Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
<p>Title: Applied OCO Techniques and Analytics</p> <p>Description: This effort investigates the application of machine learning technologies to assist in capability development and mission execution processes with respect to OCO/RF Enabled capabilities.</p> <p>FY 2023 Plans: Complete technology readiness level (TRL) 4 OCO/RF enabled effects for an identified target of interest. Continue development of machine assisted technique development based on existing and known system vulnerabilities. Conduct experiments and assess the machine assisted techniques against targets of interest.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned conclusion of this effort and transitions to Project Element (PE) 0603457 (C3I Cyber Advanced Development) / Project 9CY (Network Access and Effects Advanced Technology).</p>	6.479	7.798	-
<p>Title: Network Exploitation Research and Development (NERD) Technology</p> <p>Description: This effort will investigate computer assisted/automated methodologies and tools to reduce the timelines associated with the exploitation of emerging and validated targets of interest, the development of courses of action, and the execution of offensive attack capabilities in the cyber and radio frequency domains at the pace of a near-peer engagement on a highly complex battlefield of ever evolving cyberspace threats.</p>	-	-	10.588

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) 3CY / Network Access and Effects Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p><i>FY 2024 Plans:</i> Will investigate and characterize vulnerabilities of targets of interest to determine the effectiveness of existing access and effect capabilities; investigate the use of artificial intelligence reasoning engines, informed by battlefield intelligence/situation awareness data, and the feasibility of their application to interpreting commander's intent and deriving offensive cyber and/or RF platform firing solutions.</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding increase reflects planned initiation of this effort.</p>			
Accomplishments/Planned Programs Subtotals	6.479	7.798	10.588

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) 5CY / Offensive Cyber Operations (OCO) Mirror Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
5CY: Offensive Cyber Operations (OCO) Mirror Technology	-	0.987	1.022	-	-	-	-	-	-	-	0.000	2.009

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops emerging cyber techniques and cyber situational awareness technologies to enhance Army capabilities. This Project leverages behavioral Modeling and Simulation to mitigate risks and investigates cyber collection and mapping technologies to offer real time cyber situational awareness to enable interpretation of current threats and predict future enemy activities. This allows commanders to develop operational courses of action in time to act decisively.

Work in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project CB4 (Offensive Cyber Operations (OCO) Mirror Adv Tech).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Offensive Cyber Operations Mirror Technology	0.987	1.022	-
Description: Designs and develops emerging internet technologies that enable OCO infrastructure maneuver within the neutral (gray) cyberspace environment; conduct experiments within a modeling and simulation environment (to include behavioral components) to enhance rapid offensive cyber developed capabilities, cyber mission rehearsal, and training.			
FY 2023 Plans: Develop and mature second increment of the Discrete Event Simulator user interface. Conduct assisted cyber maneuver development to assist in successful execution of cyber missions.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding reflects planned conclusion of this project.			
Accomplishments/Planned Programs Subtotals	0.987	1.022	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / <i>C3I Applied Cyber</i>	Project (Number/Name) <i>5CY / Offensive Cyber Operations (OCO) Mirror Technology</i>

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) CY1 / Information Assurance and Network Resiliency Tech
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>CY1: Information Assurance and Network Resiliency Tech</i>	-	3.397	3.927	-	-	-	-	-	-	-	0.000	7.324

Note

In Fiscal Year (FY) 2024 this Project is realigned to Program Element (PE) 0602213A (C3I Applied Cyber Technology) / Project CY6 (Autonomous Cyber) to streamline the cyber portfolio by consolidating cyber applied research under one Project.

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops techniques for detecting, disrupting, understanding and predicting complex adversarial activities and their impacts for developing agile, adaptive maneuvers in defense of information and networks (Agile Cyber Maneuver and Resilience).

Work in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) /Project 8CY (Information Trust Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Information Assurance and Network Resiliency Technology	3.397	3.927	-
Description: This effort designs and characterizes software for the protection of information and networks in wireless tactical environments. The goal is to develop software algorithms that detect and defeat malicious activities of adversaries in bandwidth constrained tactical networks.			
FY 2023 Plans: Develop algorithms and methodologies for machine learning enabled network analysis tools (e.g. deep packet inspection); experiment with feature extraction, selection, and generation in testing phase of machine learning models for deep packet inspection; investigate network modality based AML poisoning threats and defenses; develop techniques to improve the Intrusion Detection Systems (IDS) model performance through adversarial retraining.			
FY 2023 to FY 2024 Increase/Decrease Statement: Funding administratively realigned to PE 0602213A Project CY6 Autonomous Cyber Technology to streamline the cyber portfolio by consolidating cyber applied research under one Project.			
Accomplishments/Planned Programs Subtotals	3.397	3.927	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) CY1 / Information Assurance and Network Resiliency Tech

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber				Project (Number/Name) CY6 / Autonomous Cyber Technology			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CY6: Autonomous Cyber Technology	-	0.655	-	9.072	-	9.072	20.424	13.366	10.181	4.306	0.000	58.004

Note

In Fiscal Year (FY) 2024 effort from PE 0602213A (Autonomous Cyber Technology) / Project CY1 (Information Assurance and Network Resiliency Tech) was administratively realigned to Project CY6 to streamline the cyber portfolio by consolidating cyber applied research under one Project.

A. Mission Description and Budget Item Justification

This Project investigates and applies robust cyber security techniques and applications to advanced communications and networking devices, software, algorithms and protocols utilized within wireless tactical networks to protect against nation state level cyber effects and maintain Warfighter confidence in network information, resources, identities and mission partners by hardening the blue force attack surface.

Work in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Autonomous Cyber Technology	0.655	-	-
Description: This effort develops defensive cyber technology to secure the automated network decisions (e.g., Primary, Alternate, Contingency, and Emergency (PACE)) and defend against adaptive, autonomous cyber-attacks at machine speed.			
Title: Predictive Intelligent Networking (PIN)	-	-	1.739
Description: Enables the tactical network with algorithms that autonomously identify, learn, predict and react seamlessly to changes in the network. Uses machine learning enabled drivers to ensure end-to-end network communications resiliency against adversarial AI-enabled Electronic Attacks (EA), Electronic Support (ES), and cyberattacks.			
FY 2024 Plans: Will investigate hardware/software modules that are compatible with the current Mounted Mission Command Software (MMC-S) program of record, that can process collected spectrum data from multiple receivers and feed the predictive decision software with spectrum-aware information software			
FY 2023 to FY 2024 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) CY6 / Autonomous Cyber Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Funding increase reflects planned initiation of this effort				
<p>Title: Network Obscuration</p> <p>Description: Develops the capability to obscure cyberspace operations to delay/deter adversaries that attack and exploit blue cyberspace in enterprise or tactical networks. This project creates cyber obscuration technologies that imitate networks, systems, hosts, users and files to distract/disrupt cyber attackers to mitigate or delay their attacks thereby increasing network resiliency</p> <p>FY 2024 Plans: Will leverage industry and National Security Agency's (NSA) Camouflage (CAMO) project, begin to investigate the use of machine learning to build obscuration techniques and modeling concepts for pre-placed, remotely administered network obscurations at the systems, applications, users, and data levels.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned initiation of this effort</p>		-	-	2.959
<p>Title: Proactive Cyber Defense</p> <p>Description: This effort designs and characterizes software for the protection of information and networks in wireless tactical environments. The goal is to develop software algorithms that detect and defeat malicious activities of adversaries in bandwidth constrained tactical networks and maintain agile, adaptive cyber maneuver.</p> <p>FY 2024 Plans: Will develop algorithms and methodologies for machine learning enabled network analysis tools; experiment with feature extraction, selection, and generation in testing phase of machine learning models for deep packet inspection; investigate network modality based Adversarial Machine Learning (AML) poisoning threats and defenses; develop techniques to improve the Intrusion Detection Systems (IDS) model performance through adversarial retraining; investigate the use of cyber agility and misrepresentation algorithms and methodologies as well as additional evasion defensive algorithms against Adversarial Machine Learning (AML) in order to make tactical and enterprise systems resistant to attacks on their cyber defenses that rely on machine learning.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: In FY 2024, funding administratively realigned from PE 0602213A (C3I Applied Cyber Technology) / Project CY1 (Information Assurance and Network Resiliency Tech) to streamline the cyber portfolio by consolidating cyber applied research under one Project.</p>		-	-	4.374
Accomplishments/Planned Programs Subtotals		0.655	-	9.072

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) CY6 / Autonomous Cyber Technology

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602386A / <i>Biotechnology for Materials - Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	19.889	21.811	16.736	-	16.736	10.956	7.356	7.360	7.441	Continuing	Continuing
CP6: <i>Foundational Biotechnology Design and Dev</i>	-	19.889	21.811	16.736	-	16.736	10.956	7.356	7.360	7.441	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) investigates, designs, and performs research focused on novel biotechnological methods, techniques, and materials to increase the resiliency of the military supply chain. The Army is responsible for centrally managing funding for Tri-Service Biotechnology for a Resilient Supply Chain (T-BRSC) efforts. T-BRSC leverages bio-industrial manufacturing to ensure critical domestic supply chain resilience for defense needs through domestic production of raw materials and critical products. Efforts under this PE collaborate with sister Services and select allied partners to create a cohesive biotechnology architecture to enable defense needs. Applied research projects investigate and design bio-engineered materials to ensure domestic sourcing for critical supply chain resiliency. This PE designs and validates technologies to enable rapid prototyping and evaluating of bio-engineered and bio-manufactured materials. Also under this PE are efforts determine and validate a digital architecture to secure biotech data and create computer aided design software to support the safe design and enhanced biosecurity of biotechnology products and applications.

Research in this PE is coordinated with PE 0603386A (Biotechnology for Materials - Advanced Research).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this PE is performed by the United States (US) Army Futures Command (AFC).

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	20.643	21.919	16.662	-	16.662
Current President's Budget	19.889	21.811	16.736	-	16.736
Total Adjustments	-0.754	-0.108	0.074	-	0.074
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.754	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.074	-	0.074
• FFRDC Transfer	-	-0.108	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity
2040: *Research, Development, Test & Evaluation, Army / BA 2: Applied Research*

R-1 Program Element (Number/Name)
PE 0602386A / *Biotechnology for Materials - Applied Research*

Change Summary Explanation

Increased funding due to revised economic assumptions.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602386A / <i>Biotechnology for Materials - Applied Research</i>	Project (Number/Name) CP6 / <i>Foundational Biotechnology Design and Dev</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CP6: <i>Foundational Biotechnology Design and Dev</i>	-	19.889	21.811	16.736	-	16.736	10.956	7.356	7.360	7.441	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Project works collaboratively with Joint Service partners to investigate and determine novel biotechnology methods and processes to establish a domestic resilient supply chain for defense needs. Applied research designs and conducts experiments on bio-derived, bio-functionalized, and bio-manufactured materials and biosynthetic precursors. Efforts under this Project investigate and validate models for design of defense applications. Areas of focus may include reclamation or sequestration of rare Earth/critical elements in the defense supply chain and drop-in replacements for currently employed military materials.

Work in this Project compliments Program Element (PE) 0603386A (Biotechnology for Materials - Advanced Research) / CP7 (Biotechnology Demonstration and Evaluation).

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

Work in this Project is performed by the United States Army Futures Command.

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

	FY 2022	FY 2023	FY 2024
Title: Biotechnology Safety by Design for Defense	19.889	21.015	16.736
Description: This task designs and investigates novel and emerging biotechnologies related to bio-engineered or bio-manufactured materials and their precursors to address vulnerabilities in the critical material supply chain for military needs.			
FY 2023 Plans: Funds research at the convergence of biotechnologies and information science to expand defense biotechnology capabilities to enable the application of biotechnology solutions for new materials. Validate computational models and computer aided design software supporting simulation of biotechnology solutions for defense needs. Identify and investigate potential risks and safety concerns of biotechnology capabilities throughout the research cycle through implementation of the final product. Develop and validate biosecurity methods that can be operationalized to develop the foundation for the secure use of biotechnology solutions in the future. Validate methods that control and secure DoD biotechnology data and enable their exchange with collaborators across the biotechnology ecosystem with minimal risk, facilitating development and leveraging of critical partnerships that promote responsible usages and best practices of biotechnology.			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602386A / <i>Biotechnology for Materials - Applied Research</i>	Project (Number/Name) CP6 / <i>Foundational Biotechnology Design and Dev</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will refine models based on experiments and iterate on design to unlock more rapid, innovative, and diverse biotechnology applications than currently recognize or realize, and determine the direction of biotechnology solutions for defense needs. Operationalize safety-by-design measures to protect biotechnology capabilities throughout the product and program lifecycle through implementation of the final product. Operationalize biosecurity methods to develop the foundation for the secure use of biotechnology solutions in the future. Operationalize a digital framework enabling interchange of data amongst the collaborators across the biotechnology ecosystem to promote interoperability and critical partnership. Exploit biotechnologies to recover rare earth elements (REE) necessary for critical defense components and advanced technologies. Develop processes and improve the performance for a biotechnology pipeline.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.</p>		-	0.796	-
Accomplishments/Planned Programs Subtotals		19.889	21.811	16.736
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602785A / <i>Manpower/Personnel/Training Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	18.414	19.649	19.969	-	19.969	18.334	19.399	19.422	19.641	0.000	134.828
790: <i>Personnel Performance & Training Technology</i>	-	18.414	19.649	19.969	-	19.969	18.334	19.399	19.422	19.641	0.000	134.828

A. Mission Description and Budget Item Justification

This Program Element (PE) designs and validates applied behavioral and social science research to enhance the Soldier Lifecycle (e.g., selection, assignment, training, and leader development) and human relations (e.g., unit cohesion). This PE develops new personnel measures and methods that more fully assess potential and predict performance, behavior, attitudes, and resilience. These technologies also provide innovative and effective Talent Management methods to optimize individual and team performance to ensure the Army can meet mission requirements in uncertain and complex environments. This PE develops new performance measures and metrics for individuals and units, designs innovative training methods, and conducts scientific assessments to inform Human Capital policy and programs. Research in this PE will result in effective non-materiel solutions to help the Army adjust to changes in force size and structure, a variety of mission demands and contexts, challenges in human relations, and budgetary constraints.

Research in this PE complements PE 0603007A (Manpower, Personnel and Training Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Vision, the Army's Talent Management Strategy, and the Army Modernization Strategy.

Research is performed by the Army Research Institute (ARI) for the Behavioral and Social Sciences at Fort Belvoir, VA.

B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	18.701	19.649	19.337	-	19.337
Current President's Budget	18.414	19.649	19.969	-	19.969
Total Adjustments	-0.287	0.000	0.632	-	0.632
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.287	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.632	-	0.632

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602785A / <i>Manpower/Personnel/Training Technology</i>	
<u>Change Summary Explanation</u> Increased funding due to revised economic assumptions.		

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602785A / <i>Manpower/Personnel/Training Technology</i>	Project (Number/Name) 790 / <i>Personnel Performance & Training Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>790: Personnel Performance & Training Technology</i>	-	18.414	19.649	19.969	-	19.969	18.334	19.399	19.422	19.641	0.000	134.828

A. Mission Description and Budget Item Justification

This Project conducts applied behavioral and social science research to enhance the Soldier Lifecycle (e.g., selection, assignment, training, leader development) and human relations (e.g., unit cohesion). This Project develops new personnel measures and methods that more fully assess potential and predict performance, behavior, attitudes, and resilience. These technologies also provide innovative and effective Talent Management methods to optimize individual and team performance to ensure the Army can meet mission requirements in uncertain and complex environments. This Project develops new performance measures and metrics for individuals and units, designs innovative training methods, and conducts scientific assessments to inform Human Capital policy and programs. Research in this Project will result in effective non-materiel solutions to help the Army adjust to changes in force size and structure, a variety of mission demands and contexts, challenges in human relations, and budgetary constraints.

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, the Army Vision, the Army People Strategy, the Army's Talent Management Strategy, Army Human Capital Strategy, and the Army Modernization Strategy.

Research is performed by the United States Army Research Institute (ARI) for the Behavioral and Social Sciences in Fort Belvoir, VA.

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

	FY 2022	FY 2023	FY 2024
Title: Talent Assessment and Development	18.414	19.343	19.969
Description: This effort conducts applied research that provides the Army with innovative approaches to personnel assessment, improved prediction and modeling of personnel outcomes (e.g., attrition, retention) and an improved capability to improve prediction and modeling (e.g., potential performance, behaviors, attitudes, and resilience of Soldiers). Conducts applied research to provide the Army with effective leader assessment and development methods to measure, develop, and sustain individual/leader competencies and performance across the Soldier life cycle. Conducts research to create scientifically valid models, tools and techniques for team assignment and development to optimize team effectiveness in-garrison and future operational environments.			
FY 2023 Plans: Determining in-service assessment proof of concept measures to improve enlisted personnel assignment; continuing to develop methods and analytic models of personnel assessment; designing and developing innovative methods to generate job analysis			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602785A / <i>Manpower/Personnel/Training Technology</i>	Project (Number/Name) 790 / <i>Personnel Performance & Training Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>content; generating competency assessments for junior officer and senior NCOs; developing assessments for team-based personnel assignment and measures for small unit performance.</p> <p>FY 2024 Plans: Will continue to design in-service assessment proof-of-concept measures to improve enlisted personnel assignment; will continue to develop predictive models of career progression and retention; will continue to design innovative and novel methods to generate job analysis content; will continue to develop competency assessments for junior officers and senior NCOs. Will develop composition frameworks for team-based personnel assignment and develop measures for small unit performance.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.</p>	-	0.306	-
Accomplishments/Planned Programs Subtotals	18.414	19.649	19.969

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	124.002	80.656	66.266	-	66.266	73.066	20.851	20.867	21.099	0.000	406.807
BS7: <i>Medical Technology (CA)</i>	-	34.467	46.680	-	-	-	-	-	-	-	0.000	81.147
MK4: <i>Warfighter Health Applied Rsch Technology</i>	-	28.480	31.916	64.326	-	64.326	70.422	18.155	18.171	18.373	0.000	249.843
MM4: <i>Cbt Casualty Care Applied Rsch Technology</i>	-	22.794	1.935	1.815	-	1.815	2.525	2.576	2.577	2.606	0.000	36.828
MM6: <i>Medical Technologies to Support Dispersed Ops Tech</i>	-	10.297	0.125	0.125	-	0.125	0.119	0.120	0.119	0.120	0.000	11.025
MM8: <i>Infectious Diseases and Applied Rsch Technology</i>	-	27.964	-	-	-	-	-	-	-	-	0.000	27.964

A. Mission Description and Budget Item Justification

This Program Element (PE) supports application of knowledge gained through basic research to refine drugs, vaccines, medical devices, diagnostics, medical practices/procedures, and other preventive measures essential to the protection and sustainment of Warfighter health. Research is conducted in five principal areas: Combat Casualty Care, Military Operational Medicine, Military Relevant Infectious Diseases, Clinical and Rehabilitative Medicine, Medical Capabilities to Support Dispersed Operations, and Systems Biology/Network Sciences. Projects are coordinated with the Defense Health Agency.

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

Work in this Program element (PE) is performed by the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

All medical applied research is conducted in compliance with Food and Drug Administration (FDA) or Environmental Protection Agency (EPA) regulations. The FDA requires thorough testing in animals (preclinical testing) to ensure safety and, where possible, effectiveness prior to evaluation in controlled human clinical trials (upon transition to Advanced Technology Development). This PE focuses on research and refinement of technologies such as product formulation and purification and laboratory test refinement with the aim of identifying candidate solutions. This work often involves testing in animal models. The EPA also requires thorough testing of products, such as sterilants, disinfectants, repellents, and insecticides to ensure the environment is adequately protected before these products are licensed for use. Program refinement and execution is externally peer-reviewed and fully coordinated with all Services as well as other agencies through the Joint Technology Coordinating Groups of the Biomedical Community of Interest. The Biomedical Community of Interest, formed under the authority of the Assistant Secretary of Defense for Research and Engineering, serves to facilitate coordination and prevent unnecessary duplication of effort within the Department of Defense (DoD) biomedical research community, as well as their associated enabling research areas.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	120.747	33.976	17.584	-	17.584
Current President's Budget	124.002	80.656	66.266	-	66.266
Total Adjustments	3.255	46.680	48.682	-	48.682
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	46.680			
• Congressional Directed Transfers	-	-			
• Reprogrammings	3.255	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	48.682	-	48.682

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: BS7: *Medical Technology (CA)*

Congressional Add: *Program Increase - Military Force Vector Borne Health Protection*

Congressional Add: *Biological Performance Technology*

Congressional Add: *Program Increase - Center for Excellence in Military Health and Performance Enhancement*

Congressional Add: *Program Increase - Holistic Health and Fitness*

Congressional Add: *National Trauma Research Repository Data Population Project*

Congressional Add: *Physiological Study of Female Warfighters to Improve Training*

Congressional Add: *Program Increase - RNA Therapeutics for Infectious Disease Threats*

Congressional Add: *Program Increase - BIOMATERIALS FOR COMBAT WOUND CARE*

Congressional Add: *Program Increase - ENGINEERED ANTIBODIES FOR SKIN AND SOFT-TISSUE INFECTIONS*

Congressional Add: *Program Increase - PHOTONIC INTEGRATED CIRCUIT PLATFORM*

Congressional Add: *Program Increase - SURGICAL INSTRUMENT STERILIZATION*

Congressional Add: *Program Increase - TRAMA IMMUNOLOGY*

Congressional Add: *Human Optimization*

Congressional Add Subtotals for Project: BS7

Congressional Add Totals for all Projects

	FY 2022	FY 2023
	5.000	-
	5.000	-
	3.567	5.000
	1.500	5.680
	1.900	-
	5.000	-
	7.500	8.000
	-	3.000
	-	5.000
	-	5.000
	-	10.000
	5.000	-
Congressional Add Subtotals for Project: BS7	34.467	46.680
Congressional Add Totals for all Projects	34.467	46.680

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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	

Change Summary Explanation

Increased funding in FY24 supports research in emerging directed energy mechanisms and biological effects.

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602787A / Medical Technology				Project (Number/Name) BS7 / Medical Technology (CA)			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
BS7: Medical Technology (CA)	-	34.467	46.680	-	-	-	-	-	-	-	0.000	81.147

Note

Congressional Interest Item funding provided for Medical Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Medical Technology.

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

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

	FY 2022	FY 2023
Congressional Add: Program Increase - Military Force Vector Borne Health Protection	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Military Force Vector Borne Health Protection		
Congressional Add: Biological Performance Technology	5.000	-
FY 2022 Accomplishments: Congressional Interest Item funding provided for Biological Performance Technology		
Congressional Add: Program Increase - Center for Excellence in Military Health and Performance Enhancement	3.567	5.000
FY 2022 Accomplishments: Congressional Interest Item funding provided for Center for Excellence in Military Health and Performance Enhancement		
FY 2023 Plans: Congressional Interest Item funding provided for Center for Excellence in Military Health and Performance Enhancement		
Congressional Add: Program Increase - Holistic Health and Fitness	1.500	5.680
FY 2022 Accomplishments: Congressional Interest Item funding provided for Holistic Health and Fitness		
FY 2023 Plans: Congressional Interest Item funding provided for Holistic Health and Fitness		
Congressional Add: National Trauma Research Repository Data Population Project	1.900	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army	Date: March 2023
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) BS7 / <i>Medical Technology (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for National Trauma Research Repository Data Population Project		
<i>Congressional Add:</i> Physiological Study of Female Warfighters to Improve Training	5.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Physiological Study of Female Warfighters to Improve Training		
<i>Congressional Add:</i> Program Increase - RNA Therapeutics for Infectious Disease Threats	7.500	8.000
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for RNA Therapeutics for Infectious Disease Threats		
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for RNA Therapeutics for Infectious Disease Threats		
<i>Congressional Add:</i> Program Increase - BIOMATERIALS FOR COMBAT WOUND CARE	-	3.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for BIOMATERIALS FOR COMBAT WOUND CARE		
<i>Congressional Add:</i> Program Increase - ENGINEERED ANTIBODIES FOR SKIN AND SOFT-TISSUE INFECTIONS	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for ENGINEERED ANTIBODIES FOR SKIN AND SOFT-TISSUE INFECTIONS		
<i>Congressional Add:</i> Program Increase - PHOTONIC INTEGRATED CIRCUIT PLATFORM	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for PHOTONIC INTEGRATED CIRCUIT PLATFORM		
<i>Congressional Add:</i> Program Increase - SURGICAL INSTRUMENT STERILIZATION	-	5.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for SURGICAL INSTRUMENT STERILIZATION		
<i>Congressional Add:</i> Program Increase - TRAMA IMMUNOLOGY	-	10.000
<i>FY 2023 Plans:</i> Congressional Interest Item funding provided for Trama Immunology		
<i>Congressional Add:</i> Human Optimization	5.000	-
<i>FY 2022 Accomplishments:</i> Congressional Interest Item funding provided for Human Optimization.		
Congressional Adds Subtotals	34.467	46.680

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army Date: March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) BS7 / <i>Medical Technology (CA)</i>
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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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>				Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
MK4: <i>Warfighter Health Applied Rsch Technology</i>	-	28.480	31.916	64.326	-	64.326	70.422	18.155	18.171	18.373	0.000	249.843

A. Mission Description and Budget Item Justification

This Project conducts research to prevent and protect Warfighters from training and operational injuries; refine mechanisms for detection of physiological (human physical and biochemical function) and psychological (mental) health problems; reduce the effects of trauma and promote rapid recovery from acute stress in far forward operational environments; evaluate hazards to head, neck, spine, eyes, and ears; set the standards for rapid return to duty; and determine new methods to sustain and enhance performance and readiness across the operational spectrum. This research provides medical information important to the design and operational use of military systems, and this work forms the basis for behavioral, training, and nutritional interventions.

- The four main areas of study are:
- (1) Physiological Health and Performance
 - (2) Environmental Health and Protection
 - (3) Injury Prevention and Reduction
 - (4) Psychological Health and Resilience

Research in this Project is coordinated with and complimentary to work done in Program Element (PE) 0602143A (Soldier Lethality Technology) and PE 0603118A (Soldier Lethality Advanced Technology).

The cited research is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2022	FY 2023	FY 2024
Title: Operational Risk Planning Tools for Battlefield Environmental Threats	2.268	1.349	1.277
Description: This effort investigates and incorporates mechanisms for health risks of heat, cold, and altitude injuries to develop guidelines and advise countermeasure development for operations in extreme environments. Investigates health risks from industrial chemicals and pollutants found in dense urban and subterranean (SubT) environments in which Soldiers operate.			
FY 2023 Plans:			
Will continue to develop risk profiles for exposures to cold water and expand effort to include subzero/artic conditions; advise on functional clothing to prevent freezing injury during military free fall; validate heat injury biomarkers to inform return to duty guidance; determine the influence of female sex hormones on physiological responses and adaptations during heat acclimation;			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
develop gene expression profile signatures to predict individual susceptibility to acute mountain sickness and acclimatization status prior to high altitude ascent. FY 2024 Plans: Will develop risk profiles for exposures in extreme environments including sub zero/artic conditions; will identify individual factors that make an individual more susceptible to environmental injury (including age, sex, etc); mature "smart" fabrics that detect temperature & moisture in real-time to prevent frostbite injury. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.				
Title: Prevention of Soldier Performance Degradation in Extreme Environments Description: This effort develops and matures non-invasive technologies, decision-aid tools, and other countermeasure to prevent and enhance Soldier performance in extreme environments of heat, cold, altitude, dense urban and SubT environments. This effort includes validation of approved pharmaceuticals as well as provides improved sensors and predictive algorithms models. FY 2023 Plans: Will validate performance of pharmaceuticals and nutrition-based pharmacologic interventions to reduce acute mountain sickness, heat injuries and other environmental exposures; design physiological modes to predict human state during complex military scenarios; evaluate cold acclimatization as an intervention to augment peripheral blood flow in cold exposure; study the effects of vascular preconditioning to reduce cold-induced blood vessel constriction to maintain core body heat and improve manual dexterity. FY 2024 Plans: Design physiological modes to predict the state of men and women during complex military scenarios; evaluate cold habituation as an intervention to augment peripheral blood flow in cold exposure; study the effects of vascular preconditioning to reduce cold-induced peripheral vasoconstriction and improve manual dexterity. Will develop risk profiles for exposures in extreme environments including sub zero/artic conditions; determine the influence of female sex hormones on physiological responses and adaptations during heat acclimation; Investigate and validate physiological mechanisms for design and development of rapid heat acclimation protocols; validate transcriptomic signatures to predict individual susceptibility to acute mountain sickness and acclimatization status prior to high altitude ascent FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.		4.171	4.005	3.331
Title: Leader Decision Aid to Manage Blast Head Injury in All Settings		0.253	0.853	1.135

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: Develop injury risk assessment/guidance/criteria that will inform the development of technologies (i.e., personal protection equipment, vehicles) and strategies (i.e., health hazard assessments) to protect the Soldier against current and emerging operational threats (i.e., blast, blunt, ballistic, and accelerative). Improve the prevention of and reduce the severity of spinal injuries experienced by military vehicle occupants and dismounted Warfighters during non-underbody blast operational exposures (aircrew crash, vibration, head-supported mass) through the development of improved, biomedically valid spinal injury criteria and health hazard assessments.</p> <p>FY 2023 Plans: Will continue to develop injury risk criteria for head supported technologies in multiple military operational environments (mounted and dismounted).</p> <p>FY 2024 Plans: Will continue to develop and refine cervical spine injury risk criteria for head supported technologies and protective equipment in multiple military operational environments (mounted and dismounted).</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>			
<p>Title: Physical Fitness Standards to Prevent Musculoskeletal Injuries</p> <p>Description: Develops validated standards and strategies to optimize Soldier readiness and performance related to musculoskeletal injury (MSKI) in order to provide military leadership with strategies and standards to mitigate musculoskeletal injuries, facilitate quick return to combat effectiveness after MSKI, and decrease risk of re-injury once been cleared to return after injury to increase the probability of mission success.</p> <p>FY 2023 Plans: Will continue to support the United States Army Training and Doctrine Command (TRADOC) Center for Initial Military Training (CIMT) and the United States Army Forces Command (FORSCOM) in development of accurate and reliable physical assessment strategies after musculoskeletal injury to promote more effective and timely return-to-duty with reduced probability for re-injury.</p> <p>FY 2024 Plans: Will continue to support TRADOC CIMT and FORSCOM in development of accurate and reliable physical assessment strategies after musculoskeletal injury.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>	1.614	0.869	1.258
<p>Title: Leader Tools to Reduce Musculoskeletal Injury In All Settings</p>	3.603	2.383	2.088

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: Enhances the Army's understanding of the physiological mechanisms underlying musculoskeletal injuries and identifies countermeasures to mitigate injury risk in order to reduce musculoskeletal injuries in new recruits, thereby directly impacting force readiness and improving lethality.</p> <p>FY 2023 Plans: Will develop and refine models of musculoskeletal injury risk during basic training, specifically bone health optimization strategies that will transition to TRADOC-CIMT.</p> <p>FY 2024 Plans: Will complete model development of musculoskeletal injury (stress fracture risk) for validation.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>			
<p>Title: Forward Neuro-Muscular Skeletal Injury Assessment</p> <p>Description: Focus on developing portable imaging technologies to identify soft tissue musculoskeletal injury severity in the field and generate capabilities to guide musculoskeletal injury management to inform appropriate evacuation vs. return to duty (RTD) decisions.</p> <p>FY 2023 Plans: Will develop and refine ultrasound techniques and algorithm development to detect foot and ankle musculoskeletal injuries using machine learning techniques.</p> <p>FY 2024 Plans: Will develop recommendations for evidence-based guidance detailing the predictive metrics of those physical/ physiological, cognitive/psychological, and behavioral contributions that optimize Soldiers' MSKI tolerance and risk.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>	0.389	0.311	0.297
<p>Title: Biomedical Performance Enhancement</p> <p>Description: This effort evaluates strategies and technologies that enhance Soldier physical and mental performance in Multi-Domain operations. Additional efforts concentrate on characterization of physiological and genetic factors that contribute to physiological resilience to military stressors.</p> <p>FY 2023 Plans:</p>	6.469	4.725	5.013

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
<p>Will continue to investigate pharmacological strategies for improving Soldier vigilance & endurance. Will continue to investigate pharmacological strategies for improving Soldier vigilance & endurance. Will also continue to refine electrical stimulation technologies.</p> <p>FY 2024 Plans: Will complete investigation of pharmacological strategies for improving Soldier vigilance & endurance; Will finalize identification of the physiological responses of elite female and male soldiers to continuous prolonged military operations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>				
<p>Title: Expeditionary Force Nutrition to Improve Performance</p> <p>Description: Characterizes and refines field fueling and garrison practices to sustain Medical readiness, military performance and recovery from military operations. Evaluates combat ration components to sustain Medical Readiness and performance in deployed, disaggregated and dispersed operations.</p> <p>FY 2023 Plans: Will continue experiments to improve understanding of environmental influences (heat, cold, altitude) on eating behavior; investigate the effects of protein source on muscle mass growth, strength and maintenance; evaluate nutritional requirements for maintenance of cognitive, physical and immune function during arduous military training.</p> <p>FY 2024 Plans: Will finalize experiments to; investigate the effects of protein source on muscle mass growth, strength and maintenance; evaluate nutritional requirements for maintenance of cognitive, physical and immune function during arduous military training.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.</p>		1.781	1.462	1.727
<p>Title: Medical Interventions to Reduce Impact of Fatigue on Performance</p> <p>Description: Investigates and determines strategies and technologies that prevent or mitigate fatigue-related performance decrements and injuries during training and operations. Refines interventions that prevent or mitigate clinical sleep disorders in Soldiers. Evaluates technologies to non-intrusively & non-invasively monitor vigilance and performance in real-time.</p>		2.334	-	-
<p>Title: Optimal Delivery of Far Forward Behavioral Health Care</p> <p>Description: This effort will develop a Far Forward Behavioral Health (BH) delivery system of care for rapid recovery in austere</p>		2.735	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
environments, and guidelines for use of pharmacologic and non-pharmacologic solutions for BH issues in MDO without dedicated BH assets, tailored to needs and training of medics, that will reduce the development of deployment-related psychological health issues.				
Title: Unit-Level Psychological Interventions to Enhance Performance Description: This effort will deliver evidence-based strategies and inform policies to optimize, enhance and sustain Service member and Unit psychological health, well-being, resilience and readiness.		2.863	-	-
Title: Energy Field Biological Effects and Mechanisms Description: Investigate the area of emerging directed energy threat mechanisms and biological effects. Conduct research to support the Department of Defense and US Government's threat mitigation strategy. FY 2023 Plans: Design and develop threat-relevant directed energy source technologies for laboratory investigation; investigate directed energy coupling, penetration, and absorption in biological structures; design and develop directed energy biological effect modeling and simulation tools; explore and characterize the biological effects of directed energy exposure; research to identify mechanisms by which effects are produced. FY 2024 Plans: Will continue to develop and validate threat-relevant directed energy source technologies for laboratory investigation; investigate fundamental biophysical and physiological mechanisms; identify relevant biological mechanisms for accelerated study; mature cross-cutting / multi-disciplinary research processes to allow rapid advances; investigate component technologies necessary to complete laboratory research; complete infrastructure improvements for unclassified and classified laboratory space and equipment; investigate fundamental limitations on directed energy coupling, penetration, and absorption in surrogate structures and at relevant protocol levels; investigate low frequency electromagnetic bioeffects; validate the design of directed energy biological effect modeling and simulation tools; conduct experiments on previous investigation of biological effects of directed energy exposure; conduct research to compare biological effects theories and models against real world data; transition data on biological mechanisms and effects to DoD medical community to support research and development efforts for directed energy induced injury prevention and treatment. FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports research in emerging directed energy threat mechanisms and biological effects in support of the Department of Defense and US Government's threat mitigation strategy.		-	15.209	48.200
Title: SBIR/STTR Transfer		-	0.750	-

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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfighter Health Applied Rsch Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2022	FY 2023	FY 2024
Description: Funding transferred in accordance with Title 15 USC §638.				
FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638.				
FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.				
Accomplishments/Planned Programs Subtotals		28.480	31.916	64.326
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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM4 / <i>Cbt Casualty Care Applied Rsch Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
<i>MM4: Cbt Casualty Care Applied Rsch Technology</i>	-	22.794	1.935	1.815	-	1.815	2.525	2.576	2.577	2.606	0.000	36.828

A. Mission Description and Budget Item Justification

This Project refines and assesses concepts, techniques, and materiel that improve survivability and treatment outcomes for Warfighters wounded during combat operations and treated under austere field conditions, including prolonged field care, and during medical evacuation, and maintains laboratory capability to perform these functions. Combat casualty care research addresses control of severe bleeding; resuscitation and stabilization; advanced automated life support systems suitable for use in forward areas, treatment of severe orthopedic injuries, treatment of severe burns, and combat-related brain injury.

Promising efforts identified in this Project are further matured under Program Element (PE) 0603002A (Medical Advanced Technology).

The cited research is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy.

Research in this Project is performed by the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2022	FY 2023	FY 2024
Title: Modular and Automated Battlefield Sustainment of Critical Organ Function Cap Set 2	1.222	-	-
Description: This effort performs applied research to support development of novel, disruptive technologies to improve survival of the most severely injured casualties when medical evacuation is delayed and access to definitive surgical care is limited.			
Title: Battlefield Pain Control without Physiological Impairment	2.287	-	-
Description: This effort performs applied research in laboratory and animal studies to determine novel, non-opioid drugs to treat pain in the austere battlefield environment with minimal side effects.			
Title: Candidate Capabilities for Rapid Burn Treatment	1.649	-	-
Description: This effort conducts research to enhance the ability to treat acute severe burns at or near the point of injury, protect burn wounds from further injury, infection and inflammation, especially when definitive surgical burn wound care is delayed or unavailable, and accelerate wound healing and return to combat duty.			
Title: Autonomous Cardiopulmonary Resuscitation	0.513	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM4 / <i>Cbt Casualty Care Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Description: This effort investigates new technologies addressing major causes of battlefield mortality, including non-compressible hemorrhage, safe mitigation of hemorrhagic shock, and airway obstruction and ventilation.</p>			
<p>Title: Unconventionally-acquired Brain Injury (UBI)</p> <p>Description: This effort performs applied research aimed at determining the physiological effects of unconventionally-acquired threat technologies to support development of future diagnostic and treatment tools.</p>	8.659	-	-
<p>Title: Automated Management of Traumatic Brain Injury (TBI) and Concussion in Prolonged MDO</p> <p>Description: This effort performs applied research to support development of therapies to treat and clinically manage brain injury under prolonged care conditions.</p>	1.231	-	-
<p>Title: Prevention and Treatment of Brain Injury</p> <p>Description: This effort supports refinement of drug (includes mature drug technologies and those that are United States Food and Drug Administration (FDA) approved for other indications) and therapeutic strategies to manage brain injury resulting from battlefield trauma.</p>	1.456	-	-
<p>Title: Next Generation Rapid Burn Injury Treatment and Return to Duty Cap Set 2</p> <p>Description: This effort conducts research to support development of novel, disruptive technologies that will significantly enhance the ability to treat acute severe burns at or near the point of injury, protect burn wounds from further injury, infection and inflammation, especially when definitive surgical burn wound care is delayed or unavailable, and accelerate wound healing and return to combat duty.</p>	0.706	-	-
<p>Title: Bioengineered Blood Surrogate</p> <p>Description: This effort performs applied research focused on development of modified whole blood or blood products, and synthetic blood products that will stop life threatening bleeding, stabilize tissue metabolism, mitigate shock and restore normal blood clotting, and will improve prompt hemorrhage control and minimize sustainment requirements.</p>	0.349	-	-
<p>Title: Next Generation Human-Derived Blood Replacement</p> <p>Description: This effort performs applied research focused on development of improved blood products and biopharmaceutical technologies that stop life threatening bleeding, stabilize tissue metabolism, mitigate shock and restore normal blood clotting, and will improve prompt hemorrhage control and minimize sustainment requirements.</p>	0.749	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM4 / <i>Cbt Casualty Care Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
<p>Title: Future En Route Casualty Care Sustainment System Cap Set</p> <p>Description: This effort performs applied research to support development of technologies that will increase capability and capacity to provide combat casualty care from point of injury to final point of care.</p> <p>FY 2023 Plans: Will perform studies to determine test conditions and development standards for aeromedical patient movement systems. Will perform studies to determine impact of en route care environment and patient number on medical care provider performance.</p> <p>FY 2024 Plans: Will evaluate use of patient-specific medical device alarms during multi-patient medical evacuation scenarios. Will determine effect of vehicle vibration and jolt on medical provider performance in a simulated en route care environment.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	1.793	1.885	1.815
<p>Title: Candidate Capabilities for Field Stabilization of Bone in Preparation for Evacuation</p> <p>Description: This effort focuses on multiple disruptive technologies for early treatment of extremity fractures to accelerate healing and mitigate complications, while maintaining soldier mobility.</p>	0.527	-	-
<p>Title: Candidate Capabilities for Limb Function Repair and Return to Combat Duty</p> <p>Description: This effort focuses on multiple disruptive technologies directed toward early treatment of extremity fractures to accelerate healing and mitigate complications and includes compartment syndrome (Increased pressure within a closed body space, especially of the leg or forearm. May require surgery and loss tissue or extremity).</p>	0.579	-	-
<p>Title: Candidate Capabilities for Battlefield Sustainment of Critical Organ Function</p> <p>Description: This effort performs applied research to study the physiological implications of delayed medical evacuation and limited access to definitive surgical care in severely injured casualties.</p>	1.074	-	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement:</p>	-	0.050	-

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM4 / <i>Cbt Casualty Care Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Funding transferred in accordance with Title 15 USC §638.			
Accomplishments/Planned Programs Subtotals	22.794	1.935	1.815

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 2024 Army **Date:** March 2023

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>				Project (Number/Name) MM6 / <i>Medical Technologies to Support Dispersed Ops Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
MM6: <i>Medical Technologies to Support Dispersed Ops Tech</i>	-	10.297	0.125	0.125	-	0.125	0.119	0.120	0.119	0.120	0.000	11.025

A. Mission Description and Budget Item Justification

This Project supports applied research in two task areas: 1) Medical Robotic and Autonomous Systems (Med-RAS) - will a) leverage emerging technologies in biomedical engineering, robotics, autonomy, unmanned systems, and assured position navigation and timing, to improve capabilities and expand capacity to deliver prolonged care, perform evacuation, delivery emergency resupply of medical material supplies (Class VIII), such as blood products, by ground or air, in dispersed and Multi-Domain Operations and b) establish medical performance criteria to ensure Soldiers are able to effectively perform manned-unmanned teaming tasks; and, 2) Virtual Health - will leverage emerging technologies in information science, artificial intelligence, telecommunications network engineering, and cyber security to enable prolonged care, remote telemonitoring, automated decision support, and telementoring between providers in Role of Care 3 and 4 to patients in Role of Care 1 and 2. Promising work in this Project will be further matured in PE 0603002A (Medical Advanced Technology) / Project MM7 (Enabling Med Cap to Support Dispersed OPS Adv Tech).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Work in this Project is performed by the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2022	FY 2023	FY 2024
Title: Medical Robotic and Autonomous Systems	7.083	0.120	0.125
Description: Research, design, and validate autonomous and unmanned capabilities to deliver high quality combat casualty care in dispersed operations with limited or absent medical care personnel, and future medical robotic systems capable of providing autonomous combat casualty care while optimizing the medical logistic footprint in far-forward and dispersed geographic environments in support of the Army Multi-Domain Operations (MDO) concept and the Army Force 2025 and Beyond vision documents.			
FY 2023 Plans: Will expand research platforms for the Semi-Autonomous Casualty Management Module (SACM2) and integration for technologies for in-flight interventions; provide communication infrastructure and cyber security solutions for remote patient monitoring, remote supervision and control of semi-autonomous patient management systems			
FY 2024 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM6 / <i>Medical Technologies to Support Dispersed Ops Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Utilizing the identified candidate for emerging semi-autonomous en route care technologies for providing patient management during UAS missions, will validate designs for integrating autonomous critical casualty care and management systems with common user, multi-purpose, unmanned aerial system platforms. Will also advance the interoperable data systems. FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: Virtual Health Applications for Multi Domain Operational Environments Description: Investigate future Virtual Health enterprise process architectures and integrated physical solutions capable of supporting prolonged field care in conditions with limited or lacking traditional field communications. Deliver sustainable high quality medical care using advanced technology approaches to export medical expertise to ill/injured soldiers where and when it is needed regardless of geographic location of medical providers, enabling the MDO tenet of maximizing human potential.	3.214	-	-
Title: SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC §638. FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638. FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638.	-	0.005	-
Accomplishments/Planned Programs Subtotals	10.297	0.125	0.125

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 2024 Army										Date: March 2023		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>				Project (Number/Name) MM8 / <i>Infectious Diseases and Applied Rsch Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
MM8: <i>Infectious Diseases and Applied Rsch Technology</i>	-	27.964	-	-	-	-	-	-	-	-	0.000	27.964

A. Mission Description and Budget Item Justification

This Project conducts applied (pre-clinical) research for medical countermeasures to prevent naturally occurring infectious diseases that impact operational readiness and maintains laboratory capability to perform these functions. The Project builds on basic research to optimize lead countermeasures and determines their safety and efficacy in animal models of infection. Effective preventive countermeasures protect the Warfighter from disease and sustain readiness and operations. Infectious disease threats from parasitic diseases, bacterial diseases, and viral diseases are high priorities for military operations.

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

- (1) Parasitic Diseases
- (2) Bacterial Diseases
- (3) Viral Diseases

The cited research is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy.

Work is managed by the United States Army Medical Research and Development Command (USAMRDC) in coordination with the Naval Medical Research Center (NMRC). The Army is responsible for programming and funding all Department of Defense (DoD) naturally occurring infectious disease research requirements, thereby precluding duplication of effort within the Military Departments.

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

	FY 2022	FY 2023	FY 2024
Title: Prevention & Treatment of Combat Wound Infections during Prolonged Care	11.327	-	-
Description: Determine and validate combat wound infection preclinical animal models. Investigate and validate prophylactic and treatment safety and effectiveness in validated combat wound infection preclinical animal models. Fund research to down-select lead combat wound infection prophylactic and treatment candidates for use in human clinical trials.			
Title: Prevention and Treatment of Endemic Diseases	16.637	-	-
Description: Determine and validate endemic bacterial and viral disease preclinical animal models. Investigate and validate prophylactic and treatment safety and effectiveness in validated bacterial and viral disease preclinical animal models. Down-select lead bacterial and viral infection prophylactic and treatment candidates for use in human clinical trials.			

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army		Date: March 2023
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MM8 / <i>Infectious Diseases and Applied Rsch Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2022	FY 2023	FY 2024
Accomplishments/Planned Programs Subtotals	27.964	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A