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**Department of Defense
Fiscal Year (FY) 2023 Budget Estimates**

April 2022



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 2023 • 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, \$13,703,609,000.00 to remain available for obligation until September 30, 2024.

The FY 2023 Overseas Operations accounted for in the base budget are as follows:

Combat or direct combat support expenses that discontinue once combat operations end at major contingency location \$12,800,000.

In-theater and in-CONUS expenses that remain after combat operations cease and have been previously funded in OCO \$5,875,000.

COST STATEMENT

The following Justification Books were prepared at a cost of \$474,495.00: 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 2023 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 2022.

2. **Relationship of the FY 2023 Budget Submitted to Congress to the FY 2022 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:

<i>Budget Activity</i>	<i>OSDPE / Project</i>	<i>Project Title</i>
02	0602002A / DC4	Army Applied Innovation
02	0602002A / DC5	Team Ignite
02	0602141A / CII	Advanced Armaments Lethality Technology
02	0602141A / CZ9	Foundational Hypersonic Weapons Research
02	0602144A / CV3	Engineer Enablers Maneuver, LOG, & Sustainment Apl
02	0602144A / DA1	SAFR Alternatives for Readiness Applied Research
02	0602145A / CU5	Platform Agnostic Armaments Applied Technology
02	0602146A / CU6	Adaptive Information Mediation and Analytics
02	0602146A / CV4	Pathfinder 3D Applied Technology
02	0602150A / CV7	High Energy Laser Direct Diode Apl Tech
02	0602150A / CV8	Vulnerability Modules for Multi-Domain Operations
02	0602150A / DA9	Radar Survivability through Dis Sensing Tech
02	0602180A / DA5	AI Enabled Talent Management Applied Research
02	0602180A / DA6	AI-Enabled Command and Coordination Apl Research
02	0602183A / CU7	Control & Autonomy for Tactical Superiority Tech
02	0602183A / CU8	Structures Tech for Enduring Efficient Resilience

02	0602183A / CU9	Systems Design Technology
02	0602184A / CV9	Technical-SAVVY Soldier Applied Research
03	0603025A / DA3	Army Advanced Innovation
03	0603040A / CN6	Predictive Maintenance Advanced Technology
03	0603040A / DA7	AI-Enabled Command and Coordination Adv Tech
03	0603041A / DA4	All Domain Convergence Engineering & Architectures
03	0603043A / CV1	Control & Autonomy for Tactical Superiority Adv
03	0603043A / CV2	Structures Platform Int Resilience & Efficiency
03	0603119A / CV5	Engineer Enablers Maneuver, LOG, & Sustainment Adv
03	0603119A / DA2	SAFR Alternatives for Readiness Advanced Tech
03	0603466A / CV6	Optimized High Energy Laser Source Adv Tech
03	0603466A / DB3	Radar Survivability through Dis Sensing Adv Tech
04	0604020A / DC8	Army Experimentation and Prototyping
05	0604641A / CF5	Robotic Combat Vehicle (BA5) NGCV-CFT
05	0604827A / S65	Platoon Power Generator
05	0604854A / 516	Paladin/FAASV
06	0605235A / CQ4	Mid-Range Capability

Program Element/Project Restructures:

<u>Budget Activity</u>	<u>Old OSDPE / Project: Title</u>	<u>New OSDPE / Project</u>
02	0602143A / BE6: Reactive/Resp Surfaces & Matls-Soldiers & Sys	0602184A / CW9
02	0602146A / A02: Stand-In Advanced RF Effects (STARE)	0602146A / AP5
02	0602146A / AR3: Intelligent Environmental Battlefield Awareness	0602182A / CX3
02	0602146A / AR7: Sensing in Contested Environments Technology	0602182A / CX5
02	0602146A / AR9: Persistent Geophysical Sensing-Infrasound Tech	0602182A / CX4
02	0602146A / AT2: Subterranean Detection and Monitoring Technology	0602182A / CX6
02	0602146A / AV7: Atmospheric Modeling and Meteorological Technology	0602182A / CW2
02	0602146A / CK1: Assured PNT Enabling Technologies	0602182A / CZ6
02	0602148A / AI9: Future UAS Engine Technology	0602183A / CW6

02	0602148A / AJ2: Next Generation Rotorcraft Transmission Technology	0602183A / CW8
02	0602148A / AJ6: Advanced Rotors Technology	0602183A / CW3
02	0602148A / AJ8: Experimental and Computational Aeromechanics Techn	0602183A / CW5
02	0602148A / AL2: High Performance Computing for Rotorcraft App Tech	0602183A / DC2
02	0602148A / AL4: High Speed and Efficient VTOL Vehicle Technology	0602183A / CW7
02	0602148A / AL5: Air Vehicle Structures and Dynamics Technology	0602183A / CW4
02	0602148A / AL8: Holistic Situational Awareness and Dec Making Tech	0602141A / CG4
02	0602150A / AD2: High Energy Laser (HEL) Enabling and Support Techn	0602150A / DC1
02	0602150A / AD3: Maneuver Air Defense Technology	0603466A / AD4
02	0602182A / CM9: Convergent CEMA Deception	0602182A / CZ7
03	0602145A / BJ9: Autonomous Mobility Tech	0603462A / BK1
03	0602146A / AM8: Protected SATCOM Technology	0603463A / AM9
03	0602148A / AK4: Multi-Role Small Guided Missile Technology	0603465A / AK5
03	0603463A / AR4: Intelligent Env Battlefield Awareness Adv Tech	0603042A / CX7
03	0603463A / AS9: Persistent Geophysical Sensing-Infrasound Adv Tech	0603042A / CX8
03	0603463A / AR8: Sensing in Contested Environments Adv Technology	0603042A / CX9
03	0603463A / AT3: Subterranean Detection and Monitoring Adv Technology	0603042A / CZ5
03	0603465A / AJ7: Advanced Rotors Advanced Technology	0603043A / CX1
03	0603043A / AJ3: Next Generation Rotorcraft Transmission Adv Technology	0603043A / CX2
03	0603043A / AL3: HPC for Rotorcraft Applications Adv Tech	0603043A / DC3
03	0603463A / AU2: Optimization of Geospatial Data for Visualization	0603463A / AT8
03	0603463A / AV1: GEOInt/Ops Logistics Integration-Planning Adv Tech	0603463A / AU4
03	0602147A / AF1: Long Range Maneuverable Fires (LRMF) Technology	0603464A / AF2
03	0603464A / AE8: Land-Based Anti-Ship Missile (LBASM) Advanced Tech	0603464A / CZ8
03	0603465A / CH6: Adapt & Resilnt Tach Autnmy Cont&Struct Adv Tech	0603043A / CV1
03	0603465A / CH6: Adapt & Resilnt Tach Autnmy Cont&Struct Adv Tech	0603043A / CV2
03	0603465A / CH8: UAS Survivability Advance Technology	0603465A / AK3
03	0603465A / CH8: UAS Survivability Advance Technology	0603465A / CG1
03	0602148A / BZ7: Future Vertical Lift Medical Technologies	0603465A / CJ5
04	0603466A / AD1: High Energy Laser Tactical Vehicle Demo Adv Tech	0604019A / BU9
04	0305251A / FA8: Cyberspace Operations Forces and Force Support	0305251A / DD3
04	0603801A / B47: Future Vertical Lift	0603801A / CS7
04	0604117A / FI4: Maneuver - Short Range Air Defense (M-SHORAD)	0604117A / CR9
04	0605054A / FI3: Rapid Capability Development and Maturation	0604117A / CR9
04	0604117A / FI4: Maneuver - Short Range Air Defense (M-SHORAD)	0604117A / CS1

04	0604644A / MR1: Mobile Intermediate Range Missile	0604135A / MR2
04	0604644A / MR1: Mobile Intermediate Range Missile	0604135A / MR3
04	0604644A / MR1: Mobile Intermediate Range Missile	0604135A / MR4
04	0604182A / HX1: Long Range Hypersonic Weapon	0604182A / HX3
04	0604182A / HX1: Long Range Hypersonic Weapon	0604182A / HX4
04	0604182A / HX1: Long Range Hypersonic Weapon	0604182A / HX5
04	0604182A / HX1: Long Range Hypersonic Weapon	0604182A / HX6
05	0604818A / EJ5: Mounted Computing Environment (MCE)	0604805A / 593
05	0605013A / T05: Army Business System Modernization Initiatives	0605013A / BY3
05	0608041A / CD1: Defensive Cyber - Software Prototype Devel	0605041A / XU3
05	0605042A / FA1: Manpack Radio	0605236A / CQ1
05	0605042A / FA2: Rifleman Radio (RR)	0605236A / CQ1
06	0605602A / 628: Developmental Test Technology & Sustainment	0605602A / FJ3
06	0605602A / 62C: Modeling and Simulation Instrumentation	0605602A / FJ3
07	0303142A / 456: MILSATCOM System Engineering	0303142A / CO7
07	0205778A / EG2: GMLRS Alternative Warheads	0205778A / EG3

Program Terminations (including transfers to Procurement and Sustainment):

<u>Budget Activity</u>	<u>OSDPE / Project</u>	<u>Project Title</u>
01	0601104A / CI9	University & Industry Rsch Ctrs / Strategic University Basic Research Alliance
02	0602141A / CJ6	Lethality Technology / Advanced Energetics for Missile Technologies
02	0602143A / BB9	Soldier Lethality Technology / Human Performance Tech for Mobility & Lethality
02	0602144A / CG5	Ground Technology / Ground Vehicle Sensor Concepts and Technologies
02	0602146A / AR1	Network C3I Technology / Robust, Resilient and Intelligent C3I Technology
02	0602150A / AD5	Air and Missile Defense Technology / Next Generation Fires Radar Technology
03	0603002A / MN3	Medical Advanced Technology / Immediate Cardiopulmonary Stabilization Adv Tech
03	0603002A / MN4	Medical Advanced Technology / Advanced Life Support Advanced Technology
03	0603002A / MN5	Medical Advanced Technology / Next Generation Blood Products Advanced Technology
03	0603002A / MN9	Medical Advanced Technology / Far Forward Behavioral Health Care Advanced Tech

03	0603463A / AN2	Network C3I Advanced Technology / Narrowband SATCOM Advanced Technology
03	0603466A / AD4	Air and Missile Defense Adv Technology / Maneuver Air Defense Advanced Technology
04	0604785A / DS4	Integrated Base Defense / Integrated Base Defense
05	0604854A / HB6	Artillery Systems EMD / Mobile 155MM Howitzer

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 the Army
 FY 2023 President's Budget
 Exhibit R-1 FY 2023 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

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<u>Summary Recap of Budget Activities</u>	<u>FY 2021</u> <u>(Base + OCO)</u>	<u>FY 2022</u> <u>Enactment</u>	<u>FY 2023</u> <u>Request</u>
Basic Research	552,521	606,509	466,823
Applied Research	1,518,220	1,529,888	883,759
Advanced Technology Development	1,948,792	2,190,430	1,392,065
Advanced Component Development & Prototypes	3,589,313	3,818,276	4,098,749
System Development & Demonstration	2,979,946	3,254,230	4,031,334
Management Support	1,832,049	1,553,905	1,554,252
Operational Systems Development	1,719,691	1,466,180	1,188,403
Software and Digital Technology Pilot Programs	56,706	108,841	94,888
Total Research, Development, Test & Evaluation	14,197,238	14,528,259	13,710,273
 <u>Summary Recap of FYDP Programs</u>			
General Purpose Forces	589,523	579,473	392,489
Intelligence and Communications	372,869	275,873	210,597
Research and Development	13,099,825	13,566,200	13,009,253
Central Supply and Maintenance	130,785	103,720	91,270
Administration and Associated Activities	253		
Classified Programs	3,983	2,993	6,664
Total Research, Development, Test & Evaluation	14,197,238	14,528,259	13,710,273

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Apr 2022

Appropriation: 2040A Research, Development, Test & Eval, Army

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Se c
1	0601102A	Defense Research Sciences	01	344,031	368,751	279,328	U
2	0601103A	University Research Initiatives	01	84,697	91,241	70,775	U
3	0601104A	University and Industry Research Centers	01	118,716	126,267	100,909	U
4	0601121A	Cyber Collaborative Research Alliance	01	5,077	5,067	5,355	U
5	0601601A	Artificial Intelligence and Machine Learning Basic Research	01		15,183	10,456	U
		Basic Research		552,521	606,509	466,823	
6	0602002A	Army Agile Innovation and Development-Applied Research	02			9,534	U
7	0602115A	Biomedical Technology	02	11,403	11,925		U
8	0602134A	Counter Improvised-Threat Advanced Studies	02	1,927	1,976	6,192	U
9	0602141A	Lethality Technology	02	117,484	91,626	87,717	U
10	0602142A	Army Applied Research	02	29,257	28,654	27,833	U
11	0602143A	Soldier Lethality Technology	02	201,511	205,058	103,839	U
12	0602144A	Ground Technology	02	159,358	216,550	52,848	U
13	0602145A	Next Generation Combat Vehicle Technology	02	258,341	245,525	174,090	U
14	0602146A	Network C3I Technology	02	202,256	164,804	64,115	U
15	0602147A	Long Range Precision Fires Technology	02	119,007	93,785	43,029	U
16	0602148A	Future Verticle Lift Technology	02	169,536	133,158	69,348	U
17	0602150A	Air and Missile Defense Technology	02	107,584	93,549	27,016	U
18	0602180A	Artificial Intelligence and Machine Learning Technologies	02		15,034	16,454	U
19	0602181A	All Domain Convergence Applied Research	02		25,967	27,399	U
20	0602182A	C3I Applied Research	02		12,406	27,892	U
21	0602183A	Air Platform Applied Research	02		6,597	41,588	U

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Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Sec
22	0602184A	Soldier Applied Research	02		11,064	15,716	U
23	0602213A	C3I Applied Cyber	02	18,816	12,119	13,605	U
24	0602386A	Biotechnology for Materials - Applied Research	02		20,643	21,919	U
25	0602785A	Manpower/Personnel/Training Technology	02	20,399	18,701	19,649	U
26	0602787A	Medical Technology	02	101,341	120,747	33,976	U
Applied Research				1,518,220	1,529,888	883,759	
27	0603002A	Medical Advanced Technology	03	95,146	137,804	5,207	U
28	0603007A	Manpower, Personnel and Training Advanced Technology	03	11,344	14,273	15,598	U
29	0603025A	Army Agile Innovation and Demonstration	03		22,231	20,900	U
30	0603040A	Artificial Intelligence and Machine Learning Advanced Technologies	03		909	6,395	U
31	0603041A	All Domain Convergence Advanced Technology	03		17,743	45,463	U
32	0603042A	C3I Advanced Technology	03		3,151	12,716	U
33	0603043A	Air Platform Advanced Technology	03		754	17,946	U
34	0603044A	Soldier Advanced Technology	03		890	479	U
35	0603115A	Medical Development	03	26,711	26,508		U
36	0603116A	Lethality Advanced Technology	03		8,066	9,796	U
37	0603117A	Army Advanced Technology Development	03	64,163	76,815	134,874	U
38	0603118A	Soldier Lethality Advanced Technology	03	154,161	152,369	100,935	U
39	0603119A	Ground Advanced Technology	03	196,055	280,490	32,546	U
40	0603134A	Counter Improvised-Threat Simulation	03	24,087	24,747	21,486	U
41	0603386A	Biotechnology for Materials - Advanced Research	03		53,736	56,853	U
42	0603457A	C3I Cyber Advanced Development	03	43,357	61,426	41,354	U

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Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Sec
43	0603461A	High Performance Computing Modernization Program	03	221,161	229,123	251,964	U
44	0603462A	Next Generation Combat Vehicle Advanced Technology	03	309,860	299,712	193,242	U
45	0603463A	Network C3I Advanced Technology	03	215,337	211,068	125,565	U
46	0603464A	Long Range Precision Fires Advanced Technology	03	177,142	141,909	100,830	U
47	0603465A	Future Vertical Lift Advanced Technology	03	220,334	261,880	177,836	U
48	0603466A	Air and Missile Defense Advanced Technology	03	173,244	145,826	11,147	U
49	0603920A	Humanitarian Demining	03	16,690	19,000	8,933	U
Advanced Technology Development				1,948,792	2,190,430	1,392,065	
50	0603305A	Army Missile Defense Systems Integration	04	139,518	56,702	12,001	U
51	0603308A	Army Space Systems Integration	04	25,584	25,755	17,945	U
52	0603327A	Air and Missile Defense Systems Engineering	04	47,098	15,000		U
53	0603619A	Landmine Warfare and Barrier - Adv Dev	04	56,067	46,637	64,001	U
54	0603639A	Tank and Medium Caliber Ammunition	04	106,881	73,844	64,669	U
55	0603645A	Armored System Modernization - Adv Dev	04	130,485	164,328	49,944	U
56	0603747A	Soldier Support and Survivability	04	5,312	2,897	4,060	U
57	0603766A	Tactical Electronic Surveillance System - Adv Dev	04	182,400	113,365	72,314	U
58	0603774A	Night Vision Systems Advanced Development	04	15,179	62,820	18,048	U
59	0603779A	Environmental Quality Technology - Dem/Val	04	20,906	22,921	31,249	U
60	0603790A	NATO Research and Development	04	4,589	3,777	3,805	U
61	0603801A	Aviation - Adv Dev	04	694,296	1,178,460	1,162,344	U
62	0603804A	Logistics and Engineer Equipment - Adv Dev	04	15,287	11,055	9,638	U
63	0603807A	Medical Systems - Adv Dev	04	36,006	37,053	598	U

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64	0603827A	Soldier Systems - Advanced Development	04	23,905	25,925	25,971	U
65	0604017A	Robotics Development	04	92,401	80,525	26,594	U
66	0604019A	Expanded Mission Area Missile (EMAM)	04		27,872	220,820	U
67	0604020A	Cross Functional Team (CFT) Advanced Development & Prototyping	04			106,000	U
68	0604021A	Electronic Warfare Technology Maturation (MIP)	04	15,034			U
69	0604035A	Low Earth Orbit (LEO) Satellite Capability	04	21,850	19,638	35,509	U
70	0604036A	Multi-Domain Sensing System (MDSS) Adv Dev	04		50,548	49,932	U
71	0604037A	Tactical Intel Targeting Access Node (TITAN) Adv Dev	04		28,347	863	U
72	0604100A	Analysis Of Alternatives	04	9,714	10,091	10,659	U
73	0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04	1,328	926	1,425	U
74	0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	59,183	76,349	95,719	U
75	0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	308,805	297,629	382,147	U
76	0604115A	Technology Maturation Initiatives	04	141,109	132,561	269,756	U
77	0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	5,776	39,376	225,147	U
78	0604119A	Army Advanced Component Development & Prototyping	04	167,990	189,483	198,111	U
79	0604120A	Assured Positioning, Navigation and Timing (PNT)	04	115,688	83,952	43,797	U
80	0604121A	Synthetic Training Environment Refinement & Prototyping	04	112,093	206,335	166,452	U
81	0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04	13,326	13,379	15,840	U
82	0604135A	Strategic Mid-Range Fires	04			404,291	U
83	0604182A	Hypersonics	04	841,666	315,131	173,168	U
84	0604403A	Future Interceptor	04		6,895	8,179	U
85	0604531A	Counter - Small Unmanned Aircraft Systems Advanced Development	04		19,148	35,110	U

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86	0604541A	Unified Network Transport	04	39,192	35,172	36,966	U
87	0604644A	Mobile Medium Range Missile	04	88,100	286,445		U
88	0604785A	Integrated Base Defense (Budget Activity 4)	04	2,020	2,040		U
89	0305251A	Cyberspace Operations Forces and Force Support	04	50,525	55,895	55,677	U
Advanced Component Development & Prototypes				3,589,313	3,818,276	4,098,749	
90	0604201A	Aircraft Avionics	05	7,011	6,654	3,335	U
91	0604270A	Electronic Warfare Development	05	56,624	30,840	4,243	U
92	0604601A	Infantry Support Weapons	05	89,497	79,339	66,529	U
93	0604604A	Medium Tactical Vehicles	05	8,213	9,524	22,163	U
94	0604611A	JAVELIN	05	5,983	7,094	7,870	U
95	0604622A	Family of Heavy Tactical Vehicles	05	22,254	28,445	50,924	U
96	0604633A	Air Traffic Control	05	3,383	4,405	2,623	U
97	0604641A	Tactical Unmanned Ground Vehicle (TUGV)	05			115,986	U
98	0604642A	Light Tactical Wheeled Vehicles	05	4,371	2,055		U
99	0604645A	Armored Systems Modernization (ASM) - Eng Dev	05	123,992	122,778	71,287	U
100	0604710A	Night Vision Systems - Eng Dev	05	52,959	43,417	62,679	U
101	0604713A	Combat Feeding, Clothing, and Equipment	05	2,734	1,658	1,566	U
102	0604715A	Non-System Training Devices - Eng Dev	05	27,013	26,514	18,600	U
103	0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	62,058	59,518	39,541	U
104	0604742A	Constructive Simulation Systems Development	05	9,779	22,240	29,570	U
105	0604746A	Automatic Test Equipment Development	05	5,375	8,807	5,178	U
106	0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	7,605	12,453	8,189	U

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Appropriation: 2040A Research, Development, Test & Eval, Army

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Sec
107	0604768A	Brilliant Anti-Armor Submunition (BAT)	05	20,175			U
108	0604780A	Combined Arms Tactical Trainer (CATT) Core	05	3,438			U
109	0604798A	Brigade Analysis, Integration and Evaluation	05	18,737	21,423	21,228	U
110	0604802A	Weapons and Munitions - Eng Dev	05	277,344	297,086	263,778	U
111	0604804A	Logistics and Engineer Equipment - Eng Dev	05	53,676	54,642	41,669	U
112	0604805A	Command, Control, Communications Systems - Eng Dev	05	10,674	20,107	40,038	U
113	0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	48,285	44,400	5,513	U
114	0604808A	Landmine Warfare/Barrier - Eng Dev	05	9,239	29,137	12,150	U
115	0604818A	Army Tactical Command & Control Hardware & Software	05	126,676	155,017	111,690	U
116	0604820A	Radar Development	05	105,271	122,607	71,259	U
117	0604822A	General Fund Enterprise Business System (GFEBs)	05	15,428	15,979	10,402	U
118	0604823A	Firefinder	05	18,278			U
119	0604827A	Soldier Systems - Warrior Dem/Val	05	6,546	6,454	11,425	U
120	0604852A	Suite of Survivability Enhancement Systems - EMD	05	62,012	96,132	109,702	U
121	0604854A	Artillery Systems - EMD	05	36,187	25,000	23,106	U
122	0605013A	Information Technology Development	05	123,659	129,380	124,475	U
123	0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	111,078	67,701	67,564	U
124	0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	76,140	35,560		U
125	0605030A	Joint Tactical Network Center (JTNC)	05	15,671	16,350	17,950	U
126	0605031A	Joint Tactical Network (JTN)	05	30,540	28,905	30,169	U
127	0605033A	Ground-Based Operational Surveillance System - Expeditionary (GBOSS-E)	05	5,758			U
128	0605035A	Common Infrared Countermeasures (CIRCM)	05	29,770	16,630	11,523	U

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Appropriation: 2040A Research, Development, Test & Eval, Army

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Sec
129	0605038A	Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV) Sensor Suite	05	4,669	7,618		U
130	0605041A	Defensive CYBER Tool Development	05	28,544	18,811	33,029	U
131	0605042A	Tactical Network Radio Systems (Low-Tier)	05	20,511	28,741	4,497	U
132	0605047A	Contract Writing System	05	22,025	20,960	23,487	U
133	0605051A	Aircraft Survivability Development	05	99,403	61,768	19,123	U
134	0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	152,399	182,257	131,093	U
135	0605053A	Ground Robotics	05	12,010	16,360	26,809	U
136	0605054A	Emerging Technology Initiatives	05	294,366	226,802	185,311	U
137	0605143A	Biometrics Enabling Capability (BEC)	05		4,326	11,091	U
138	0605144A	Next Generation Load Device - Medium	05		15,397	22,439	U
139	0605145A	Medical Products and Support Systems Development	05	919	962		U
140	0605148A	Tactical Intel Targeting Access Node (TITAN) EMD	05		54,972	58,087	U
141	0605203A	Army System Development & Demonstration	05	177,501	122,175	119,516	U
142	0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05	5,780	2,275	6,530	U
143	0605224A	Multi-Domain Intelligence	05		9,313	19,911	U
144	0605225A	SIO Capability Development	05		22,713		U
145	0605231A	Precision Strike Missile (PrSM)	05		188,452	259,506	U
146	0605232A	Hypersonics EMD	05		111,473	633,499	U
147	0605233A	Accessions Information Environment (AIE)	05		16,790	13,647	U
148	0605235A	Strategic Mid-Range Capability	05			5,016	U
149	0605236A	Integrated Tactical Communications	05			12,447	U
150	0605450A	Joint Air-to-Ground Missile (JAGM)	05	7,566	2,134	2,366	U

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151	0605457A	Army Integrated Air and Missile Defense (AIAMD)	05	213,956	159,873	265,288	U
152	0605531A	Counter - Small Unmanned Aircraft Systems Sys Dev & Demonstration	05		33,386	14,892	U
153	0605625A	Manned Ground Vehicle	05	162,390	202,320	589,762	U
154	0605766A	National Capabilities Integration (MIP)	05	7,670	13,454	17,030	U
155	0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	05	1,500	2,564	9,376	U
156	0605830A	Aviation Ground Support Equipment	05	1,413	1,201	2,959	U
157	0303032A	TROJAN - RH12	05	3,451	3,362	3,761	U
158	0303667A	Citizen Broadband Radio System	05	900			U
159	0303767A	AMBIT - Pre-Auctioned SRF	05	9,785			U
160	0304270A	Electronic Warfare Development	05	59,755	75,520	56,938	U
System Development & Demonstration				2,979,946	3,254,230	4,031,334	
161	0604256A	Threat Simulator Development	06	41,487	61,422	18,437	U
162	0604258A	Target Systems Development	06	35,279	42,404	19,132	U
163	0604759A	Major T&E Investment	06	119,231	93,617	107,706	U
164	0605103A	Rand Arroyo Center	06	12,989	32,296	35,542	U
165	0605301A	Army Kwajalein Atoll	06	221,949	240,877	309,005	U
166	0605326A	Concepts Experimentation Program	06	46,847	79,585	87,122	U
167	0605502A	Small Business Innovative Research	06	369,715			U
168	0605601A	Army Test Ranges and Facilities	06	390,366	367,125	401,643	U
169	0605602A	Army Technical Test Instrumentation and Targets	06	81,829	59,253	37,962	U
170	0605604A	Survivability/Lethality Analysis	06	36,001	36,370	36,500	U
171	0605606A	Aircraft Certification	06	2,736	2,489	2,777	U

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172	0605702A	Meteorological Support to RDT&E Activities	06	6,360	6,521	6,958	U
173	0605706A	Materiel Systems Analysis	06	21,830	21,558	22,037	U
174	0605709A	Exploitation of Foreign Items	06	8,936	13,631	6,186	U
175	0605712A	Support of Operational Testing	06	54,116	55,122	70,718	U
176	0605716A	Army Evaluation Center	06	56,827	65,854	67,058	U
177	0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	2,478	2,633	6,097	U
178	0605801A	Programwide Activities	06	89,023	96,558	89,793	U
179	0605803A	Technical Information Activities	06	25,817	31,987	28,752	U
180	0605805A	Munitions Standardization, Effectiveness and Safety	06	50,648	63,042	48,316	U
181	0605857A	Environmental Quality Technology Mgmt Support	06	1,715	1,789	1,912	U
182	0605898A	Army Direct Report Headquarters - R&D - MHA	06	50,859	48,981	53,271	U
183	0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	74,089	80,921	90,088	U
184	0606003A	CounterIntel and Human Intel Modernization	06	5,200	5,363	1,424	U
185	0606105A	Medical Program-Wide Activities	06	18,973	39,041		U
186	0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	6,496	5,466	5,816	U
187	0909999A	Financing for Cancelled Account Adjustments	06	253			U
		Management Support		1,832,049	1,553,905	1,554,252	
188	0603778A	MLRS Product Improvement Program	07	9,785	12,314	18,463	U
189	0605024A	Anti-Tamper Technology Support	07	8,436	8,868	9,284	U
190	0607131A	Weapons and Munitions Product Improvement Programs	07	24,666	35,828	11,674	U
191	0607134A	Long Range Precision Fires (LRPF)	07	100,146			U
192	0607136A	Blackhawk Product Improvement Program	07	8,300	14,773		U

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193	0607137A	Chinook Product Improvement Program	07	49,409	67,872	52,513	U
194	0607139A	Improved Turbine Engine Program	07	232,159	260,024	228,036	U
195	0607142A	Aviation Rocket System Product Improvement and Development	07	11,321	12,417	11,312	U
196	0607143A	Unmanned Aircraft System Universal Products	07	19,460	4,594	512	U
197	0607145A	Apache Future Development	07	52,502	10,067	10,074	U
198	0607148A	AN/TPQ-53 Counterfire Target Acquisition Radar System	07		47,752	62,559	U
199	0607150A	Intel Cyber Development	07	14,652	3,611	13,343	U
200	0607312A	Army Operational Systems Development	07	35,851	28,029	26,131	U
201	0607313A	Electronic Warfare Development	07		5,673	6,432	U
202	0607665A	Family of Biometrics	07	1,276	1,144	1,114	U
203	0607865A	Patriot Product Improvement	07	178,984	125,932	152,312	U
204	0203728A	Joint Automated Deep Operation Coordination System (JADOCS)	07	43,060	25,489	19,329	U
205	0203735A	Combat Vehicle Improvement Programs	07	213,726	280,107	192,310	U
206	0203743A	155mm Self-Propelled Howitzer Improvements	07	217,959	175,076	136,680	U
207	0203744A	Aircraft Modifications/Product Improvement Programs	07	11,261	10,000		U
208	0203752A	Aircraft Engine Component Improvement Program	07	80	132	148	U
209	0203758A	Digitization	07	4,351	3,903	2,100	U
210	0203801A	Missile/Air Defense Product Improvement Program	07	1,241	127	3,109	U
211	0203802A	Other Missile Product Improvement Programs	07	15,268	10,265	9,027	U
212	0205412A	Environmental Quality Technology - Operational System Dev	07	250	262	793	U
213	0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	72,817	60,733	20,180	U
214	0208053A	Joint Tactical Ground System	07	9,510	13,379	8,813	U

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Appropriation: 2040A Research, Development, Test & Eval, Army

Line No	Program Element Number	Item	Act	FY 2021 (Base + OCO)	FY 2022 Enactment	FY 2023 Request	Sec
216	0303028A	Security and Intelligence Activities	07	23,367	24,531		U
217	0303140A	Information Systems Security Program	07	28,270	15,680	17,209	U
218	0303141A	Global Combat Support System	07	70,652	45,297	27,100	U
219	0303142A	SATCOM Ground Environment (SPACE)	07	18,002	15,222	18,321	U
222	0305179A	Integrated Broadcast Service (IBS)	07	382	5,430	9,926	U
223	0305204A	Tactical Unmanned Aerial Vehicles	07	38,151	8,410	4,500	U
224	0305206A	Airborne Reconnaissance Systems	07	28,858	24,460	17,165	U
225	0305208A	Distributed Common Ground/Surface Systems	07	40,771			U
226	0307665A	Biometrics Enabled Intelligence	07		2,066		U
227	0708045A	End Item Industrial Preparedness Activities	07	130,785	103,720	91,270	U
9999	9999999999	Classified Programs		3,983	2,993	6,664	U
		Operational Systems Development		1,719,691	1,466,180	1,188,403	
228	0608041A	Defensive CYBER - Software Prototype Development	08	56,706	108,841	94,888	U
		Software and Digital Technology Pilot Programs		56,706	108,841	94,888	
Total Research, Development, Test & Eval, Army				14,197,238	14,528,259	13,710,273	

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14	02	0602146A	Network C3I Technology.....	Volume 1b - 226
15	02	0602147A	Long Range Precision Fires Technology.....	Volume 1b - 310
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17	02	0602150A	Air and Missile Defense Technology.....	Volume 1b - 385
18	02	0602180A	Artificial Intelligence and Machine Learning Technologies.....	Volume 1b - 414
19	02	0602181A	All Domain Convergence Applied Research.....	Volume 1b - 429
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23	02	0602213A	C3I Applied Cyber.....	Volume 1b - 507
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25	02	0602785A	Manpower/Personnel/Training Technology.....	Volume 1b - 524
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Army Applied Research	0602142A	10	02.....	Volume 1b - 51
Artificial Intelligence and Machine Learning Technologies	0602180A	18	02.....	Volume 1b - 414
Biomedical Technology	0602115A	7	02.....	Volume 1b - 7
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C3I Applied Cyber	0602213A	23	02.....	Volume 1b - 507
C3I Applied Research	0602182A	20	02.....	Volume 1b - 435
Counter Improvised-Threat Advanced Studies	0602134A	8	02.....	Volume 1b - 11
Future Verticle Lift Technology	0602148A	16	02.....	Volume 1b - 334
Ground Technology	0602144A	12	02.....	Volume 1b - 113
Lethality Technology	0602141A	9	02.....	Volume 1b - 14
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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army I BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602002A / <i>Army Agile Innovation and Development-Applied Research</i>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	-	9.534	-	9.534	14.088	19.640	23.393	20.995	0.000	87.650
DC4: <i>Army Applied Innovation</i>	-	-	-	2.073	-	2.073	3.121	3.637	7.278	5.717	0.000	21.826
DC5: <i>Team Ignite</i>	-	-	-	7.461	-	7.461	8.843	9.769	10.189	10.913	0.000	47.175
DC6: <i>Sci & Analysis for Autonomous Sys & Counter-Auton*</i>	-	-	-	-	-	-	2.124	6.234	5.926	4.365	0.000	18.649

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

Note

This is a new start in FY 2023.

In Fiscal Year 2023 (FY23), this Program Element is a new start.

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 from a newly created Innovation Board will evaluate internal and external constraints to implementation on the basis of Army modernization needs, Army standards and resources 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 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	9.534	-	9.534
Total Adjustments	0.000	0.000	9.534	-	9.534
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	9.534	-	9.534

Change Summary Explanation

In Fiscal Year 2023 (FY2023), this program element is a new start.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DC4: Army Applied Innovation	-	-	-	2.073	-	2.073	3.121	3.637	7.278	5.717	0.000	21.826

Note

This is a new start in FY 2023.

In Fiscal Year (FY) 2023, this project is a new start.

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 with the ability to adapt and integrate multi-disciplinary innovative technologies by bridging the interfaces between internal and external efforts for 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, with emphasis on open/modular systems architecture and digital thread/engineering, 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 prior to budget year programming 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 all Army Modernization Priorities.

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

Title: Army Applied Innovation	FY 2021	FY 2022	FY 2023
Description: The Army seeks to research, evaluate, and validate technology that display unique and innovative potential in a cross-domain fashion. This effort will serve as funding to rapidly prepare disruptive and groundbreaking capabilities that fall outside of the normal acquisition pipeline.	-	-	2.073
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>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.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> In Fiscal Year (FY) 2023, this project is a new start.</p>			
Accomplishments/Planned Programs Subtotals	-	-	2.073

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DC5: <i>Team Ignite</i>	-	-	-	7.461	-	7.461	8.843	9.769	10.189	10.913	0.000	47.175

Note

This is a new start in FY 2023.

This is a new start in Fiscal Year 2023.

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).

This effort is an FY23 New Start.

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

	FY 2021	FY 2022	FY 2023
Title: Team IGNITE	-	-	7.461
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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
models to determine the operational value at early levels of idea maturity and directly link operational metrics and capabilities to technical metrics. FY 2022 to FY 2023 Increase/Decrease Statement: This effort is an FY23 New Start.			
Accomplishments/Planned Programs Subtotals	-	-	7.461

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	11.403	11.925	-	-	-	0.000	0.000	0.000	0.000	0.000	23.328
EB2: <i>HIV Biomedical Technology</i>	-	11.403	11.925	-	-	-	-	-	-	-	0.000	23.328

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)

	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	11.403	11.925	0.000	-	0.000
Current President's Budget	11.403	11.925	0.000	-	0.000
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>EB2: HIV Biomedical Technology</i>	-	11.403	11.925	-	-	-	-	-	-	-	0.000	23.328

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 Assistant 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 2021	FY 2022	FY 2023
Title: HIV Biomedical Technology	9.631	9.593	-
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.			
FY 2022 Plans: In Fiscal Year 2022 (FY22) the Military HIV Research Program will continue to characterize next generation HIV vaccines and evaluate their capability to induce protective immune responses. The Military HIV Research Program will elucidate mechanisms by which different Army-owned adjuvants contribute to vaccine protection in monkeys. The program will leverage animal models of HIV remission to test novel treatments, including immune therapies (therapeutic vaccines and monoclonal antibodies). The			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>program will continue to assess the HIV threat due to evolving virus genes around the world and continue to track rates of new HIV infections at likely future clinical trial sites.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 602115DHA, Project Code 372G.</p>				
<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> <p>FY 2022 Plans: The CARB program will continue to evaluate and progress viable small molecule candidate antibacterial agents by: investigating powerful front line treatments for wound infections sustained on the battlefield for combat medics to maximally increase the golden hour in support of the Multi-Domain Operations (MDO) concept; fund research to progress established, non-DoD antibiotic programs for utility against priority pathogens identified as threats to the Warfighter and design an Integrated Product Team (IPT) in order to support product maturation toward clinical development; design clinical trials to expand indications of approved or mature investigational antibiotics to treat wound infections and/or sepsis; internally investigate an additional prototype series to lead optimization and down-select one development candidate.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 602115DHA, Project Code 372G.</p>		1.772	1.897	-
<p>Title: SBIR/STTR Tax</p> <p>FY 2022 Plans: SBIR/STTR tax.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638.</p>		-	0.435	-
Accomplishments/Planned Programs Subtotals		11.403	11.925	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army Date: April 2022

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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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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	1.927	1.976	6.192	-	6.192	6.215	6.210	6.232	6.230	0.000	34.982
CD2: <i>Counter Improvised-Threat Advanced Studies</i>	-	1.927	1.976	6.192	-	6.192	6.215	6.210	6.232	6.230	0.000	34.982

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	1.927	1.976	0.000	-	0.000
Current President's Budget	1.927	1.976	6.192	-	6.192
Total Adjustments	0.000	0.000	6.192	-	6.192
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	6.192	-	6.192

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CD2: <i>Counter Improvised-Threat Advanced Studies</i>	-	1.927	1.976	6.192	-	6.192	6.215	6.210	6.232	6.230	0.000	34.982

A. Mission Description and Budget Item Justification

This Project researches 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 2021	FY 2022	FY 2023
Title: Counter IED Emerging Technologies	1.927	1.904	6.192
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 2022 Plans: Will investigate novel radio frequency (RF), electromagnetic (EM), electro-optical and infrared (EOIR), neutron-based sensing, and other emerging technologies and technology components. Will continue to investigate and develop multiple technologies to assess their ability to counter IED threats in laboratory environments and transition promising technologies to the sister Project, Program Element (PE) 0603134A (Counter Improvised-Threat Simulation) / Project CD3 (Counter Improvised-Threat Simulation).			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will investigate, research and validate emerging RF, EM, EO/IR and other novel IED detection technologies and technology components. Will investigate advanced neutralization techniques and components that can be applied to predicting threat emplacements. Will evaluate multiple technologies in a laboratory environment for their ability to counter IED threats.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0603134A (Counter Improvised-Threat Simulation) / Project CD3 (Counter Improvised-Threat Simulation) to enable longer-term applied research pipeline of novel methods for detecting and defeating IEDs for transition.</p> <p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.072	-
Accomplishments/Planned Programs Subtotals		1.927	1.976	6.192
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 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602141A / Lethality Technology							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	117.484	91.626	87.717	-	87.717	77.976	79.845	90.480	93.176	Continuing	Continuing
AH6: Disruptive Energetics and Propulsion Technologies	-	8.124	8.413	8.682	-	8.682	8.713	8.756	8.759	8.757	0.000	60.204
AH7: Lethal and Scalable Effects Technologies	-	1.018	1.911	1.346	-	1.346	1.567	1.565	1.566	1.565	Continuing	Continuing
AH8: Lethality Materials and Processes Technology	-	4.254	4.019	1.868	-	1.868	1.898	1.895	1.895	1.895	0.000	17.724
AH9: Advanced Warheads Technology	-	22.933	25.032	26.780	-	26.780	28.319	27.085	29.067	31.722	0.000	190.938
A11: Advanced Terrain Shaping Technology	-	4.655	-	-	-	-	-	-	-	-	0.000	4.655
BS6: Lethality Technology (CA)	-	76.500	27.500	-	-	-	-	-	-	-	0.000	104.000
CF7: Solid-state Laser Concepts and Architectures	-	-	7.547	8.567	-	8.567	9.848	9.837	9.840	9.838	0.000	55.477
CF8: Terminal Effects Against Critical Targets Tech	-	-	4.040	3.938	-	3.938	2.170	1.026	5.141	4.299	0.000	20.614
CG4: Advanced Radar Concepts and Technologies	-	-	4.687	5.891	-	5.891	5.982	5.996	8.932	8.929	0.000	40.417
CI1: Advanced Armaments Lethality Technology	-	-	-	1.544	-	1.544	1.677	2.568	3.065	3.754	0.000	12.608
CJ1: Lethality Enabling University Applied Research	-	-	5.794	6.570	-	6.570	7.165	7.814	8.284	8.282	0.000	43.909
CJ6: Advanced Energetics for Missile Technologies	-	-	1.185	-	-	-	-	-	-	-	0.000	1.185
CJ7: Future Air Defense Missile Enabling Tech	-	-	1.498	14.655	-	14.655	2.314	4.573	4.574	4.573	0.000	32.187
CZ9: Foundational Hypersonic Weapons Research	-	-	-	7.876	-	7.876	8.323	8.730	9.357	9.562	0.000	43.848

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 0602141A / <i>Lethality Technology</i>
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Note
Project C11 (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).

<u>B. Program Change Summary (\$ in Millions)</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	117.484	64.126	0.000	-	0.000
Current President's Budget	117.484	91.626	87.717	-	87.717
Total Adjustments	0.000	27.500	87.717	-	87.717
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	27.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	87.717	-	87.717

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

Project: BS6: *Lethality Technology (CA)*

FY 2021	FY 2022

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity
 2040: *Research, Development, Test & Evaluation, Army / BA 2: Applied Research*

R-1 Program Element (Number/Name)
 PE 0602141A / *Lethality Technology*

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

	FY 2021	FY 2022
Congressional Add: <i>Program increase - next generation remote sensing</i>	5.000	3.000
Congressional Add: <i>Program increase - Advanced lethality concepts and analysis</i>	7.500	-
Congressional Add: <i>Program increase - counter UAS technology in arctic environments</i>	10.000	-
Congressional Add: <i>Program Increase- Hybrid additive manufacturing</i>	10.000	5.000
Congressional Add: <i>Program increase - novel and sustainable energetic materials</i>	24.000	-
Congressional Add: <i>Program increase - quantum technologies for armament systems</i>	10.000	-
Congressional Add: <i>Program increase - solid fuel propulsion technology</i>	10.000	-
Congressional Add: <i>Hypersonic Wind Tunnel Development</i>	-	6.500
Congressional Add: <i>Materials Processing Manufacturing Technology</i>	-	10.000
Congressional Add: <i>Universal Nanocrystalline Alloys</i>	-	3.000
Congressional Add Subtotals for Project: BS6	76.500	27.500
Congressional Add Totals for all Projects	76.500	27.500

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH6: <i>Disruptive Energetics and Propulsion Technologies</i>	-	8.124	8.413	8.682	-	8.682	8.713	8.756	8.759	8.757	0.000	60.204

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 2021	FY 2022	FY 2023
Title: Synthesis, Formulation and Diagnostics of Energetic Materials	4.764	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.			
FY 2022 Plans: Will synthesize and scale-up novel high energy density materials, polymer precursors, plasticizers, and high temperature energetics for inclusion in formulations (melt-cast, cast-cure, and additively manufactured) targeting 50% increased performance in explosive and propellant applications; develop novel small scale rapid experimental assessment methodologies and apply these methodologies to characterize novel energetic material candidates and formulations to assess enhancements in both range and lethality.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project.				
<p>Title: Modeling and Simulation of Energetics and Munitions</p> <p>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.</p> <p>FY 2022 Plans: Will further develop novel grain scale modeling capability for inclusion into engineering continuum scale codes for explosive applications; predict expanded sets of chemical kinetic rates for usage in continuum propulsion software for modeling of novel propellants and propulsion concepts; support synthesis and formulation chemists in the prediction of material properties prior to synthesis through the development of machine learning toolsets.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project.</p>		1.787	1.738	-
<p>Title: Advanced Weapon Concepts</p> <p>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.</p> <p>FY 2022 Plans: Will develop, validate, and transition novel weapon concepts, advanced additively manufactured propellant designs, printing technologies, and solid fuel ramjet concepts to partners to enable extended ranges, higher muzzle velocities, and reduced system mass.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to ?Synthesis, Formulation, Modeling and Diagnostics of Energetic Materials for Explosive and Propellant Applications? within this Project</p>		1.573	1.530	-
<p>Title: Synthesis, Formulation, Modeling, and Diagnostics of Energetic Materials for Explosive and Propellant Applications</p> <p>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</p>		-	-	8.682

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from ?Synthesis, Formulation and Diagnostics of Energetic Materials?, ?Modeling and Simulation of Energetics and Munitions?, and ?Advanced Weapon Concepts? within this Project.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.307	-
Accomplishments/Planned Programs Subtotals	8.124	8.413	8.682

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH7: <i>Lethal and Scalable Effects Technologies</i>	-	1.018	1.911	1.346	-	1.346	1.567	1.565	1.566	1.565	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 2021	FY 2022	FY 2023
Title: Munition Efficiency and Scalability	1.018	1.841	1.346
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 2022 Plans: Will continue conducting experiments and lethality studies, will select promising materials and mechanisms for preliminary component-level terminal ballistic experiments; will design and develop devices incorporating improved metals and energetics and integrate concepts into warheads for assessments in full-scale experiments.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
design studies to examine performance gains provided by improved manufacturing techniques, novel energetics, and metals designed for warhead applications. FY 2022 to FY 2023 Increase/Decrease Statement: Funding reduction due to decrease in number of lethality studies planned for FY23 in accordance with the lifecycle plan for the effort.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.070	-
Accomplishments/Planned Programs Subtotals		1.018	1.911	1.346
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH8: <i>Lethality Materials and Processes Technology</i>	-	4.254	4.019	1.868	-	1.868	1.898	1.895	1.895	1.895	0.000	17.724

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 2021	FY 2022	FY 2023
Title: Materials for Advanced Lethality	4.007	3.872	1.868
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 2022 Plans: Will develop algorithms to design novel geometries of propellant grains that give progressive or other novel burn behaviors to increase projectile speeds and ranges; assess the effect of ceramic powder modifications for long wave infrared transmission capability on the material toughness and light transmission in the this regime.			
FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding reduced/realigned to support the creation of PE 0602141A (Lethality Technology), Project CZ9 (Foundational Hypersonic Weapons Research).			
Title: High Temperature Materials for Lethality. Description: Improve survivability, extend range, and reduce weight of hypersonic systems operating under extreme thermal and aerodynamic loads.	0.247	-	-
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.147	-
Accomplishments/Planned Programs Subtotals	4.254	4.019	1.868

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH9: <i>Advanced Warheads Technology</i>	-	22.933	25.032	26.780	-	26.780	28.319	27.085	29.067	31.722	0.000	190.938

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 2021	FY 2022	FY 2023
Title: Advanced Warheads	10.488	10.370	11.922
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 2022 Plans: Will continue to investigate reactive and novel materials including advanced fragmentation designs for integration in warheads that can survive high-g gun environments during projectile launch. Will investigate advanced manufacturing methods, designs and materials for warhead and lethal mechanism concepts to create advances in lethality at increased range and standoff across a broad spectrum of applications. Will investigate advanced Explosively Formed Penetrators (EFP) concepts for increased performance. Will design and develop advanced Modeling and Simulation capabilities using deep learning methods to optimize Shape Charge, Fragmentation and EFP Designs. Will conduct experiments to validate these materials and designs for integration into future munition projects. Will investigate the utility of novel warhead geometries for increased lethality in distributed scenarios.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will design reactive and novel materials, including advanced fragmentation, and alternate disruptive effects to enhance lethal effects on target operating in a high-g environment. Will investigate potential lethal mechanism technologies for potential unmanned, multi-mission, ground & aerial target engagements. Will investigate technology advances to mature warhead designs that are effective across multiple domains. Will continue to develop advanced Modeling and Simulation capabilities using available technologies, including advanced algorithms to optimize Shape Charge, Fragmentation and EFP Designs. Will conduct experiments to validate materials and advanced warheads designs In a high-G environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase to focus on acceleration to mature novel warhead component technologies for application across various platforms.</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 2022 Plans: Will investigate novel energetic materials; will conduct experiments of enhanced lethality explosive formulations; will conduct experiments of enhanced novel propellant formulations. Will mature advanced initiation concepts and conduct experiments of high energy formulations in representative munitions. Will validate processing parameters necessary to produce energetic materials for additive manufacturing; will investigate modeling and simulation tools required to accurately predict energetic materials performance in novel and unique geometries. Will investigate analytical and experimental capabilities to characterize advanced energetic materials.</p> <p>FY 2023 Plans: Will continue to investigate novel energetic materials; will design enhanced lethality explosive formulations; will conduct experiments of enhanced novel propellant formulations for use in representative munitions. Will develop advanced initiation concepts and advanced ignition concepts. Will 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. Will design analytical and experimental capabilities to characterize advanced energetic materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		11.246	12.342	13.297
<p>Title: Energetics (Propellants)</p>		1.199	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>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.</p> <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 of novel pyrotechnic technologies that will enable disruptive capabilities for Multidomain Operations. This effort supports the Army Modernization Priorities.</p> <p>FY 2022 Plans: Will investigate novel pyrotechnic materials, components, and configurations. Will investigate pyrotechnic concepts and evaluate the performance and effectiveness for military utility. Will conduct experiments on pyrotechnic components and formulations supporting Army Modernization and Multi-Domain Operations.</p> <p>FY 2023 Plans: Will design novel pyrotechnic materials, components, and configurations. Will design advanced pyrotechnic concepts and assess the performance and effectiveness for military utility through modeling and experimental validation. Will continue to conduct experiments on pyrotechnic components and formulations supporting Army Modernization and Multi-Domain Operations.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase for exploration of novel pyrotechnic technologies for application across all Army priorities.</p>	-	1.406	1.561
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.914	-
Accomplishments/Planned Programs Subtotals	22.933	25.032	26.780

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army Date: April 2022

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>
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D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / <i>Lethality Technology</i>				Project (Number/Name) A11 / <i>Advanced Terrain Shaping Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>A11: Advanced Terrain Shaping Technology</i>	-	4.655	-	-	-	-	-	-	-	-	0.000	4.655

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 high-velocity 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.

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 (U.S.) Engineer Research and Development Center (ERDC) in coordination with U.S. Army Futures Command (AFC).

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Terminal Weapons Effects Technology	4.655	-	-
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.			
Accomplishments/Planned Programs Subtotals	4.655	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BS6: <i>Lethality Technology (CA)</i>	-	76.500	27.500	-	-	-	-	-	-	-	0.000	104.000

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 2021	FY 2022
Congressional Add: Program increase - next generation remote sensing FY 2021 Accomplishments: Conducted applied research in Next Generation Remote Sensing. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Next Generation Remote Sensing	5.000	3.000
Congressional Add: Program increase - Advanced lethality concepts and analysis FY 2021 Accomplishments: Conducted applied research in Advanced Lethality Concepts and Analysis. Work executed by Army Futures Command.	7.500	-
Congressional Add: Program increase - counter UAS technology in arctic environments FY 2021 Accomplishments: Conduct applied research in Counter UAS Technology in Artic Environments. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase- Hybrid additive manufacturing FY 2021 Accomplishments: Conducted applied research in Hybrid Additive Manufacturing.	10.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Hybrid Additive Manufacturing for Advanced Lethality		
Congressional Add: Program increase - novel and sustainable energetic materials FY 2021 Accomplishments: Conducted applied research in Novel and Sustainable Energetic Materials.	24.000	-
Work executed by Army Futures Command. Congressional Add: Program increase - quantum technologies for armament systems FY 2021 Accomplishments: Conducted applied research in Quantum Technologies for Armament Systems.	10.000	-
Work executed by Army Futures Command. Congressional Add: Program increase - solid fuel propulsion technology FY 2021 Accomplishments: Conducted applied research in Solid Fuel Propulsion Technology.	10.000	-
Work executed by Army Futures Command. Congressional Add: Hypersonic Wind Tunnel Development FY 2022 Plans: Congressional Interest Item funding provided for Hypersonic Wind Tunnel Development	-	6.500
Congressional Add: Materials Processing Manufacturing Technology FY 2022 Plans: Congressional Interest Item funding provided for Materials Processing Manufacturing Technology	-	10.000
Congressional Add: Universal Nanocrystalline Alloys FY 2022 Plans: Congressional Interest Item funding provided for Universal Nanocrystalline Alloys	-	3.000
Congressional Adds Subtotals	76.500	27.500

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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602141A / Lethality Technology				Project (Number/Name) CF7 / Solid-state Laser Concepts and Architectures			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CF7: Solid-state Laser Concepts and Architectures	-	-	7.547	8.567	-	8.567	9.848	9.837	9.840	9.838	0.000	55.477

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 2021	FY 2022	FY 2023
Title: High Energy Laser (HEL) Enabling Technologies for Tactical Directed Energy Weapons	-	7.271	8.567
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 2022 Plans: Will further explore the potential of fiber laser power scaling based on crystalline core/crystalline cladding (C4) fiber designs, as it pertains to power scaling to a 5 kW power level, continuous wave (CW); design and develop new high power pump couplers with reduced insertion loss and advanced heat management; investigate advanced fiber end-capping techniques, enabling power scaling out of a single fiber aperture well beyond the current state-of-the-art; model and analyze wide band gap semiconductor performance in the power switching system with the goal of providing higher efficiency.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
materials and thermal management techniques; funds research of new compact and efficient DE specific power conversion topology concepts. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports additional research into Directed Energy power conversion topology concepts.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.276	-
Accomplishments/Planned Programs Subtotals	-	7.547	8.567

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CF8: <i>Terminal Effects Against Critical Targets Tech</i>	-	-	4.040	3.938	-	3.938	2.170	1.026	5.141	4.299	0.000	20.614

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.

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 (U.S.) Engineer Research and Development Center (ERDC) in coordination with U.S. Army Futures Command (AFC).

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

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Terminal Weapons Effects Technology	-	3.893	3.938
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.			
FY 2022 Plans: Conduct lab and scaled field experiments of blast/fragmentation munitions against critical protective materials; design and develop fast running engineering tools to support LRPF weapon design and performance evaluation; and investigate Battle Damage Assessment (BDA) using Non-Line-of-Sight (NLOS) imagery.			
FY 2023 Plans: Will investigate low velocity and low aspect ratio impact conditions for penetration code prediction capabilities of army warheads, will 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.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding change reflects the planned lifecycle of this effort to realign resources to PE 0603116A (Lethality Advanced Technology) / Project CH5 (Terminal Effects Against Critical Targets Adv Tech) as technologies are transitioned for maturation and demonstration.			
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.147	-
Accomplishments/Planned Programs Subtotals	-	4.040	3.938

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CG4: Advanced Radar Concepts and Technologies</i>	-	-	4.687	5.891	-	5.891	5.982	5.996	8.932	8.929	0.000	40.417

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 2021	FY 2022	FY 2023
Title: Antennas and Radio Frequency (RF) Device Components for Advanced Electronic Systems	-	4.516	4.952
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 2022 Plans: Will investigate the growth and properties of single crystal diamond and diamond/boron nitride heterostructures, including different carbon-boron-nitrogen compositions, n-type and p-type doping of the alloys, and the generation of defects associated with growth techniques and fundamental studies on chip-scale.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects 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: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding administratively realigned from PE 0602148A (Future Vertical Lift Technology) / Project AL8 (Holistic Situational Awareness and Dec Making Tech), to support the creation of this ?Distributed Radar Architectures? task.</p>		-	-	0.939
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.171	-
Accomplishments/Planned Programs Subtotals		-	4.687	5.891

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>
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 2023 Army **Date:** April 2022

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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>C11: Advanced Armaments Lethality Technology</i>	-	-	-	1.544	-	1.544	1.677	2.568	3.065	3.754	0.000	12.608

Note

This is a new start in FY 2023.

This Project is a New Start for Fiscal Year 2023 (FY23).

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 (AFC).

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

	FY 2021	FY 2022	FY 2023
Title: Advanced Armaments Lethality Technology	-	-	1.544
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.			
FY 2023 Plans: Will 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.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY 2023 this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	1.544

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CJ1: Lethality Enabling University Applied Research</i>	-	-	5.794	6.570	-	6.570	7.165	7.814	8.284	8.282	0.000	43.909

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 supports the Army Modernization Priority Long Range Precision Fires and Air and Missile Defense.

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 Program Element 0602147A (Long Range Precision Fires) and Program Element 0602150A (Air and Missile Defense Technologies)

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

	FY 2021	FY 2022	FY 2023
Title: Laser Diagnostics for Hypersonics and Directed Energy	-	1.925	1.689
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 2022 Plans: Will investigate methods to expand laser diagnostics and the flight envelope of the existing glide body, accelerate design of block upgrades and future hypersonic glide bodies; reduce flight test risks. Will investigate new backward lasing guidestar methods to			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change 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 2022 Plans: Will design and develop modeling techniques to expand the flight envelop and control of the existing glide body. Funds applied research to inform the development of the B.A.M. range for testing and evaluation of aerothermodynamic performance at hypersonic speeds.</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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	1.800	1.783
<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 2022 Plans:</p>		-	1.047	1.200

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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.</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 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Intelligent Hypersonics and Other Vehicle Systems</p> <p>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.</p> <p>FY 2022 Plans: Will investigate characterization of hardware ablation (or structural deformation) using Mach 5 or above wind tunnel. Will design and develop testing hardware for data collection and training of deep neural network using wind tunnel data and synthetic flight control system of a geometrically relevant vehicle. Will develop intelligent defense vehicle systems using DL algorithms for improved surveillance, detection, and tracking and overcoming line-of-sight constraints.</p> <p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Increase funding supports optimal designs of scramjet propulsor leveraging new innovation concepts.</p>		-	0.811	1.898
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans:</p>		-	0.211	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	5.794	6.570
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CJ6: Advanced Energetics for Missile Technologies</i>	-	-	1.185	-	-	-	-	-	-	-	0.000	1.185

Note

This Project is Terminated for Fiscal Year 2023 (FY23).

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 Assistant 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 2021	FY 2022	FY 2023
<p>Title: Advanced Energetics Technology (Missiles)</p> <p>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.</p> <p>FY 2022 Plans: Will investigate current and future substances that provide higher delivered specific impulse density in rocket propellants; novel binders (both energetic and inert); will mature processing techniques to improve mass fraction; and will investigate explore concepts for improved combustion properties to improve efficiency.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort completes in FY22.</p>	-	1.142	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>	-	0.043	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	1.185	-

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CJ7: Future Air Defense Missile Enabling Tech</i>	-	-	1.498	14.655	-	14.655	2.314	4.573	4.574	4.573	0.000	32.187

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 Program Element (PE) 0602141A (Lethality Technology) / Project CJ6 (Advanced Energetics for Missile Technologies); PE 0602147A (Long Range Precision Fires Technology / Project AF3 (Extended Range Propulsion Technology) and Project AF8 (Affordable Extended Range Precision Technology). The research complements PE 0602150A (Air and Missile Defense Technology) / Project AD3 (Maneuver Air Defense Technology) and PE 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense 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 2021	FY 2022	FY 2023
Title: Future Air Defense Missile Enabling Technology	-	1.443	14.655
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 2022 Plans: Will conduct component level trade studies and will investigate reduced space, weight, power and cost designs for improved future Air Defense missile seeker, guidance and control, aerostructures, and propulsion technologies.			
FY 2023 Plans: Will develop hardware, software, and algorithms for reduced space, weight, power and cost improved future Air Defense missile seeker, guidance and control, aerostructures, and propulsion technologies. Will design, develop and evaluate an Active Electronically Scanned Array (AESA) radar seeker capable of supporting a variety of missions, weapon sizes and threats. Will develop and evaluate seeker-based fuzing; Will develop and evaluate strap-down guidance techniques for maneuvering targets.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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; Will assess and mature component designs using high-fidelity models and simulation tools against future threats.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Increase in funding required to continue critical and high priority BA 2 investments in advanced seeker technologies and future interceptor concepts to increase lethality and defeat against Tactical / Lethal Unmanned Aerial System (UAS), Cruise Missile (CM), Rotary Wing (RW), and Fixed Wing (FW) threats. Funding realigned from PE 0603466A (Air and Missile Defense Tech) / Project AD4 (Maneuver Air Defense Advanced Technology).</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.055	-
Accomplishments/Planned Programs Subtotals		-	1.498	14.655
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CZ9: Foundational Hypersonic Weapons Research</i>	-	-	-	7.876	-	7.876	8.323	8.730	9.357	9.562	0.000	43.848

Note

This is a new start in FY 2023.

This Project is a New Start for Fiscal Year 2023 (FY23).

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)

Title: Foundational Hypersonic Weapon Materials	FY 2021	FY 2022	FY 2023
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	-	-	6.150

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: This effort is a New Start for Fiscal Year 2023 (FY23).				
Title: Foundational Hypersonic Weapons Flight and Control 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. FY 2023 Plans: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: This effort is a New Start for Fiscal Year 2023 (FY23).		-	-	1.726
Accomplishments/Planned Programs Subtotals		-	-	7.876
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	29.257	28.654	27.833	-	27.833	29.958	31.059	31.328	29.760	0.000	207.849
BS1: <i>Army Applied Research</i>	-	29.257	28.654	27.833	-	27.833	29.958	31.059	31.328	29.760	0.000	207.849

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.

B. Program Change Summary (\$ in Millions)

	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	30.757	28.654	0.000	-	0.000
Current President's Budget	29.257	28.654	27.833	-	27.833
Total Adjustments	-1.500	0.000	27.833	-	27.833
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.500	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.833	-	27.833

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army											Date: April 2022	
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	201.511	205.058	103.839	-	103.839	109.924	117.521	112.793	104.888	0.000	955.534
AY6: Soldier Squad Small Arms Armaments Technology	-	13.122	8.825	10.897	-	10.897	10.098	13.670	16.239	16.235	0.000	89.086
AY8: Small Arms Fire Control Technology	-	1.828	4.172	2.170	-	2.170	-	-	-	-	0.000	8.170
AZ2: Body Armor & Integrated Headborne Technology	-	6.575	6.649	6.617	-	6.617	6.693	5.763	5.765	5.763	0.000	43.825
AZ5: Soldier Protection Technology - Vulnerability	-	11.738	9.357	11.141	-	11.141	11.320	11.310	11.313	11.310	0.000	77.489
AZ9: Soldier Protection Advanced Tech - Detectability	-	3.278	1.883	1.762	-	1.762	1.468	2.135	2.217	2.239	0.000	14.982
BB4: Dismounted Soldier Survivability Materials	-	2.991	2.828	3.023	-	3.023	3.095	3.092	3.093	3.092	0.000	21.214
BB5: Physical Augmentation: Tech for Human Interactions	-	1.451	1.332	0.574	-	0.574	1.188	1.199	1.200	1.199	0.000	8.143
BB7: Exoskeleton: Technology for Man-Machine Interface	-	1.541	-	-	-	-	-	-	-	-	0.000	1.541
BB9: Human Performance Tech for Mobility & Lethality	-	2.997	2.947	-	-	-	-	-	-	-	0.000	5.944
BC2: Next Gen Mobility & Lethality Tech for Warfighters	-	7.245	7.704	4.333	-	4.333	4.432	7.159	6.371	6.109	0.000	43.353
BC3: Soldier Decision Making & Comms Performance Tech	-	4.375	-	-	-	-	-	-	-	-	0.000	4.375
BC6: Human Perf - Tech for Warfighter Enhancement	-	2.918	3.334	1.377	-	1.377	1.342	3.088	3.651	3.880	0.000	19.590
BC7: Training Technology (Other than STE)	-	13.651	14.244	25.247	-	25.247	33.673	33.208	29.601	22.246	0.000	171.870
BD1: Adv Soldier Sensors/ Displays Tech for Dismounts	-	11.100	11.651	16.229	-	16.229	16.484	16.472	16.469	16.465	0.000	104.870

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022			
Appropriation/Budget Activity					R-1 Program Element (Number/Name)								
2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					PE 0602143A / Soldier Lethality Technology								
BD6: Soldier Sys Interfaces/ Integration- Sensor Tech	-	1.084	0.513	0.237	-	0.237	-	-	-	-	0.000	1.834	
BD8: Soldier & Sm Unit Tactical Energy Tech	-	9.043	4.467	6.291	-	6.291	6.881	7.408	7.386	6.864	0.000	48.340	
BE3: Joint Service Combat Feeding Technology	-	4.109	4.024	4.627	-	4.627	4.698	4.692	4.934	4.933	0.000	32.017	
BE6: Reactive/Resp Surfaces & Mats-Soldiers & Sys	-	6.215	2.944	-	-	-	-	-	-	-	0.000	9.159	
BE8: Synthetic Training Environment (STE) Technology	-	13.649	14.708	5.902	-	5.902	5.474	5.251	0.843	0.843	0.000	46.670	
BP9: Soldier Lethality Technologies (CA)	-	79.000	100.000	-	-	-	-	-	-	-	0.000	179.000	
BR9: Personnel & Airdrop Safety Technology	-	3.601	3.476	3.412	-	3.412	3.078	3.074	3.711	3.710	0.000	24.062	

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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 0602143A / <i>Soldier Lethality Technology</i>
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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).

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	201.750	105.168	0.000	-	0.000
Current President's Budget	201.511	205.058	103.839	-	103.839
Total Adjustments	-0.239	99.890	103.839	-	103.839
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	100.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.239	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	103.839	-	103.839
• FFRDC Transfer	-	-0.110	-	-	-

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 - Rapidly Deployable Shelters*
- Congressional Add: *Program increase - UTDD Catalyst*
- Congressional Add: *Program increase - Lightweight Body Armor Mechanisms and Materials*
- Congressional Add: *Program increase - Advanced Textile-Based Products*
- Congressional Add: *Program increase - HEROES Program*
- Congressional Add: *Program increase - Soldier Ballistic Technologies*

	FY 2021	FY 2022
	8.000	8.000
	10.000	10.000
	3.000	-
	5.000	-
	10.000	-
	6.000	-
	5.000	5.000
	5.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 0602143A / <i>Soldier Lethality Technology</i>
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<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>	FY 2021	FY 2022
Congressional Add: <i>Program increase - Medical Simulation and Training</i>	4.000	-
Congressional Add: <i>Program increase - Body Armor Study</i>	4.000	-
Congressional Add: <i>Program increase - Academic Accelerator Pilot Program</i>	15.000	15.000
Congressional Add: <i>Program increase - Advanced Ballistics Technology for Personal Protective Systems</i>	4.000	-
Congressional Add: <i>Advanced Silicon Anode Material for Batteries</i>	-	10.000
Congressional Add: <i>Advanced Textiles and Shelters</i>	-	6.000
Congressional Add: <i>Catalyst Traca Data Ready</i>	-	5.000
Congressional Add: <i>Digital Night Vision Technology</i>	-	5.000
Congressional Add: <i>Enhancing Soldier Ballistic Technologies</i>	-	5.000
Congressional Add: <i>Materials Development for Personal Protective Systems</i>	-	10.000
Congressional Add: <i>Military Footwear Research</i>	-	3.000
Congressional Add: <i>Nanolayered Polymer Optics</i>	-	10.000
Congressional Add: <i>Pathfinder Translational Research Advanced Capability Acceleration</i>	-	8.000
Congressional Add Subtotals for Project: BP9	79.000	100.000
Congressional Add Totals for all Projects	79.000	100.000

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AY6: <i>Soldier Squad Small Arms Armaments Technology</i>	-	13.122	8.825	10.897	-	10.897	10.098	13.670	16.239	16.235	0.000	89.086

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 2021	FY 2022	FY 2023
Title: Soldier/Squad Lethality Technology	4.103	3.880	4.743
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 2022 Plans: Will design the basic theory for dispersion to reduce the dispersion complex lethal mechanisms required by next generation individual and precision (sniper) weapons; investigate advanced experimental capabilities to reduce the time and significantly increase the capacity of free flight spark ranges; investigate the potential capability for medium and heavy weapons that offer significant improvements in size, weight (reductions), and lethality (classified) performance; continue pursuing incapacitation potential of advanced high powered microwave and acoustic directed energy technologies in small and large animal models using new experimental facilities for determining underlying theory of these technologies.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports additional research into system demonstrators for medium and heavy weapons concepts.</p>				
<p>Title: Human-Agent Interactions for Intelligent Squad Weapons</p> <p>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.</p>		3.713	-	-
<p>Title: Next Generation Family of Ammo (NGFoA)</p> <p>Description: This effort designs and develops a family of ammunition for automatic rifles and carbine weapons with the objective of decreasing weight, increasing lethality and hit performance over current fielded systems; develops capabilities to defeat threat targets at extended ranges.</p>		1.677	-	-
<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 2022 Plans: Will Investigate and conduct experiments on remote armaments for precision, volume, and counter defilade fires; augmentation technologies for increased weapon system/man-in-the loop performance; non-line of sight, three-dimensional battlefield target sensing and reconstruction; and technologies that reduce small arms weapon maintenance. Will investigate component technologies for future small arms concepts to enable a more efficient, effective, and lethal Joint Warfighter.</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,</p>		3.629	4.623	6.154

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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.				
FY 2022 to FY 2023 Increase/Decrease Statement: The increase provides for investigation and experiments for the Dismounted Soldier advances in denied and austere environments in the areas of Next Generation Squad Weapons (NGSW) supporting component technologies, passive technologies to reduce weapon system signature, and leverage and integrate emerging AI technology to weapon enablers.				
Title: FY2022 SBIR/STTR Transfer		-	0.322	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		13.122	8.825	10.897
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AY8: <i>Small Arms Fire Control Technology</i>	-	1.828	4.172	2.170	-	2.170	-	-	-	-	0.000	8.170

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.

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.

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

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

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

	FY 2021	FY 2022	FY 2023
Title: Adv. Fire Control Tech	1.828	4.019	2.170
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.			
FY 2022 Plans: Will investigate and validate mature technology development work for enhanced dismounted combatant/non-combatant automated target recognition algorithms; design improved decision aides for small arms maneuver; validate technical approaches through modeling and simulation; conduct investigations into the ability to recognize threats based on behavior.			
FY 2023 Plans: Will 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.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Funding decrease represents planned lifecycle change for this effort as Fiscal Year 2023 (FY23) is the last year of funding.			
Title: FY2022 SBIR/STTR Transfer	-	0.153	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.828	4.172	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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AZ2: Body Armor & Integrated Headborne Technology</i>	-	6.575	6.649	6.617	-	6.617	6.693	5.763	5.765	5.763	0.000	43.825

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 2021	FY 2022	FY 2023
Title: Body Armor & Integrated Headborne Technology	6.575	6.406	6.617
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 2022 Plans: Will investigate the application of single lens technology with variable light transmission and active and passive anti-fog mitigation approaches from single curve substrates to complex curves shapes for incorporation into future head mounted displays and eye protection; execute concept exploration efforts to study alternative headborne protection concepts from blast overpressure threats utilizing the advanced blast simulator to systematically study headborne equipment in a controlled blast environment; conduct experiments to systematically study emerging high performance materials, associated processing conditions to include layups, consolidation methods, temperature and pressure consolidation conditions with the objective of increasing protection against future small arms threat requirements.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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; will investigate rigid fiber reinforcement composite architectures for improving ballistic performance against small arms threats.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.243	-
Accomplishments/Planned Programs Subtotals		6.575	6.649	6.617
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AZ5: Soldier Protection Technology - Vulnerability</i>	-	11.738	9.357	11.141	-	11.141	11.320	11.310	11.313	11.310	0.000	77.489

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 2021	FY 2022	FY 2023
Title: Soldier Protection Technologies	3.700	3.507	3.981
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 2022 Plans: Will validate armor mechanisms to protect dismounted Soldiers from advanced ballistic threats through experimental and computational analysis; conduct simulations and analyze results for active armor concepts across anthropometric spectrum (e.g.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
body measurements and proportions such as height and weight); explore helmet material designs to improve protection against ballistic impacts and blast exposure while reducing helmet weight FY 2023 Plans: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Soldier-Borne Composite Materials 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. FY 2022 Plans: Will assess improved material composite backers and helmet shells that utilize computational geometry and layering, improved fibers and films, and novel manufacturing methods such as pressure processing and fiber placement. FY 2023 Plans: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		2.311	2.626	2.881
Title: Soldier-Borne Advanced Protection Materials 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/		2.730	2.883	4.279

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>protection schemes for the individual Warfighter. This effort supports Soldier Protection Technologies bullet and small caliber lethal mechanisms research in PE 0602143A (Soldier Lethality Technology) / Project AY6 (Soldier Squad Small Arms Armaments Technology),</p> <p>FY 2022 Plans: Will explore computational methods to capture failure mechanisms in different material architectures, allowing pathways for future rifle projectile defeat materials development; investigate alternative processing methodologies for multi-scale architecture that provide higher resolution, broader geometric flexibility, or tailored interfaces, and explore novel ceramic blends and ceramic structures for improved ballistic performance at reduced weight; design high throughput modeling and experimental methodologies to accelerate correlations between material structure, properties, and processing with ballistic performance.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports additional research into the lightweight and dynamic materials for camo and concealment.</p>				
<p>Title: Multifunctional Soldier Materials - Soldier Augmentation</p> <p>Description: This effort researches novel multifunctional Soldier protection materials and associated processing science aimed at enabling critical Army applications in survivability via Soldier augmentation technologies. Research efforts include: multifunctional fibers, films, and coatings; adaptive and responsive materials for passive biomechanical assistance; materials for sensing body forces and kinematics; materials for high power and high speed actuation; actuator fibers and textiles; functionally graded materials; and color-changing materials.</p>		2.997	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>		-	0.341	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		11.738	9.357	11.141
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AZ9: Soldier Protection Advanced Tech - Detectability</i>	-	3.278	1.883	1.762	-	1.762	1.468	2.135	2.217	2.239	0.000	14.982

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 2021	FY 2022	FY 2023
Title: Camouflage, Concealment and Decoys Technologies for Soldier and High-Value Assets	3.278	1.815	1.762
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 2022 Plans: Will conduct systematic studies of fiber processing, additives, coatings and complex geometries to assess new techniques that enable heat transfer and emission control of Soldier thermal signatures against near peer and peer sensor threats operating in the electromagnetic spectrum; investigate virtual reality based methods to assess operational impact of camouflage effectiveness against direct line of sight small arms engagement scenarios and developing advanced (lifelike) Soldier camouflage avatars;			

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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) AZ9 / <i>Soldier Protection Advanced Tech - Detectability</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>continue to design and mature components of active color changing materials assessing film based materials incorporating recent advancements in electrowetting, electrodesposition, and plasmonics, for future integration into Soldier clothing and individual equipment.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.068	-
Accomplishments/Planned Programs Subtotals	3.278	1.883	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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BB4: <i>Dismounted Soldier Survivability Materials</i>	-	2.991	2.828	3.023	-	3.023	3.095	3.092	3.093	3.092	0.000	21.214

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)

	FY 2021	FY 2022	FY 2023
Title: Dismounted Soldier Survivability Materials	2.991	2.725	3.023
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			
FY 2022 Plans: Will explore the incorporation of additional dimensions to fabric structures by researching approaches to take fibers and fabrics from traditional two-dimensional substrates to a third dimension, adding functionality within the substrate, to include stimuli-responsive fibers and yarns for real-time situational awareness, physiological monitoring, and environmental protection; investigate non-traditional procedures and techniques using additive approaches to tailor multi-functionality of Soldier personnel			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>protective equipment at very small length scales and incorporate the results of prior year?s multi-functional and e-textile findings; in support of developing personal water filtration capabilities to enable Soldiers to filter and hydrate from contaminated water sources, conduct experiments of leading candidate sophisticated breadboard hardware, capable of separating salt and other contaminants from brackish and salt water sources; investigate the potential of handheld or embedded sensing concepts to provide continuous monitoring of water quality, before and after treatment.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.103	-
Accomplishments/Planned Programs Subtotals	2.991	2.828	3.023

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BB5: <i>Physical Augmentation: Tech for Human Interactions</i>	-	1.451	1.332	0.574	-	0.574	1.188	1.199	1.200	1.199	0.000	8.143

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).

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

	FY 2021	FY 2022	FY 2023
Title: Training Adaptation and Movement Science	1.451	1.283	0.574

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<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 2022 Plans: Will refine and modify training interventions for more complex, potentially multi-joint devices that may require novel or adjusted training interventions to optimize physical interactions between the Soldier and augmentation systems; improve robustness of smart control systems for characterizing movement and predicting movement intent, and will evaluate in varied environments; expand experiments to include additional Soldier loads, grades, and speeds, that manipulate control parameters of augmentation systems to determine optimal control settings for additional Soldier tasks (e.g., loaded walking, running) and to account for individual variability.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects realignment to support higher priority efforts in PE 0602184A (Soldier Applied Research) / CO2 (Soldier-Intelligent Technology Research).</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.049	-
Accomplishments/Planned Programs Subtotals	1.451	1.332	0.574

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BB7 / <i>Exoskeleton: Technology for Man-Machine Interface</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BB7: Exoskeleton: Technology for Man-Machine Interface</i>	-	1.541	-	-	-	-	-	-	-	-	0.000	1.541

A. Mission Description and Budget Item Justification

This Project conducts applied research on metrics, measures, tools, and techniques to understand the relationships which 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 allows the Soldier and systems to jointly achieve maximum performance. Major efforts explore novel techniques for Soldier assessment, characterization of individual variability effects on performance, and development of evidence based design guidance for the application of augmentation technologies 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, establish database of human movement variability to inform intelligent system design, and identify high impact applications of augmentation.

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 2021	FY 2022	FY 2023
Title: Exoskeleton	1.541	-	-
Description: This effort will accelerate Soldier lifting and mobility capabilities through applied research on exoskeleton systems with improved safety and reduced training requirements.			
Accomplishments/Planned Programs Subtotals	1.541	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BB9: Human Performance Tech for Mobility & Lethality</i>	-	2.997	2.947	-	-	-	-	-	-	-	0.000	5.944

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 2021	FY 2022	FY 2023
Title: Human Interaction for Situational Understanding	2.997	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.			
FY 2022 Plans: Will conduct experiments to determine the best approaches for visually cueing Soldiers for rapid target acquisition via augmented reality displays; continue to investigate the impact of mixed reality design parameters (e.g., graphical level of detail, uncertainty, degraded network conditions, focal depth) in ambulatory settings on decision-making, situational awareness, and navigation (including subterranean environments). This work will transition for further maturation and demonstration to a variety of partners including the United States Army Training and Doctrine Command (TRADOC) Mobile (for schoolhouse distribution), the Combat			

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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) BB9 / <i>Human Performance Tech for Mobility & Lethality</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Capabilities Development Command (CCDC) Armaments Center, CCDC Command, Control, Computers, Communications, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) Center, the Synthetic Training Environment-CFT, and the Integrated Visual Augmentation System (IVAS).</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflective of planned task ending in FY2022 upon the conclusion of the OSD Measuring and Advancing Soldier Tactical Readiness and Effective (MASTR-E) Science and Technology program funding increase in FY2022.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.108	-
Accomplishments/Planned Programs Subtotals		2.997	2.947	-
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BC2: <i>Next Gen Mobility & Lethality Tech for Warfighters</i>	-	7.245	7.704	4.333	-	4.333	4.432	7.159	6.371	6.109	0.000	43.353

A. Mission Description and Budget Item Justification

This Project investigates the means to monitor, assess and predict Soldier and squad shoot and move performance to provide design guidance for individual and mission specific equipment (e.g., individual protection, small arms, load carriage, etc.). Research conducted focuses on translating mission tasks to measures of human performance. These measures of human performance will inform predictive algorithms and human based modeling and simulation 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.

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 leverages PE 0603118A (Soldier Lethality Advanced Technology) / Project AY9 (Body Armor & Integrated Headborne Advanced Tech), Project AY5 (Soldier Squad Small Arms Armaments Advanced Technology), Project BD7 (Soldier Sys Interfaces/Integration-Sensor AdvTech), and Project BB6 (Physical Augmentation: Adv Tech for Field Demo).

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)

	FY 2021	FY 2022	FY 2023
Title: Human Interaction for Mobility & Lethality	7.245	7.422	4.333
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.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>FY 2022 Plans: Will design processing pipeline to prepare data for analysis and interpretation; validate innovative wearable sensors for maturity of the technology and evaluate dimensionality reduction techniques; validate predictive algorithms for monitoring and assessment of situational awareness, cognitive state and decision-making during critical Soldier tasks to provide the means for Soldier and Squad assessment for both training and test & evaluation purposes; refine predictive measures for Soldier shoot, move, communicate, navigate, and decide tasks during conditions of physical and cognitive stress in future operating scenarios; through machine learning, develop performance algorithms and a predictive squad performance model for validation in a relevant environment; develop additional head supported mass requirements based on Soldier task performance, design guidance for maxillofacial protection, and guidance for the design of headborne displays that enables cognitive/perceptual performance, including decision making and situation awareness</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects the conclusion of Office of the Secretary of Defense (OSD) Measuring and Advancing Soldier Tactical Readiness and Effective (MASTR-E) Science and Technology program funding increase in Fiscal Year 2022 (FY22). Funding also reflects a shift from PE 0602143A (Soldier Lethality Technology) /AZ2 (Body Armor & Integrated Headborne Technology), PE 0630118A (Soldier Lethality Advanced Technology) / BC1 (Human Performance Adv Tech for Mobility & Lethality), BD7 (Soldier Sys Interfaces Integration-Sensor Adv Tech), and BD9 (Soldier & Sm Unit Tactical Energy Adv Tech) to focus on the gaps discovered during the OSD plus up of the MASTR-E program.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	0.282	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	7.245	7.704	4.333

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>				Project (Number/Name) BC3 / <i>Soldier Decision Making & Comms Performance Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BC3: <i>Soldier Decision Making & Comms Performance Tech</i>	-	4.375	-	-	-	-	-	-	-	-	0.000	4.375

A. Mission Description and Budget Item Justification

This Project conducts applied research to create analytical and empirical capabilities to characterize, model, and forecast human behavior related to cyber electromagnetic events through experimentation and field data collection. The result is increased mission effectiveness that enables strong mission command, intelligence operations, and cyber defenses, which lead to high information sharing, situational awareness, and collaboration. Major efforts focus on applied research to understand the conduct of effective cyber electromagnetic operations in that knowledge is required to create and effectively deploy cyber work systems that optimize human-machine interactions and account for operator and adversary behavior to achieve maximum effects.

Results of these efforts are provided to Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Program Managers, Human Systems Integration (HSI) Directorate (Army G1), and the Army Test and Evaluation Command (ATEC).

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 2021	FY 2022	FY 2023
<p>Title: Soldier Performance in Sociotechnical Environments</p> <p>Description: This research provides human cyber operations assessment and advanced human decision-support capabilities to deploy cyber work systems that optimize human-machine interactions and account for operator and adversary behavior. Without these capabilities, future cyber work systems will be too complex and burdensome for operator use and training resulting in critical bottlenecks as operators have to ?catch-up? with the speed of cyber activity. This research also supports technologies for Squad-level SA 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.</p>	2.926	-	-
<p>Title: Algorithms for Sensing Soldier in Mission Context</p> <p>Description: This effort investigates enhanced decision making under conditions of uncertain, complex, time sensitive, and dynamically changing information to optimize human-artificial intelligence (AI) shared situational understanding. Enhances</p>	1.449	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602143A / <i>Soldier Lethality Technology</i>	Project (Number/Name) BC3 / <i>Soldier Decision Making & Comms Performance Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
operational performance of individuals and teams of Soldiers through novel visualization technologies that represent complex time-sensitive information in uncertain dynamic environments.			
Accomplishments/Planned Programs Subtotals	4.375	-	-

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BC6: <i>Human Perf - Tech for Warfighter Enhancement</i>	-	2.918	3.334	1.377	-	1.377	1.342	3.088	3.651	3.880	0.000	19.590

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), PE 0603118A (Soldier Lethality Advanced Technology) / BD7 (Soldier Sys Interfaces/Integration-Sensor AdvTech), 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 2021	FY 2022	FY 2023
Title: Human Performance Technology for Warfighter Enhancement	2.918	3.212	1.377
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, 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.			
FY 2022 Plans:			

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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) BC6 / <i>Human Perf - Tech for Warfighter Enhancement</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Will design beta neurostimulation trade space tool and continue experiments to investigate for whom, when, and how neurostimulation is effective for improving tactically relevant skill acquisition and performance; conduct experiments and collect data to quantify the impact of neurostimulation on measures of small arms kill chain performance including threat detection, classification, and marksmanship; investigate biomarkers from the gut microbiome related to Soldier performance outcomes; conduct experiments to characterize candidate probiotic interventions to augment Soldier performance and recovery in stressful operational environments.</p> <p>FY 2023 Plans: Will 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. Will 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>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change results in a reduction of iterative testing and validation of the meta-regression model with COTs neurostimulation devices (from 5 to 2 iterations), a reduction of GI-jA2COB experiments/iterations and biomarker discovery experiments as related to Soldier performance will be de-scoped.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.122	-
Accomplishments/Planned Programs Subtotals	2.918	3.334	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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BC7: <i>Training Technology (Other than STE)</i>	-	13.651	14.244	25.247	-	25.247	33.673	33.208	29.601	22.246	0.000	171.870

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 2021	FY 2022	FY 2023
Title: Medical Training Technology	3.190	3.511	3.225
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 2022 Plans: Will design automated, multi-sensor, computer vision and artificial intelligence (AI)-based medical grading and mentoring capabilities; determine if direct brain measures can be correlated to medical knowledge transfer; investigate additive manufacturing capabilities to create soft and hard tissues based on human anatomic measures; determine smart medical device			

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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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>surrogates for training on dumb patient manikins; investigate the usability of hyper fidelity haptic delivery in mixed and virtual medical training environments.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</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 2022 Plans: Will investigate visual abstraction techniques to portray objects in resource constrained (low bandwidth, reduced computing power) virtual environments without a loss in training effectiveness; design a common framework allowing collaboration across multiple disciplines to design virtual human appearances and behaviors to create interactive artificially intelligent characters for training.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from another task within this Project (Innovative Training Technology) reflecting a shift in research focus from the near term development of the Synthetic Training Environment (STE) capabilities to longer term research supporting training of multi-domain operations.</p>		1.272	3.731	7.252
Title: Cyberspace Electromagnetic Activities (CEMA) Effects Modeling and Simulation		1.464	1.418	-

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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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: This effort investigates and develops capabilities to more accurately model and simulate CEMA necessary to support training events for Corps and below.</p> <p>FY 2022 Plans: Will investigate the training fidelity of cloud-based network simulation services to support collective Army cyber training events; design and develop software to tag information on simulated networks to enable training Information Warfare techniques relevant to the conduct of Multi-Domain Operations (MDO); investigate techniques to validate collective training measurement methods for CEMA training assessments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects planned lifecycle of this effort to progress into advanced technology development under the Synthetic Cyberspace Effects for Training task in PE 0603118A (Soldier Lethality Advanced Technology) / BC8 (Training Advanced Technology (Other than STE)).</p>			
<p>Title: Innovative Synthetic Training Technology</p> <p>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.</p> <p>FY 2022 Plans: Will investigate reinforcement learning techniques using neural networks to create artificially intelligent entities in synthetic, virtual training environments to simulate complex military training behaviors; investigate the use of photogrammetric techniques to create photorealistic 3D synthetic terrains for the use in virtual and augmented reality training applications; investigate using advanced virtual humans using sensory feedback, natural language, and cognitive architectures to create simulated social engagements focused on leader development; design a simulation environment to accelerate the design and assessment of emerging simulation technologies using artificial intelligence.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to another task within this Project (Warfighting M/S Concepts and Design) reflecting a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations through the application of artificial intelligence.</p>	5.507	2.885	-
<p>Title: STE Live Training</p>	2.218	2.179	-

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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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will investigate state-of-the-art sensor technologies to establish a baseline sensor suite with acceptable size, weight, power and performance characteristics; design capability to simulate tactical engagements using high fidelity micro terrain; design and develop algorithms to simulate ballistic fly-out of various infantry munitions to determine validity of geo-pairing solution in a virtual environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>			
<p>Title: Digital Terrain for Live Training</p> <p>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.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>	-	-	5.679
<p>Title: Simulation Management Technologies</p> <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>	-	-	3.502

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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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p><i>FY 2023 Plans:</i> Will 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><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding change reflects a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>			
<p><i>Title:</i> Multi-Domain Environments for Training</p> <p><i>Description:</i> 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><i>FY 2023 Plans:</i> Will 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><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding change reflects a shift in research focus from the near term development of the Synthetic Training Environment (STE) capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>	-	-	5.589
<p><i>Title:</i> FY2022 SBIR/STTR Transfer</p> <p><i>Description:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638</p>	-	0.520	-
Accomplishments/Planned Programs Subtotals	13.651	14.244	25.247

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BD1: <i>Adv Soldier Sensors/Displays Tech for Dismounts</i>	-	11.100	11.651	16.229	-	16.229	16.484	16.472	16.469	16.465	0.000	104.870

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 2021	FY 2022	FY 2023
Title: Advanced Soldier Sensors/Displays Technology for Dismounts	11.100	11.226	16.229
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 2022 Plans: Will conduct experiments with mixed reality (MR) applications to validate sensor system target performance; investigate atmospheric simulation techniques to improve the generation of images in the visible and infrared spectrums; examine tools that support image generation from a synthetic low light level sensor to enable data augmentation and virtual prototyping efforts; design high quantum efficiency (QE) low light level focal plane arrays; determine dark current and system noise reduction techniques to improve the sensitivity for low light level sensor performance under starlight; investigate digital readout integrated circuits (ROICs) with the Application Specific Integrated Chips (ASIC) and processing approaches to enable dynamically binned readouts for high resolution, high definition imagery in light conditions, and improved sensitivity in dark conditions; investigate			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>frame rate throttling of sensors to adapt to environmental and usage conditions including low-light to avoid degradation of situational awareness.</p> <p>FY 2023 Plans: Will investigate new mixed and augmented reality (MR/AR) component technologies to enhance multi sensor and multi system simulation capabilities; will 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 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 2022 to FY 2023 Increase/Decrease Statement: Funding increase represents the development of needed hardware componentry to enable the next generation of dismounted Soldier sensors.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.425	-
Accomplishments/Planned Programs Subtotals	11.100	11.651	16.229

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BD6: <i>Soldier Sys Interfaces/Integration- Sensor Tech</i>	-	1.084	0.513	0.237	-	0.237	-	-	-	-	0.000	1.834

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 2021	FY 2022	FY 2023
Title: Soldier System Interfaces & Integration (Sensor Technology)	1.084	0.495	0.237
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 2022 Plans:			
Will investigate, design, and develop autonomous navigation algorithms (e.g. collaborative autonomy, dynamic retasking and task decomposition), to enhance the movement and maneuver of dismounted Small Unmanned Aerial Systems (SUAS); investigate, design, and develop algorithms to enable perch and stare and precision landing capabilities for SUAS to enable extended operations; investigate, design, and develop target pose estimation and advanced motion planning algorithms to enhance autonomous search capability for resource constrained SUAS; investigate, design, and develop multi-agent teaming algorithms and associated user interfaces to enable collaboration between Platoon and Squad level autonomous systems;			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
validate functionality of algorithms on open architecture SUAS platforms in laboratory and simulated environment to reduce risk and improve system design. <i>FY 2023 Plans:</i> Will 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. <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.				
<i>Title:</i> FY2022 SBIR/STTR Transfer <i>Description:</i> Funding transferred in accordance with Title 15 USC ?638 <i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638 <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638		-	0.018	-
Accomplishments/Planned Programs Subtotals		1.084	0.513	0.237
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BD8: <i>Soldier & Sm Unit Tactical Energy Tech</i>	-	9.043	4.467	6.291	-	6.291	6.881	7.408	7.386	6.864	0.000	48.340

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 2021	FY 2022	FY 2023
Title: Tactical Power for Soldier Lethality	3.695	3.427	5.341
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 2022 Plans:			
Research High Voltage Electrolyte (HiVE) and innovative high power density cathode materials; investigate pairing these research materials with Silicon and Li-Metal anode technologies to validate the functionality of the Technology Readiness Level 4 material developments in a laboratory environment, which will enable greater material energy densities from 400-600 WH/Kg for longer runtimes, in distributed operations, with limited resupply; conduct experiments to quantify power trade space and requirements analysis that will enable development of high energy density materials for longer runtime durations for Soldier Tactical Power, Robotics, and Swarming unmanned aircraft systems (UAS) or other priorities identified by the Soldier Lethality Cross Functional			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Team (CFT); investigate power generation technologies to provide autonomous, on-the-move recharging through power management and distribution for critical Soldier Lethality applications and enable extended duration missions.</p> <p>FY 2023 Plans: Will down-select, design, and develop safe, high voltage electrolyte materials and will 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. Will 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 Soldier Tactical Power, Robotics, and other critical Soldier Lethality applications for 7 day semi-autonomous operations with limited resupply.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding in this effort was realigned from PE 0603118A (Soldier Lethality Advanced Technology) / Project BC9 (Adv Soldier Sensors/Displays AdvTech for Dismounts) and will be used to down select 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 2022 Plans: Will design, develop, and validate conceptual device that couples multifuel, excess enthalpy reactors with solid state thermal energy conversion for portable power generation; explore microchannel and porous media surface composition and thermal designs to vaporize liquid fuels while minimizing carbon deposits on microchannel walls and pressure drop; investigate fabrication and integration methods that enhance cavity design flexibility including packaging for vacuum or thermally insulating sealed cavities between microreactors, spectral control elements, and photovoltaic cells to enable high view factors, providing lower energy losses across the small gaps in the cavity, and low thermal loss when scaling for compact, thin profiles for wearable power sources</p> <p>FY 2023 Plans: Will 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</p>		5.348	0.877	0.950

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.163	-
Accomplishments/Planned Programs Subtotals		9.043	4.467	6.291
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BE3: <i>Joint Service Combat Feeding Technology</i>	-	4.109	4.024	4.627	-	4.627	4.698	4.692	4.934	4.933	0.000	32.017

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 2021	FY 2022	FY 2023
Title: Joint Service Combat Feeding Technology	4.109	3.877	4.627
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 2022 Plans: Will validate effects of high fat intake on physical performance to ensure optimal nutrient profiles in weight reduced rations; determine effects of nutritional factors on intestinal function, investigate feasibility of developing a three-dimensional (3D) intestinal tissue model to identify effects of nutritional interventions and bioactives on immune function and gastrointestinal health and investigate effect of nutrient compounds on circulating biomarkers and immune function to prevent performance decrements in deployed troops; determine correlations between lipid oxidation analysis techniques and sensory results to improve monitoring			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>ability in ration components and ensure optimized nutrition; investigate individual warfighter hydration methods to decrease logistical burdens in multi-domain operations and investigate augmented reality technologies to enable food safety inspections in austere environments</p> <p>FY 2023 Plans: Will 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; 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 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0603118A (Soldier Lethality Advanced Technology) / BE2 (Joint Service Combat Feeding Advanced Technology). Funding increase in Fiscal Year 2023 (FY)23 will enable additional development efforts to increase performance, decrease food-borne illness, and increase overall readiness of the Warfighter.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.147	-
Accomplishments/Planned Programs Subtotals		4.109	4.024	4.627
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BE6: Reactive/Resp Surfaces & Matls-Soldiers & Sys</i>	-	6.215	2.944	-	-	-	-	-	-	-	0.000	9.159

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 2021	FY 2022	FY 2023
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	2.882	2.836	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>applications in Soldier performance, situational awareness, protection and sustainment. Research from this effort has potential to transition to multiple end items and applications.</p> <p>FY 2022 Plans: Will design strategies to integrate biological building blocks with sensor platforms; mature peptide-based building blocks for strength and selectivity of target interactions, and down select candidate peptide materials; validate models and use computational and experimental tools to investigate properties of novel molecules for improved adhesion and structural stability of composites; build characterization and computation tools for rapid prototyping of biomaterials; down-select targets and use computational and analytical tools to validate models of accelerated degradation of high value targets; explore biological engineering strategy to counter material degradation.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding administratively realigned to PE 0602184A (Soldier Applied Resaerch) / CW9 (Syn Bio for Reactive-Responsive Matls-Soldiers & Sys) in FY 2023.</p>				
<p>Title: Scalable and On-Demand Production of Novel Molecules</p> <p>Description: This effort conducts applied research through the investigation of new methods to produce novel biological molecules. Typical customized molecule production is extremely expensive and difficult to achieve. Investment in synthetic biomanufacturing techniques will further the applicability and widespread use of novel molecules to further Warfighter performance.</p>		3.333	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.108	-
Accomplishments/Planned Programs Subtotals		6.215	2.944	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BE8: <i>Synthetic Training Environment (STE) Technology</i>	-	13.649	14.708	5.902	-	5.902	5.474	5.251	0.843	0.843	0.000	46.670

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)

	FY 2021	FY 2022	FY 2023
Title: STE One World Terrain	5.832	5.339	3.848
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.			
FY 2022 Plans: Will investigate tools, algorithms and communities of practice to develop automated complex terrain features for Dense Urban Environments and determine level of attribution required to extend OWT data model support for dynamic and cascading effects (e.g., transportation tunnels, civilian infrastructure); investigate and determine OWT data model compliant metadata (e.g.,			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>geometry, attributes) towards enriching OWT three-dimensional (3D) terrain mesh generation; design terrain correlated material maps with textures to advance simulation sensor implementations and enable physics-based calculation for terrain modification.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</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 2022 Plans: Will validate techniques for automating team performance assessments and actionable automated after action review (AAR) feedback to teams, leaders, and instructors; continue design of adaptive, intelligent tutor for teaming to maximize training outcomes at the point of need; investigate team tutor technologies to assess team training measures and effectiveness; determine reinforcement learning-based planning models to deliver run-time feedback to teams during simulation-based training; investigate team intelligent tutoring based on roles and functions within the team to assess the overall team readiness level; design team communication analysis toolkit using natural language processing and deep learning neural networks to analyze and assess team communications during simulated training exercises; investigate team performance assessments for the instructors using artificial intelligence models to determine an evaluation of a team's performance and recommendations to optimize training toward an acceptable readiness level; investigate the association between squad level performance measures for individuals and teams and determine how to best deliver data to assess their performance.</p> <p>FY 2023 Plans: Will 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</p>		5.269	4.805	2.054

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects a shift in research focus from the near-term development of the STE` capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>				
<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 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.</p> <p>FY 2022 Plans: Will investigate application of Artificial Intelligence (AI) techniques to enable autonomous squad-level interactions between friendly forces, non-combatants, and enemy threats in support of squad battle drills; will design methods to connect Operational Environment (OE) models, data and algorithms with emerging AI techniques in order to automate generation of representative OE simulation for collective training; will investigate cross-cutting modeling capabilities required to enable Multi-Domain Operations and their effect on model interactions, such as the introduction of complex weather modeling, that could impact the ability to deliver collective training.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects a shift in research focus from the near term development of the STE capabilities to longer term research supporting training of multi-domain operations on complex, data-intensive battlefields.</p>		2.548	4.026	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>		-	0.538	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	13.649	14.708	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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BP9: <i>Soldier Lethality Technologies (CA)</i>	-	79.000	100.000	-	-	-	-	-	-	-	0.000	179.000

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 2021	FY 2022
Congressional Add: Program increase - Pathfinder Airborne FY 2021 Accomplishments: Conducted applied research in Pathfinder Airborne. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Pathfinder Airborne	8.000	8.000
Congressional Add: Program Increase - Pathfinder Air Assault FY 2021 Accomplishments: Conducted applied research in Pathfinder Air Assault. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Pathfinder Air Assault	10.000	10.000
Congressional Add: Program increase - Rapidly Deployable Shelters FY 2021 Accomplishments: Conducted applied research in Rapidly Deployable Shelters. Work executed by Army Futures Command.	3.000	-
Congressional Add: Program increase - UTDD Catalyst FY 2021 Accomplishments: Conducted applied research in UTDD Catalyst. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program increase - Lightweight Body Armor Mechanisms and Materials	10.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022	
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>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	
FY 2021 Accomplishments: Conducted applied research in Lightweight Body Armor Mechanisms and Materials. Work executed by Army Futures Command.			
Congressional Add: Program increase - Advanced Textile-Based Products FY 2021 Accomplishments: Conducted applied research in Advanced Textile-Based Products. Work executed by Army Futures Command.	6.000	-	
Congressional Add: Program increase - HEROES Program FY 2021 Accomplishments: Conducted applied research in HEROES Program. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for HEROES	5.000	5.000	
Congressional Add: Program increase - Soldier Ballistic Technologies FY 2021 Accomplishments: Conducted applied research in Soldier Ballistic Technologies. Work executed by Army Futures Command.	5.000	-	
Congressional Add: Program increase - Medical Simulation and Training FY 2021 Accomplishments: Conducted applied research in Medical Simulation and Training. Work executed by Army Futures Command.	4.000	-	
Congressional Add: Program increase - Body Armor Study FY 2021 Accomplishments: Conducted applied research in Body Armor Study. Work executed by Army Futures Command.	4.000	-	
Congressional Add: Program increase - Academic Accelerator Pilot Program FY 2021 Accomplishments: Conducted applied research in Academic Accelerator Pilot Program.	15.000	15.000	

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BP9 / <i>Soldier Lethality Technologies (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command.		
FY 2022 Plans: Congressional Interest Item funding provided for Academic Accelerator Program		
Congressional Add: Program increase - Advanced Ballistics Technology for Personal Protective Systems	4.000	-
FY 2021 Accomplishments: Conducted applied research in Advanced Ballistics Technology for Personal Protective Systems.		
Work executed by Army Futures Command.		
Congressional Add: Advanced Silicon Anode Material for Batteries	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for Advanced Silicon Anode Material for Batteries		
Congressional Add: Advanced Textiles and Shelters	-	6.000
FY 2022 Plans: Congressional Interest Item funding provided for Advanced Textiles and Shelters		
Congressional Add: Catalyst Traca Data Ready	-	5.000
FY 2022 Plans: Congressional Interest Item funding provided for Catalyst TRACA Data Ready		
Congressional Add: Digital Night Vision Technology	-	5.000
FY 2022 Plans: Congressional Interest Item funding provided for Digital Night Vision Technology		
Congressional Add: Enhancing Soldier Ballistic Technologies	-	5.000
FY 2022 Plans: Congressional Interest Item funding provided for Enhancing Soldier Ballistic Technologies		
Congressional Add: Materials Development for Personal Protective Systems	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for Materials Development for Personal Protective Systems		
Congressional Add: Military Footwear Research	-	3.000
FY 2022 Plans: Congressional Interest Item funding provided for Military Footwear Research		
Congressional Add: Nanolayered Polymer Optics	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for Nanolayered Polymer Optics		
Congressional Add: Pathfinder Translational Research Advanced Capability Acceleration	-	8.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BP9 / <i>Soldier Lethality Technologies (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Pathfinder Translational Research Advanced Capability Acceleration		
Congressional Adds Subtotals	79.000	100.000

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BR9: <i>Personnel & Airdrop Safety Technology</i>	-	3.601	3.476	3.412	-	3.412	3.078	3.074	3.711	3.710	0.000	24.062

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 2021	FY 2022	FY 2023
Title: Personnel & Airdrop Safety Technology	3.601	3.349	3.412
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 2022 Plans: Will mature high altitude personnel and cargo insertion technologies that facilitate extended offset insertions in GPS denied conditions; carry out research on high offset air insertion and resupply mission capability enhancements; perform research into sensor integration and fusion techniques to produce robust navigational datasets suitable for guidance, navigation and control			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>of autonomous systems in contested and challenging mission environments; determine feasibility of materiel and non-materiel solutions focused on reduction of airdrop platform signature.</p> <p>FY 2023 Plans: Will 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 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.127	-
Accomplishments/Planned Programs Subtotals	3.601	3.476	3.412

<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-2, RDT&E Budget Item Justification: PB 2023 Army											Date: April 2022	
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	159.358	216.550	52.848	-	52.848	59.131	60.164	67.137	62.911	0.000	678.099
BK7: Robotics for Engineer Operations Technology	-	5.700	1.228	1.802	-	1.802	6.431	5.693	3.724	2.074	0.000	26.652
BL1: Materials and Manufacturing Research Technology	-	11.783	9.374	4.257	-	4.257	4.302	4.295	7.035	7.033	0.000	48.079
BL2: Explosives Forensics Technology	-	1.514	1.582	1.673	-	1.673	1.699	1.713	1.713	1.713	0.000	11.607
BL5: Expedient Passive Protection Technology	-	1.413	1.906	4.348	-	4.348	2.944	3.096	4.755	4.129	0.000	22.591
BL7: Power Projection in A2AD Environments Technology	-	1.843	3.151	1.871	-	1.871	2.950	2.145	3.588	2.548	0.000	18.096
BL9: Protection from Advanced Weapon Effects Technology	-	3.596	4.344	5.062	-	5.062	5.188	4.995	4.778	5.471	0.000	33.434
BN8: Ground Technology Materials(CA)	-	131.000	160.150	-	-	-	-	-	-	-	0.000	291.150
CA9: Predictive Maintenance	-	2.509	-	-	-	-	-	-	-	-	0.000	2.509
CG5: Ground Vehicle Sensor Concepts and Technologies	-	-	4.146	-	-	-	-	-	-	-	0.000	4.146
CG6: Ground Vehicle Power and Energy Concepts and Tech	-	-	2.681	2.526	-	2.526	2.594	2.643	4.010	3.959	0.000	18.413
CG7: Ground Protection Concepts and Technologies	-	-	14.565	12.344	-	12.344	12.578	12.566	14.195	14.192	0.000	80.440
CG8: Human Autonomy Teaming	-	-	8.599	9.086	-	9.086	9.222	9.213	10.534	10.550	0.000	57.204
CI2: Ground Enabling University Applied Research	-	-	4.824	3.682	-	3.682	3.889	5.491	4.591	4.590	0.000	27.067

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022			
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>								
<i>CV3: Engineer Enablers Maneuver, LOG, & Sustainment Apl</i>	-	-	-	2.518	-	2.518	2.185	1.247	1.144	-	0.000	7.094	
<i>DA1: SAFR Alternatives for Readiness Applied Research</i>	-	-	-	3.679	-	3.679	5.149	6.028	6.030	5.613	0.000	26.499	
<i>DB7: Center for Mobile Power and Energy Apl Research*</i>	-	-	-	-	-	-	-	1.039	1.040	1.039	0.000	3.118	

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	158.158	56.400	0.000	-	0.000
Current President's Budget	159.358	216.550	52.848	-	52.848
Total Adjustments	1.200	160.150	52.848	-	52.848
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	160.150			
• Congressional Directed Transfers	-	-			
• Reprogrammings	1.200	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	52.848	-	52.848

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

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

Congressional Add: *Program increase: Ice Engineering Research Facility Modernization*

Congressional Add: *Program increase: Center for Research in Extreme Batteries*

Congressional Add: *Program increase: Cellulose Nanocomposites Research*

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

Congressional Add: *Program increase - Advanced Concrete*

Congressional Add: *Program increase - Robotic RTCH*

Congressional Add: *Program increase - Military Waste Stream Conversion*

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 - Materials Manufacturing Processes*

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

Congressional Add: *Program increase - Rapid Advanced Deposition*

	FY 2021	FY 2022
	5.000	-
	10.000	-
	5.000	-
	8.000	8.000
	4.000	-
	5.000	-
	5.000	-
	5.000	5.000
	5.000	5.000
	5.000	5.000
	10.000	10.000
	10.000	-
	10.000	5.000
	10.000	5.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
Congressional Add: <i>Program increase - Defense Resiliency Against Extreme Cold Weather</i>	10.000	10.000
Congressional Add: <i>Program increase - Counter UAS Technology Research</i>	5.000	-
Congressional Add: <i>Program increase - Cell-Free Expression for Biomanufacturing</i>	10.000	-
Congressional Add: <i>Program increase - Earthen Structures Soil Enhancement</i>	4.000	4.000
Congressional Add: <i>Advanced Manufacturing Materials Processes Initiative</i>	-	10.000
Congressional Add: <i>Advanced Materials Manufacturing</i>	-	8.000
Congressional Add: <i>Anti-Corrosion Materials</i>	-	7.000
Congressional Add: <i>Ceramic Materials for Extreme Environments</i>	-	8.000
Congressional Add: <i>Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research</i>	-	6.000
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>Rare Earth Initiative</i>	-	7.000
Congressional Add: <i>Solid Oxide Fuel Cell Development</i>	-	10.000
Congressional Add: <i>Tank Tracks</i>	-	3.150
Congressional Add: <i>Verified Inherent Control</i>	-	10.000
Congressional Add Subtotals for Project: BN8	131.000	160.150
Congressional Add Totals for all Projects	131.000	160.150

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK7: <i>Robotics for Engineer Operations Technology</i>	-	5.700	1.228	1.802	-	1.802	6.431	5.693	3.724	2.074	0.000	26.652

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.

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 conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

Work in this Project is related to, and fully coordinated with, PE 0603119A (Ground Advanced Technology) / Project BK8 (Robotics for Engineer Operations Adv Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Beyond-Visual-Line-of-Sight Teleoperated Engr Ops	5.700	1.183	-
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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Investigate operator assist capabilities and operator interface aids for remote tool control; refine components to the Engineer specific library for object classification, site localization technologies, and site change and manipulation monitoring. FY 2022 to FY 2023 Increase/Decrease Statement: This effort completes in Fiscal Year 2022 with transfer of applied technologies to PE 0603119A (Ground Advanced Technology) / Project BK8 (Robotics for Engineer Operations Adv Tech).				
Title: Semi-Autonomous Engineer Operations Description: This effort will investigate and develop machine tool behaviors to perform semi-autonomous shaping of the terrain through physical interaction with the environment (push, pull, lift, and dig). The effort will develop the necessary decision-making, data fusion, localization, and inter-platform communication to allow semi-autonomy on commercial off the shelf (COTS) equipment. FY 2023 Plans: Will investigate instrumenting individual motors and movement joints on the heavy Engineer equipment for machine feedback to planning algorithms; will develop the required sensor payload, onboard processing, and path planning and control algorithms on heavy Engineer equipment to enable semiautonomous navigation. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects the planned lifecycle for this Project to develop semi-autonomous standoff robotic capabilities for heavy Engineer equipment.		-	-	1.802
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.045	-
Accomplishments/Planned Programs Subtotals		5.700	1.228	1.802
C. Other Program Funding Summary (\$ in Millions) N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL1: <i>Materials and Manufacturing Research Technology</i>	-	11.783	9.374	4.257	-	4.257	4.302	4.295	7.035	7.033	0.000	48.079

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 2021	FY 2022	FY 2023
Title: Additive Manufacturing Research	5.240	8.162	3.354
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 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will mature a closed-loop AM process control experimental capability across a broad array of AM technologies by applying a set of in-situ process (or "within" process) monitoring techniques; design and develop an AM machine learning (ML) architecture for advancing real-time AM process controls by applying the following two deep ML frameworks: (1) convolutional neural networks (CNN) supervised deep learning framework for automatically detecting in-process defects and rapidly computing predictive models such as a structure-processing-property relations model; (2) generative adversarial networks (GANs) unsupervised deep learning framework for training the in-situ data sets and generating referenced data sets in real-time to compare them against in-situ process data for detecting AM process anomalies and for predicting the geometry-dependent optimized AM process parameters.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year (FY) 2023, funding is realigned to support the creation of Project CZ9 (Foundational Hypersonic Weapons Research) within PE 0602141A (Lethality Technology).</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 2022 Plans: Will investigate advanced electrolytes to improve safety in ultrahigh energy silicon nanostructured anodes for Soldier-carried batteries including the 3/5 form factor (standard military specification for battery size, with a length over width ratio of 3 to 5) Conformal Wearable Battery (CWB); investigate materials and additives to improving safety in high energy (400 Wh/kg Li-ion); investigate high energy halide intercalation cathodes for transition of metal-free rechargeable batteries (halide intercalation is the reversible inclusion or insertion of a metal hydride molecule or ion into materials with layered structures such as graphite).</p> <p>FY 2023 Plans: Will 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</p>		1.290	0.870	0.903

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Ballistic, Aero-Optics Materials (BAM) Testing Description: Develop a national level test facility employing controlled, characterized environmental conditions and novel technology for testing and evaluation of directed energy systems, aerothermodynamic performance at hypersonic speeds, and hyper velocity impacts.		5.253	-	-
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.342	-
Accomplishments/Planned Programs Subtotals		11.783	9.374	4.257
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL2: <i>Explosives Forensics Technology</i>	-	1.514	1.582	1.673	-	1.673	1.699	1.713	1.713	1.713	0.000	11.607

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 2021	FY 2022	FY 2023
Title: Forensic Analysis of Explosives Signatures Applied Research	1.514	1.524	1.673
Description: This effort investigates forensics analytical methods for military explosives, homemade explosives (HME), HME precursors, and residue analysis for attribution.			
FY 2022 Plans: Will continue to investigate new technologies (hyperspectral imaging, compressed sensing, augmentation of current technology) for development of advanced concepts and operations of forensic analytical techniques to facilitate chemical and explosive detection and reconnaissance.			
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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer	-	0.058	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.514	1.582	1.673

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL5: <i>Expedient Passive Protection Technology</i>	-	1.413	1.906	4.348	-	4.348	2.944	3.096	4.755	4.129	0.000	22.591

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.

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 conducted by the United States (US) Army Engineer Research and Development Center and coordinated with US Army Futures Command.

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

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

	FY 2021	FY 2022	FY 2023
Title: Protection Against High Trajectory Large Caliber Rocket and Missile Threats	1.413	1.836	-
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.			
FY 2022 Plans: Develop new materials and algorithms to protect critical assets in multi-domain operations from emerging threats such as large caliber rockets and missiles and develop new design concepts for passive protection against these threats.			
FY 2022 to FY 2023 Increase/Decrease Statement: This effort completes in Fiscal Year 2022 with transfer of applied technologies to PE 0603119A (Ground Advanced Technology) / Project BL6 (Expedient Passive Protection Advanced Technology).			
Title: Assessments of Solutions for Survivability from Emerging Threats (ASSET)	-	-	4.348

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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: Will 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 will develop fast-running algorithms to estimate the effects of emerging threats on legacy protective systems and new conceptual passive protection designs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects the planned lifecycle for this Project to support increased effort to emerging weapon threat effects and increase the survivability of personnel, critical assets, and facilities.</p>				
<p>Title: FY 2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.070	-
Accomplishments/Planned Programs Subtotals		1.413	1.906	4.348
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL7: <i>Power Projection in A2AD Environments Technology</i>	-	1.843	3.151	1.871	-	1.871	2.950	2.145	3.588	2.548	0.000	18.096

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).

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 conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

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

	FY 2021	FY 2022	FY 2023
Title: Entry and Sustainment in Complex Contested Environments	0.880	1.325	-
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.			
FY 2022 Plans: Further develop portions of prediction tools for arctic mobility across snow-covered terrain and in organic soils unique to arctic regions, and validate methodologies for rapid road and trail classification and determine analytical procedures for estimating capacity of low-volume roads for military vehicles.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
This effort completes in Fiscal Year 2022 with transition of applied technologies to PE 0603119A (Ground Advanced Technology) / Project BL8 (Power Projection in A2AD Environments Adv Tech).				
<p>Title: Engineering for Battlespace Maneuver</p> <p>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.</p> <p>FY 2022 Plans: Mature materials and refine techniques for rapid ground stabilization and expedient soil hardening to support military vehicles; enhance techniques for expedient infrastructure upgrades; and develop planning aids for engineer support to route remediation.</p> <p>FY 2023 Plans: Will determine design and selection protocol for executing rapid soil hardening; will conduct experiments to quantify effectiveness of equipment attachments for executing rapid route remediation; will perform simulations to identify requirements for mechanical stabilization systems to support heavy tactical wheeled vehicle loads.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		0.963	1.711	1.871
<p>Title: FY 2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.115	-
Accomplishments/Planned Programs Subtotals		1.843	3.151	1.871
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL9: <i>Protection from Advanced Weapon Effects Technology</i>	-	3.596	4.344	5.062	-	5.062	5.188	4.995	4.778	5.471	0.000	33.434

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.

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 (U.S.) Army Engineer Research and Development Center and coordinated with the U.S. Army Futures Command.

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

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

	FY 2021	FY 2022	FY 2023
<p>Title: Materials and Modeling for Force Protection</p> <p>Description: This effort designs and develops advanced composite and other protective materials and multi-scale modeling techniques to reduce material weight and increase resistance against blast and penetration threats; designs and develops innovative virtual material design procedures; and matures manufacturing processes supported by computational modeling and simulation.</p>	1.302	-	-
<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> <p>FY 2022 Plans:</p>	2.294	2.759	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Develop a full-scale protection/structural solution with predictive algorithm to mitigate precision strike weapon effects; design multi-hit composite protection subsystems to validate algorithms and material subsystems through testing; and develop a model to inform engineers on protective design guidance.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort completes in Fiscal Year 2022 with transfer of applied technologies to PE 0603119A (Ground Advanced Technology) / Project BM1 (Protection from Advanced Weapon Effects Adv Tech).</p>				
<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 2022 Plans: Develop and refine algorithms for a multi-scale, materials-by-design methodology to model and enhance concrete protective material solutions for weapons effects; and design and develop metallic, composite, and hybrid material solutions for force protection concepts.</p> <p>FY 2023 Plans: Will expand the multi-scale materials-by-design tools for unconventional / indigenous materials for force protection, will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	1.426	1.564
<p>Title: Protection from Advanced Penetrators</p> <p>Description: This effort designs and develops protective material solutions and enhances 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:</p>		-	-	3.498

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Will investigate material solutions and structural component enhancements for use in hardened protective structures to mitigate weapons effects of advanced penetrators.				
FY 2022 to FY 2023 Increase/Decrease Statement: Funds increased for protective material technology solutions and enhances modeling and simulation tools for large hardened protective structures.				
Title: FY 2022 SBIR/STTR Transfer		-	0.159	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		3.596	4.344	5.062
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BN8: <i>Ground Technology Materials(CA)</i>	-	131.000	160.150	-	-	-	-	-	-	-	0.000	291.150

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 2021	FY 2022
Congressional Add: Program increase: Ice Engineering Research Facility Modernization FY 2021 Accomplishments: Conducted applied research in Ice Engineering Research Facility Modernization. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program increase: Center for Research in Extreme Batteries FY 2021 Accomplishments: Conducted applied research in Center for Research in Extreme Batteries. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program increase: Cellulose Nanocomposites Research FY 2021 Accomplishments: Conducted applied research in Cellulose Nanocomposites. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program increase: Advanced Polymers for Force Protection FY 2021 Accomplishments: Conducted applied research in Advanced Polymers for Force Protection. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Advanced Polymers for Force Protection	8.000	8.000
Congressional Add: Program increase - Advanced Concrete	4.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
<i>FY 2021 Accomplishments:</i> Conducted applied research in Advanced Concrete. Work executed by Army Futures Command.		
<i>Congressional Add:</i> Program increase - Robotic RTCH <i>FY 2021 Accomplishments:</i> Conducted applied research in Robotic RTCH. Work executed by Army Futures Command.	5.000	-
<i>Congressional Add:</i> Program increase - Military Waste Stream Conversion <i>FY 2021 Accomplishments:</i> Conducted applied research in Military Waste Stream Conversion. Work executed by Army Futures Command.	5.000	-
<i>Congressional Add:</i> Program increase - High Performance Polymers <i>FY 2021 Accomplishments:</i> Conducted applied research in High Performance Polymers. Work executed by Army Futures Command. <i>FY 2022 Plans:</i> Congressional Interest Item funding provided for High Performance Polymers	5.000	5.000
<i>Congressional Add:</i> Program increase - Integrity of Transparent Armor <i>FY 2021 Accomplishments:</i> Conducted applied research in Integrity of Transparent Armor. Work executed by Army Futures Command. <i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Integrity of Transparent Armor	5.000	5.000
<i>Congressional Add:</i> Program increase - Environmental Quality Enhanced Coatings <i>FY 2021 Accomplishments:</i> Conducted applied research in Environmental Quality Enhanced Coatings. Work executed by Army Futures Command. <i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Environmental Quality Enhanced Coatings	5.000	5.000
<i>Congressional Add:</i> Program increase - Autonomous Digital Design and Manufacturing <i>FY 2021 Accomplishments:</i> Conducted applied research in Autonomous Digital Design and Manufacturing.	5.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Autonomous Digital Design and Manufacturing		
Congressional Add: Program increase - Materials Recovery Technologies for Defense Supply Resiliency FY 2021 Accomplishments: Conducted applied research in Materials Recovery Technologies for Defense Supply Resiliency.	10.000	10.000
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Materials Recovery Technologies for Defense Supply Resiliency		
Congressional Add: Program increase - Materials Manufacturing Processes FY 2021 Accomplishments: Conducted applied research in Materials Manufacturing Processes.	10.000	-
Work executed by Army Futures Command. Congressional Add: Program increase - Additive Manufacturing Machine Learning Initiative FY 2021 Accomplishments: Conducted applied research in Additive Manufacturing Machine Learning Initiative.	10.000	5.000
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Additive Manufacturing Machine Learning Initiative (Community Project Funding)		
Congressional Add: Program increase - Rapid Advanced Deposition FY 2021 Accomplishments: Conducted applied research in Rapid Advanced Deposition.	10.000	5.000
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Rapid Advanced Deposition		
Congressional Add: Program increase - Defense Resiliency Against Extreme Cold Weather FY 2021 Accomplishments: Conducted applied research in Defense Resiliency Against Extreme Cold Weather.	10.000	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Defense Resiliency Against Extreme Cold Weather		
Congressional Add: Program increase - Counter UAS Technology Research FY 2021 Accomplishments: Conducted applied research in Counter UAS Technology.	5.000	-
Work executed by Army Futures Command. Congressional Add: Program increase - Cell-Free Expression for Biomanufacturing FY 2021 Accomplishments: Conducted applied research in Cell-Free Expression for Biomanufacturing.	10.000	-
Work executed by Army Futures Command. Congressional Add: Program increase - Earthen Structures Soil Enhancement FY 2021 Accomplishments: Conducted applied research in Earthen Structures Soil Enhancement.	4.000	4.000
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Earthen Structures Soil Enhancement Congressional Add: Advanced Manufacturing Materials Processes Initiative FY 2022 Plans: Congressional Interest Item funding provided for Advanced Manufacturing Materials Processes Initiative	-	10.000
Congressional Add: Advanced Materials Manufacturing FY 2022 Plans: Congressional Interest Item funding provided for Advanced Materials Manufacturing	-	8.000
Congressional Add: Anti-Corrosion Materials FY 2022 Plans: Congressional Interest Item funding provided for Anti-Corrosion Materials	-	7.000
Congressional Add: Ceramic Materials for Extreme Environments FY 2022 Plans: Congressional Interest Item funding provided for Ceramic Materials for Extreme Environments	-	8.000
Congressional Add: Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research	-	6.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
FY 2022 Plans: Congressional Interest Item funding provided for Climate and Natural Hazards, Snow-Covered and Mountain Environment Sensing Research		
Congressional Add: Electrolyzer FY 2022 Plans: Congressional Interest Item funding provided for Electrolyzer	-	7.000
Congressional Add: Flexible Hybrid Electronics and Environmental Sustainability FY 2022 Plans: Congressional Interest Item funding provided for Flexible Hybrid Electronics and Environmental Sustainability	-	12.000
Congressional Add: PFAS Modeling FY 2022 Plans: Congressional Interest Item funding provided for PFAS Modeling	-	5.000
Congressional Add: Polar Proving Ground and Training Program FY 2022 Plans: Congressional Interest Item funding provided for Polar Proving Ground and Training Program	-	2.000
Congressional Add: Rapid Infrastructure Development and Engineering FY 2022 Plans: Congressional Interest Item funding provided for Rapid Infrastructure Development and Engineering	-	3.000
Congressional Add: Rare Earth Initiative FY 2022 Plans: Congressional Interest Item funding provided for Rare Earth Initiative	-	7.000
Congressional Add: Solid Oxide Fuel Cell Development FY 2022 Plans: Congressional Interest Item funding provided for Solid Oxide Fuel Cell Development	-	10.000
Congressional Add: Tank Tracks FY 2022 Plans: Congressional Interest Item funding provided for Tank Tracks	-	3.150
Congressional Add: Verified Inherent Control FY 2022 Plans: Congressional Interest Item funding provided for Verified Inherent Control	-	10.000
Congressional Adds Subtotals	131.000	160.150

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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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D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602144A / <i>Ground Technology</i>				Project (Number/Name) CA9 / <i>Predictive Maintenance</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CA9: Predictive Maintenance</i>	-	2.509	-	-	-	-	-	-	-	-	0.000	2.509

A. Mission Description and Budget Item Justification

This Project develops and characterizes artificial intelligence (AI) and machine learning (ML) tools and capabilities to intelligently predict and analyze maintenance status for emerging and legacy ground platforms; extracts maintenance data from existing databases, sensor data and inference of missing data via virtual simulations investigating maintenance concepts that employ AI data capture and integrate AI tools into enterprise resource planning for military ground vehicles. Research enables use of predictive maintenance to increase fleet operational readiness through reduced downtime by preventing critical failure during missions, maximizing availability to combatant commands.

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 Army Science and Technology Ground Portfolio and the Joint Artificial Intelligence Center (JAIC)

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

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

	FY 2021	FY 2022	FY 2023
Title: Predictive Maintenance	2.509	-	-
Description: This effort performs research on AI, deep learning, and predictive analytics to forecast major issues on platforms and enables services to respond to upcoming failures. Focus will be to identify component failure relationships to principal end items for prediction of critical failure prior to corrective maintenance and reactive supply chain requisitions. Research will increase efficiency, decrease fleet operating and sustainment costs for equipment platforms, and reduce the time and costs associated with repair part requisition, management and transportation.			
Accomplishments/Planned Programs Subtotals	2.509	-	-

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG5: <i>Ground Vehicle Sensor Concepts and Technologies</i>	-	-	4.146	-	-	-	-	-	-	-	0.000	4.146

Note

This Project is Terminated starting in Fiscal Year 2023 (FY23).

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 2021	FY 2022	FY 2023
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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Will explore concepts to reduce dazzle from high-power handheld lasers; improve optical system protection concepts from high energy lasers (HEL); reduce the threat of jamming from white light continuum generated by ultra-short pulsed lasers (USPLs); use results from first principles modeling to validate and improve chemical mixtures designed for specific laser light absorption. FY 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year (FY) 2023, funding for this effort is eliminated.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.152	-
Accomplishments/Planned Programs Subtotals	-	4.146	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CG6: Ground Vehicle Power and Energy Concepts and Tech</i>	-	-	2.681	2.526	-	2.526	2.594	2.643	4.010	3.959	0.000	18.413

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 2021	FY 2022	FY 2023
Title: Advanced Distributed Power for Autonomous Systems	-	1.371	2.526
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 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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 2022 Plans: Will research control algorithms and topologies for power conversion systems with a focus on stability and improved real time maximum power optimization of component operation; explore coupling of decision making methods to increased awareness of tactical energy effectiveness for increased operational-tempo and to support platform operations and battlespace planning and real time energy tracking through standard energy analysis techniques; model high torque magnetic gear components for platform applications and identify additional optimization strategies and use cases.</p> <p>FY 2023 Plans: Will experimentally validate high torque magnetic gear designs and optimization strategies. Will investigate and analyze advanced control methods to improve fast battery charging. Will 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. Will investigate and analyze energy storage / battery technologies with an order of magnitude increase in energy densities. Will research advanced control methodologies at the module and component levels providing higher efficiency and reliability through energy optimization. Will research advanced transformer designs and fabrication to enable high frequency switching with improved thermal management in smaller more efficient packages.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CN1 (Disruptive Countermeasure Concepts for Aviation) to support the creation of ?Deep Autonomous Sensing?. Funding increase supports additional research into fast battery charging technologies for hybrid electric vehicles, as well as energy storage technologies.</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	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Will design and model new high performance power module using holistic co-design methods; investigate control and fabrication methods that can enable real time optimization of packaging performance; develop models for power device architectures appropriate for ultra-wide-band gap semiconductors; fabricate and assess initial test structures and devices.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CN1 (Disruptive Countermeasure Concepts for Aviation) to support the creation of ?Deep Autonomous Sensing?.</p>			
<p><i>Title:</i> FY2022 SBIR/STTR Transfer</p> <p><i>Description:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638</p>	-	0.098	-
Accomplishments/Planned Programs Subtotals	-	2.681	2.526

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG7: <i>Ground Protection Concepts and Technologies</i>	-	-	14.565	12.344	-	12.344	12.578	12.566	14.195	14.192	0.000	80.440

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)

	FY 2021	FY 2022	FY 2023
Title: Advanced Armor and Protection Technologies	-	7.868	7.211
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 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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will conduct experiments to validate several computationally designed pulsed power mechanisms to defeat a wide range of shaped charge warheads; conduct research into the understanding of energetic material response to ballistic events; validate an optimized notional hull concept that includes adaptive and active protection concepts for a combined threat suite through computational and experimental methods.</p> <p>FY 2023 Plans: Will investigate armor mechanism and protection concepts for the robotic combat vehicles to survive direct-fire engagements; will 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 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year 2023 (FY23), funding is realigned to support the creation of Project CZ9 (Foundational Hypersonic Weapons Research) in PE 0602141A (Lethality Technology).</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 2022 Plans: Will increase computational and material modeling capability to predict performance of hybrid armor protection mechanisms during threat impact; validate improved cineradiography and tomography diagnostic systems in multiple experimental facilities to capture threat interaction with armor mechanisms including multi-energy flash; designs and develops computational capability to couple the blast/fluid/solid/target interactions during threat engagements and reactive models for predicting mass (fragment), momentum (blast), and energy (heat) target effects for non-ideal explosives (a non-ideal explosive's observed detonation velocity is lower than the calculated ideal value from thermo-hydrodynamic theory); explores machine learning methodology for terminal ballistics design applications.</p> <p>FY 2023 Plans: Will design and develop physically accurate and robust modeling and simulation tools for explosive effects to inform armor development; will continue to mature the capabilities of the multi-physics models needed to rapidly assess threats and develop</p>		-	6.165	5.133

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
protection solutions to defeat those threats; will continue to mature our ballistics and explosive effects diagnostics to better assess terminal ballistics. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.532	-
Accomplishments/Planned Programs Subtotals	-	14.565	12.344

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG8: <i>Human Autonomy Teaming</i>	-	-	8.599	9.086	-	9.086	9.222	9.213	10.534	10.550	0.000	57.204

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 2021	FY 2022	FY 2023
Title: Soldier?AI Team Mission Planning for Dynamic Complex Environments	-	1.218	1.337
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 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will investigate initial approaches to leverage Soldier feedback to enable mission-to-mission adaptation of intelligent system behaviors to complement crew performance and meet evolving mission needs.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Dynamic Soldier-AI Team Resource Allocation</p> <p>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.</p> <p>FY 2022 Plans: Will investigate initial algorithms to generate task allocations across a distributed heterogeneous team to enable rapid team reconfiguration and improve team performance in dynamic environments; conduct experiments to examine approaches for Commanders to coordinate actions of a distributed team through a library of preset formations and crew configurations within the Commander's interface.</p> <p>FY 2023 Plans: Will mature algorithms to generate task allocations across a distributed heterogeneous team to enable flexible team reorganization to improve team performance in dynamic environments; will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	2.368	2.599
<p>Title: Soldier Cognition-Centric Interface Technologies</p> <p>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-</p>		-	1.555	1.705

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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 2022 Plans: Will mature approaches to characterize team cohesion in a distributed Soldier-AI team; continue experiments to investigate approaches to assess and calibrate the crew's trust in AI-enabled autonomous systems.</p> <p>FY 2023 Plans: Will conduct experiments to investigate the impact of enabling Soldiers to rapidly train autonomous systems on an individual Soldier's trust in autonomous systems; will conduct experiments to investigate the ability for Soldier guided adaptation of autonomous systems to capture individual Soldier knowledge, skills, and abilities.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects 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 2022 Plans: Will develop algorithms that learn from natural interactions to allow Soldiers to communicate their intent to adapt and train autonomous systems; investigate novel approaches using interactive machine learning to enhance the robustness of algorithms for assessing effectiveness of Soldier-AI teams; mature novel machine learning approaches to enable Soldiers to rapidly train AI systems in novel situations and environments.</p> <p>FY 2023 Plans: Will mature algorithms that learn from natural interactions to allow Soldiers to communicate intent for adaptation and training of autonomous systems; will mature algorithms for using interactive machine learning to enhance the robustness of algorithms for assessing effectiveness of Soldier-AI teams; will conduct experiments to investigate effectiveness of leveraging initial algorithms</p>		-	3.144	3.445

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
that infer Soldier intent from natural Soldier-system interactions to enhance capability to rapidly train autonomous systems with reduced data requirements.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer	-	0.314	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	8.599	9.086

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CI2: <i>Ground Enabling University Applied Research</i>	-	-	4.824	3.682	-	3.682	3.889	5.491	4.591	4.590	0.000	27.067

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 supports the Army Modernization Priority Next Generation Combat Vehicle.

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 0603119A (Ground Advanced Technology), PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2021	FY 2022	FY 2023
Title: Robust autonomous capabilities for ground vehicles	-	3.132	1.949
Description: This effort investigates AI/ML and autonomous mobility-enabled ground vehicles to conduct off-road maneuvers to transition from tele-operated to either fully-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 2022 Plans: Will develop AI/ML methods to enable robust, autonomous, 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 the speed of autonomous behavior acquisition through effective navigation and route planning using techniques to extract terrain features from imagery and transfer			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>of simulator-learned behaviors to developmental ground platforms. Develop methods of shared control (between human operators and AI/ML systems) that increase overall autonomous system performance with human input.</p> <p>FY 2023 Plans: Will mature AL/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 navigation and route planning using techniques to extract terrain features from imagery and transfer of simulator-learned behaviors to developmental ground platforms within academia.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to PE 0602182A (C3I Applied Research) / CN4 (Real-Time Tactical Networks Applied Research).</p>				
<p>Title: Human-robot/AI interactions</p> <p>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.</p> <p>FY 2022 Plans: Will investigate and develop AI/ML methods to improve autonomous systems by capturing and learning from human teleoperation commands, human interventions, and other forms of human interaction (e.g., spoken language). Will develop tactics and algorithms on common software platforms which enable robots to deal with complex environments on the fly while working fully autonomously around humans for extended periods of time.</p> <p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned life cycle of effort</p>		-	1.516	1.733
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans:</p>		-	0.176	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	4.824	3.682

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CV3: Engineer Enablers Maneuver, LOG, & Sustainment Apl</i>	-	-	-	2.518	-	2.518	2.185	1.247	1.144	-	0.000	7.094

Note

This is a new start in FY 2023.

This is a New Start Project for Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This effort designs and develops software tools to modernize the Army's logistics planning capability. The project addresses 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.

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 at the U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This work complements PE 0603119A (Ground Advanced Technology) Project CV5 (Engineer Enablers Maneuver, LOG, & Sustainment Adv).

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

	FY 2021	FY 2022	FY 2023
Title: Planning Logistics Analysis Network System Applied Research	-	-	2.518
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:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Will 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; will mature components of a multi-modal transportation network model. <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This is a New Start Project for Fiscal Year 2023 (FY23).			
Accomplishments/Planned Programs Subtotals	-	-	2.518

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DA1: <i>SAFR Alternatives for Readiness Applied Research</i>	-	-	-	3.679	-	3.679	5.149	6.028	6.030	5.613	0.000	26.499

Note

This is a new start in FY 2023.

This is a New Start Project for Fiscal Year 2023 (FY23).

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 global warming. 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)

Title: PFAS Risk Reduction Applied Research	FY 2021	FY 2022	FY 2023
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.	-	-	0.778

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p><i>FY 2023 Plans:</i> Will 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.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This is a New Start Project for Fiscal Year 2023 (FY23).</p>			
<p><i>Title:</i> Safer Alternatives for Readiness (SAFR) Applied Research</p> <p><i>Description:</i> 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.</p> <p><i>FY 2023 Plans:</i> Will research green chemistry approaches to energetic material synthesis methods; will explore novel non-metallic and non-energetic initiation techniques to replace lead-based primary explosives; and will investigate non-chemical surface cleaning and preparation techniques for relevant substrates.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This is a New Start Project for Fiscal Year 2023 (FY23).</p>	-	-	2.901
Accomplishments/Planned Programs Subtotals	-	-	3.679

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 2023 Army **Date:** April 2022

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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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	258.341	245.525	174.090	-	174.090	174.430	167.609	165.991	159.516	0.000	1,345.502
BF1: Autonomous Ground Resupply Tech	-	10.615	-	-	-	-	-	-	-	-	0.000	10.615
BF3: Combat Vehicle Robotics Tech	-	9.163	16.719	20.742	-	20.742	17.366	16.738	15.907	15.591	0.000	112.226
BF6: Crew Augmentation and Optimization Tech	-	19.022	8.883	10.761	-	10.761	11.613	11.603	10.036	10.033	0.000	81.951
BF8: Artificial Intelligence & Machine Learning Tech	-	21.425	13.732	19.906	-	19.906	20.439	17.379	17.385	17.381	0.000	127.647
BF9: Sensors for Autonomous Operations and Surv Tech	-	36.836	35.470	22.683	-	22.683	25.216	24.584	24.729	25.450	0.000	194.968
BG2: Modeling and Simulation for MUMT Technology	-	3.273	6.718	5.591	-	5.591	5.502	4.565	4.239	4.386	0.000	34.274
BG6: Advanced Concepts for Active Defense Technology	-	44.894	30.524	33.656	-	33.656	33.021	32.815	37.553	33.777	0.000	246.240
BG8: Obscuration Technology	-	1.500	2.576	2.722	-	2.722	2.762	2.786	2.787	2.787	0.000	17.920
BH5: Platform Electrification and Mobility Tech	-	20.563	13.781	14.226	-	14.226	13.702	17.136	17.276	14.769	0.000	111.453
BH9: Protection for Autonomous Systems Tech	-	0.146	-	-	-	-	-	-	-	-	0.000	0.146
BI2: Sensor Protection Technology	-	7.390	5.829	6.229	-	6.229	5.508	5.922	8.407	7.677	0.000	46.962
BI4: Materials Application and Integration Tech	-	4.378	7.648	7.722	-	7.722	7.941	7.466	7.001	6.999	0.000	49.155
BI9: Vehicle System Security Technology	-	2.676	2.359	-	-	-	-	-	-	-	0.000	5.035
BJ2: Tactical and Navigation Lasers Sensors Technology	-	5.372	5.364	5.673	-	5.673	5.765	5.818	5.816	5.814	0.000	39.622

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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>											
BJ9: <i>Autonomous Mobility Tech</i>	-	2.407	3.811	-	-	-	-	-	-	-	0.000	6.218
BK2: <i>Virtual Prototyping Technology</i>	-	5.191	8.169	9.622	-	9.622	9.866	9.878	10.579	10.577	0.000	63.882
BK3: <i>Next Gen Intelligent Fire Control (NG-IFC) Tech</i>	-	16.676	0.962	-	-	-	-	-	-	-	0.000	17.638
BK5: <i>Adv Direct In-Direct Armament Sys (ADIDAS) Tech</i>	-	3.814	9.180	13.526	-	13.526	12.299	8.841	4.276	4.275	0.000	56.211
BP5: <i>Ground Vehicle Technology (CA)</i>	-	43.000	73.800	-	-	-	-	-	-	-	0.000	116.800
CU5: <i>Platform Agnostic Armaments Applied Technology</i>	-	-	-	1.031	-	1.031	3.430	2.078	-	-	0.000	6.539

Note

Project CU5 (Platform Agnostic Armaments Applied Technology) is a new start project for Fiscal Year 2023 (FY23).

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 2023 Army **Date:** April 2022

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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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	258.351	172.166	0.000	-	0.000
Current President's Budget	258.341	245.525	174.090	-	174.090
Total Adjustments	-0.010	73.359	174.090	-	174.090
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	73.800			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.010	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	174.090	-	174.090
• FFRDC Transfer	-	-0.441	-	-	-

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

Project: BP5: *Ground Vehicle Technology (CA)*

- Congressional Add: *Program Increase - Modeling and Simulation*
- Congressional Add: *Program Increase - Silicon Carbide Electronics*
- Congressional Add: *Program Increase - Highly Electrified Vehicles*
- Congressional Add: *Program Increase - Additive Metals Manufacturing*
- Congressional Add: *Program Increase - Prototyping Energy Smart Autonomous Ground Systems*
- Congressional Add: *Advanced Materials Development for Survivability*
- Congressional Add: *Advanced Optics Program*
- Congressional Add: *Digital Design and Simulated Testing*
- Congressional Add: *Fast-Refueling Fuel Cell Engines*
- Congressional Add: *Hydrogen Technologies*
- Congressional Add: *Machine Learning Optimized Power Electronics*
- Congressional Add: *Systems Engineering for Autonomous Ground Vehicles*
- Congressional Add: *Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms*
- Congressional Add: *Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles*
- Congressional Add: *Zero Emission Combat Vehicles*

	FY 2021	FY 2022
	10.000	-
	6.000	5.500
	5.000	5.000
	10.000	-
	12.000	10.000
	-	5.000
	-	4.300
	-	4.000
	-	7.000
	-	10.000
	-	3.000
	-	9.000
	-	5.000
	-	3.000
	-	3.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 0602145A / <i>Next Generation Combat Vehicle Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2021	FY 2022
Congressional Add Subtotals for Project: BP5	43.000	73.800
Congressional Add Totals for all Projects	43.000	73.800

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BF1 / <i>Autonomous Ground Resupply Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BF1: <i>Autonomous Ground Resupply Tech</i>	-	10.615	-	-	-	-	-	-	-	-	0.000	10.615

A. Mission Description and Budget Item Justification

This Project will design and develop modeling and simulation tools and advanced software behaviors to inform future ground supply distribution system requirements across multiple levels of strategic and tactical sustainment operations. The modeling and simulation software tools will be incorporated into a suite of products designed to support every phase of Autonomous Ground Resupply (AGR) and used to develop and refine AGR concepts, test vehicle designs, evaluate design changes, determine technology performance, and predict outcomes in a wide variety of terrain, weather, and environmental conditions. The effort will utilize the modeling and simulation software tools to design, develop and mature software; and conduct experiments to increase future autonomy capabilities. Increased capabilities will transition to PE 0603462A (Next Generation Combat Vehicle Advanced Technology) to be integrated into a Soldier evaluation to obtain user feedback and inform and transition to the Leader/Follower Program of Record. The architecture and safety work under this Project also lays the groundwork for Army Modernization Priority Next Generation Combat Vehicle (NGCV).

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 NGCV Army Modernization Priority.

Work in this Project is conducted by the United States (US) Army Engineer Research and Development Center and coordinated with US Army Futures Command.

This work is done in coordination with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) and the Leader/Follower Program of Record.

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

	FY 2021	FY 2022	FY 2023
Title: Software for Autonomous Systems	9.700	-	-
Description: Develop and implement advanced system behaviors to address leader follower capabilities, including algorithms for dynamic route planning, world modeling that feature system cues and collaboration to minimize the cognitive load placed on soldiers managing groups of unmanned systems.			
Title: Simulation Tools for AGR	0.915	-	-
Description: This effort designs and develops real-time and high-fidelity, hardware and software-in-the-loop simulators capable of rapid design and assessment of ground vehicle autonomous behaviors through integration with autonomy solutions.			
Accomplishments/Planned Programs Subtotals	10.615	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BF1 / <i>Autonomous Ground Resupply Tech</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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BF3: <i>Combat Vehicle Robotics Tech</i>	-	9.163	16.719	20.742	-	20.742	17.366	16.738	15.907	15.591	0.000	112.226

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.

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 2021	FY 2022	FY 2023
Title: Autonomous Behaviors and Perception	3.555	9.018	13.258
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 2022 Plans: Will develop and validate object recognition and environment understanding for autonomous vehicles. Develop and validate a basic framework for applying this knowledge to operationally relevant missions (per U.S military doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF)), enabling customized behaviors to specific combat missions, and prioritization of autonomous mobility tasks and maneuvers when multiple tasks are assigned to a vehicle or team of vehicles. Will develop models to integrate Army operational architectures and military autonomous behavior architectures in Autonomous Ground Vehicle Reference Architecture (AGVRA). Develop robotic-specific cyber architectural views across the autonomous architecture focused on getting autonomous systems certified under the Department of Defense Risk Management Framework. Develop system behavior and structure in assurance testing via model-based systems engineering and formal			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>methods to be containerized and integrated with Department of Defense (DoD) cloud services. Develop security enhancements in autonomous system component registries to improve Robot Operating System-Military (ROS-M).</p> <p>FY 2023 Plans: Will 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). Will 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. Will research a comprehensive cyber-hardened software suite to make RAS resilient to existing and emerging cyber threats. Will research the use of enhanced a-priori data for advanced navigation and reconnaissance maneuvers for implementation in RTK. Will investigate space, weight, and power (SWAP) reduction for RTK autonomy kit hardware on small unmanned ground vehicles (UGVs). Will develop and mature additional mission subsets and task decompositions within the operational reference models for the AGVRA. Will develop an experimental unified architecture and associated model profile, library and views realizing current technologies within a model-based systems engineering (MBSE) environment. Will develop and mature the ROS-M to support the registration and distribution of developed autonomous software solutions and supporting tools.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding is increased in FY2023 for the addition of advanced capabilities in the areas of autonomous forward surveillance and small UGVs as deployable sensors. This includes research on use of enhanced a-priori data, and reduction of SWAP for small UGVs.</p>				
<p>Title: Autonomous Architecture</p> <p>Description: This effort contributes to the NGCV RAS to design and develop an open autonomous architecture for an inclusive military library of behaviors that are non-proprietary and in a modular format to allow for design and development of payloads across the enterprise. This effort matures architecture activities under the autonomous ground resupply activity, further expanding the Autonomous Ground Vehicle Robotics Architecture for increased complexity of military maneuvers as well as the ROS-M framework.</p>		1.661	-	-
<p>Title: Human Robotic Interaction</p> <p>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.</p> <p>FY 2022 Plans:</p>		3.947	7.087	5.412

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will design and develop the enhanced robotic warfighter-machine?s interface technologies for a combat scenario to demonstrate the ability to operate the robotic vehicle with decreased time to complete a task, thereby enabling the Warfighter to focus on the overall mission. Will investigate the enhanced robotic warfighter-machine?s interface technologies to enhance the robotic operator?s control of mobility, their reaction time of alerts and their overall success of the mission.</p> <p>FY 2023 Plans: Will 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. Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding is decreased in FY23 to support increased emphasis on additional capabilities in the Autonomous Behaviors and Perception task within the Project</p>				
<p>Title: M&S for Autonomy Enabled Ground Systems</p> <p>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.</p> <p>FY 2023 Plans: Will mature M&S capability to support CoVeR evaluations with the first Virtual EET planned for the Fall of 2024. Will 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 will focus on real-time models of CoVeR platforms and sensors operating in terrains and scenarios focused on the 2024 EET event. Initial capability will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding is increased in FY23 to develop and mature M&S tools necessary for the realization of virtual EET to support virtual evaluations prior to EET experiments.</p>		-	-	2.072
<p>Title: FY2022 SBIR/STTR Transfer</p>		-	0.614	-

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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) BF3 / <i>Combat Vehicle Robotics Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	9.163	16.719	20.742

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BF6: Crew Augmentation and Optimization Tech</i>	-	19.022	8.883	10.761	-	10.761	11.613	11.603	10.036	10.033	0.000	81.951

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 2021	FY 2022	FY 2023
Title: Crew & Robotic Mission with Agent Technology	1.498	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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will validate optimized sensing approaches to process, share and improve situational awareness (SA) across the crew and improve decision making and mission success within a NGCV formation. Will validate personalization of Warfighter Machine Interface (WMI) configuration to permit role/mission requirement reconfiguration and Soldier monitoring.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned conclusion of this task.</p>				
<p>Title: Crew Capability Enhancement</p> <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 2022 Plans: Will design and develop algorithms that provide an enhanced understanding of crew status, actions, intentions, and goals during simulated mission execution; design and develop initial data-driven approaches to cue Vehicle Commander of possible task sharing opportunities.</p> <p>FY 2023 Plans: Will 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. Will augment data-driven approaches to cue Vehicle Commander of potential task sharing opportunities through the addition of learning based methodologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		2.877	3.107	3.397
<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 2022 Plans:</p>		2.443	1.089	2.569

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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) BF6 / <i>Crew Augmentation and Optimization Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Will design and develop initial capability to characterize the interactions between the Soldier and AI-enabled system behaviors, and the ability to adapt to each other during unscripted simulated mission exercises.</p> <p>FY 2023 Plans: Will 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. Will determine initial visualizations of dynamic systems-based measures of crew-autonomous system effectiveness. Will investigate initial predictive models incorporating mission and human-in-the-loop data to predict team outcomes.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports the development of a predictive model of mission and human-in-the-loop data to predict team outcomes.</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 2022 Plans: Will investigate embedding of synthetic training environments in ground vehicle embedded computing devices to assess crew performance. Will investigate and design simulation capability for researching embedded training concepts using game engine based simulators. Will conduct experiments to determine data outputs required for live training and develop protocols to deliver data to the processing system for engagement modeling, real-time casualty assessment, and precision targeting. Will research mechanisms for high speed filtering and attribution of terrain features for ground platform training or operational use. Will design and conduct laboratory experiments pertaining to training Soldiers to accommodate task reassignments in order to improve coordinated platoon-level maneuver in manned-unmanned team operations, utilizing experimental crew stations. Will conduct experiments to investigate and validate intelligent data routing techniques for improved live-synthetic training data transmission.</p> <p>FY 2023 Plans: Will 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. Will 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. Will investigate the underlying technical demands</p>	2.254	1.809	1.890

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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) BF6 / <i>Crew Augmentation and Optimization Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
required for embedded or peripheral training systems to support maneuverability and fires within the robotics and autonomous systems domain. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Platoon Teaming Capability 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. FY 2022 Plans: Will validate approaches for sharing of critical tasks between crewmembers and intelligent technologies based on crewmember workload in order to enhance team performance. Will conduct experiment utilizing limited semi-autonomous maneuver for unstructured off-road operations in a live field exercise. FY 2023 Plans: Will validate approaches to efficiently process and share critical data for enhanced mutual crew-agent situational awareness across a mixed manned-unmanned platoon-level formation. Will validate algorithms to cue the vehicle commander of possible task sharing opportunities within a crew at the platoon level. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort to focus on enhanced crew-agent situational awareness and task sharing within a mixed manned-unmanned platoon-level formation.		1.339	2.085	2.905
Title: Soldier?AI Team Mission Planning for Dynamic Complex Environments Description: Planning in multi-domain operations environments is complex and has increased temporal and spatial sensitivities for Soldiers to integrate with AI systems to plan missions. This effort provides the fundamental concepts and technologies to enable Soldiers and AI systems to team together to plan for multi-domain operations from a ground vehicle perspective. This effort focuses on planning enablers to maximize manned-unmanned team performance across squads and platoons and includes crew station-based emerging technologies in the areas of human- interaction with AI technologies and human-guided machine intelligence. Approaches focus on modeling both Soldier and AI capabilities and their limitations as a function of the mission environment and mission requirements, and applying those models to forming mission plans.		1.251	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Title: Dynamic Soldier-AI Team Resource Allocation</p> <p>Description: This effort focuses on creating the concepts and technologies necessary to dynamically allocate Soldiers and unmanned systems during missions in 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 includes 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 resources of the Soldier-AI team are focused appropriately to ensure mission success.</p>		2.434	-	-
<p>Title: Soldier Cognition-Centric Interface Technologies</p> <p>Description: This effort creates 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 systems to the Soldier. This effort 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>		1.598	-	-
<p>Title: Enabling Soldier-AI Technology Adaptation</p> <p>Description: This effort develops technologies to rapidly adapt and upgrade AI-enabled system capabilities in response to advancements in AI in the commercial and adversary environments. Two focus areas include enabling 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 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>		3.328	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	0.325	-

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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) BF6 / <i>Crew Augmentation and Optimization Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	19.022	8.883	10.761

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

N/A

Remarks

D. Acquisition Strategy

N/A

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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) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BF8: Artificial Intelligence & Machine Learning Tech</i>	-	21.425	13.732	19.906	-	19.906	20.439	17.379	17.385	17.381	0.000	127.647

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 2021	FY 2022	FY 2023
Title: Scalable, Adaptive, and Resilient Autonomous Systems	4.062	2.757	8.226
Description: This effort develops and matures 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 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will investigate methods and conduct experiments to increase operational speed and environmental complexity for air and ground based autonomous vehicle perception, learning, reasoning, navigation, and physical capabilities to augment and increase the freedom of maneuver in complex and contested environments.</p> <p>FY 2023 Plans: Will design and develop methods to increase operational speed and distances in complex terrain. Will develop methods to integrate terrain awareness and platform capability into tactical decision-making process. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding increase is planned lifecycle of this effort and supports additional research into methods that coordinate multiple air and ground autonomous agents for improved maneuver.</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 2022 Plans: Will accelerate the intelligence and design phases of decision making by investigating methods and software that are semantically-aware and can identify, characterize, and exploit data from sensors and other information assets; design and develop capabilities that build on theories and fundamental models for accelerating the intelligence and design phases of machine and human decision making, through the use of aforementioned models.</p> <p>FY 2023 Plans: Will 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. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		2.235	2.335	2.600
<p>Title: Heterogeneous Computing and Computational Sciences</p>		1.794	1.719	1.916

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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 2022 Plans: Will design dynamic, scalable architectures to enable energy efficient computation on the tactical edge battlefield; develop algorithms and protocols for resilient teaming and coordination of decentralized and distributed computing device; explore intelligent algorithms for adaptive computing and information processing scheduling and distribution under mission constraints.</p> <p>FY 2023 Plans: Will apply advanced algorithms to Army-relevant tasks on low size, weight, and power (SWaP) computing devices. Will exercise the proposed algorithm/compute combinations on heterogeneous datasets to measure performance and efficiency. Will implement scalable task scheduling mechanisms that are robust to adversarial and organic failures and can be applied in centralized, distributed, and decentralized agent environments. Will develop scheduling routines to enable flexibility and efficiency under tactical environments and constraints.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<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 2022 Plans: Will explore cost-effective secure communication and data processing protocols that can be implemented in a resource-constrained tactical network; develop spatial-temporal graphs, graph neural networks, and deep learning algorithms to assist inferring temporal causality relationships of communication and services among assets; research noisy or corrupted military radar intelligence to develop unsupervised machine ML algorithms to generate multiple synthetic reconstructions from a heavily down-sampled image; research signal modulation schemes for low-signature communications and develop unsupervised ML algorithms to encode and decode text messages; develop algorithms for prototype platforms that allow trained models to be transferred between autonomous ground vehicles operating in similar domains; investigate machine learning approaches that</p>		4.010	3.988	4.501

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>allow relevant portions of trained models to be transferred across environments; conduct scientific experimentation to measure the ability of autonomous ground vehicles to navigate complex environments using semantic representations of the environment and reason over semantic observations in the environment; develop, explore, and define assessment metrics and machine learning approaches for training, augmenting, and assessing interaction between and across multi-agent systems and between soldiers and intelligent agents during joint collaborative tasks; design and conduct empirical analysis of modeling and simulation environments augmented with context-aware intelligent agents to enhance mission rehearsal, planning, and decision-making in the command and control operations.</p> <p>FY 2023 Plans: Will mature algorithms for prototype platforms that allow trained models to be transferred between autonomous ground vehicles operating in different environments. Will 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. Will implement techniques for network load balancing, task sharing, and computational offloading in adversarial settings for resource constrained devices at the tactical edge. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects 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 2022 Plans: Will conduct fundamental research, drawing on existing state-of-the-art work and biological inspiration, on novel models and algorithms that are capable of maneuver over or through complex terrain at high operational tempos, with efficiency in terms of physical movement (i.e. energy) and computation; conduct research on architectures and models that provide predictable performance appropriate for tactical teaming.</p> <p>FY 2023 Plans:</p>		1.324	1.462	1.627

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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) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will 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; will continue research on architectures and models that provide predictable performance appropriate for tactical multi-agent teaming.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Autonomous Mobility NGCV Challenge</p> <p>Description: Develop novel behaviors and algorithms for autonomous off-road mobility in tactical environments to meet capability needs of the NGCV.</p>		3.000	-	-
<p>Title: Operational Assessment of Artificial Intelligence Developmental Systems</p> <p>Description: This effort supports the Combatant Commander's needs by performing operational assessments of AI-intense developmental weapon systems.</p> <p>FY 2022 Plans: Will continue to work on an operational assessment of Artificial Intelligence developmental systems in support of the Combatant Commander identified need in FY21.</p> <p>FY 2023 Plans: Will continue to optimize results from ongoing studies to support Combatant Commander identified needs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		2.000	1.000	1.036
<p>Title: Army Universities and Technical Alliances Collaboration</p> <p>Description: This effort funds research leading to potential emerging technology development in areas of strategic importance to the Army in AI/ML and Robotics by bringing competitively selected Universities with research teams into Technical Alliances. The Technical Alliance collaborations consist of large collaborative hubs focused on developing and transitioning research in Army critical areas. Technical Alliances will be used to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary research effort. The primary focus of the Technical Alliances is expanding the frontiers of knowledge in research areas where the Army has enduring needs, and integrates state-of-the-art research programs at academic institutions to increase the supply of scientists and engineers to advance and optimize research within Army laboratories.</p>		3.000	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p>		-	0.471	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BF8 / <i>Artificial Intelligence & Machine Learning Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	21.425	13.732	19.906

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BF9: <i>Sensors for Autonomous Operations and Surv Tech</i>	-	36.836	35.470	22.683	-	22.683	25.216	24.584	24.729	25.450	0.000	194.968

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 2021	FY 2022	FY 2023
Title: Advanced Sensors with Embedded Processing	25.177	25.334	17.997
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 2022 Plans: Will optimize on-chip non-uniformity correction for electro-optical / infrared (EO/IR) sensor components. Will complete development of pixel designs using advanced Micro-electromechanical systems (MEMS) to increase sensitivity. Will optimize new electronics readout circuitry for high sensitivity uncooled sensors and conduct experiments to ascertain the limits of sensitivity possible with the new readouts. Will investigate components necessary to enable uncooled longwave infrared (LWIR) sensors using smaller pixel pitch and larger pixel count. Will determine the performance of improved uncooled LWIR sensor components for threat warning. Will validate cooled digital Regional Operations Intelligence Center (ROICs) to ensure they provide maximum attainable bit depth and information content available for high dynamic range imaging in order to see all threats no matter the level of clutter or degraded imaging environment. Will integrate low power processing threat warning approaches into the digital			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>ROICs. Will determine new exploitable scene features and target signatures in the polarized visible through LWIR portions of the spectrum. Will determine optimal sensor configurations governing correlation between environmental parameters, target properties, low to moderately cluttered background suppression, and target detectability with polarized EO/IR sensors operating at differing wavelengths.</p> <p>FY 2023 Plans: Will validate integration of on-chip non-uniformity correction for electro-optical / infrared (EO/IR) sensor components into the Digital Readout Integrated Circuit (DROIC). Will investigate on-chip signal processing to enable vast improvements in SWAP-C and System-On-Chip (SOC) capabilities. Will 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. Will mature low-power processing threat warning component approaches and fuse contextual scene information to detect incoming threats. Will validate far target location techniques and investigate optimal sensor configurations for target detectability and background reduction of cluttered scenes. Will evaluate novel sensor modalities for multi-function imaging through battlefield obscurants. Will research adaptive sensor components which can autonomously adjust imaging from visible through LWIR wavebands based on real-time conditions. Will validate sensor performance and new exploitable target signatures to better detect targets in adverse conditions. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding is decreased in FY23 due to the completion of the high sensitivity, high speed uncooled infrared research in FY22.</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 2022 Plans: Will mature higher resolution polarized optical 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. Will determine new exploitable scene features and target signatures with concealment penetrating radar portions of the spectrum.</p> <p>FY 2023 Plans: Will 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</p>		5.988	3.167	2.407

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>more advantageous UAS flight paths. Will 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 2022 to FY 2023 Increase/Decrease Statement: Decrease represents completion of component design and maturation efforts and movement into less expensive component validation and integration efforts.</p>				
<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 2022 Plans: Will conduct experiments to validate processing approaches utilizing EO/IR and position sensors for on-the-move target detection and tracking. Will investigate novel imaging techniques utilizing exploitable optical polarization-based features and signatures of threats in close combat open terrain scenarios to validate threat cueing and recognition. Will conduct experiments with compact ground and concealment penetrating radar antenna designs to determine optimal small unmanned aircraft system (UAS) and ground vehicle mountable configurations and assess detection capability in low clutter. Will investigate stacking registered radar and EO/IR imagery to improve clutter suppression. Will develop thermal spectral imaging techniques for dimensionality reduction for significantly improved target detection.</p> <p>FY 2023 Plans: Will 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. Will 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 2022 to FY 2023 Increase/Decrease Statement: Decrease represents completion of component design and maturation efforts and movement into less expensive processing techniques</p>		5.671	5.673	2.279
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	1.296	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	36.836	35.470	22.683

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BG2: <i>Modeling and Simulation for MUMT Technology</i>	-	3.273	6.718	5.591	-	5.591	5.502	4.565	4.239	4.386	0.000	34.274

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.

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 conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) / Project BG3 (Modeling and Simulation for MUMT Advanced Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Simulation Tools for Combat Vehicle Robotics (CoVeR)	3.273	6.473	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 2022 Plans: Develop M&S enabled analytical tools and adaptive learning models for predicting autonomous vehicle performance across varying meteorological conditions and terrain; and develop advanced algorithms to detect obstacles that affect maneuver corridors in unstructured environments.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will validate high-fidelity M&S tools to support development of autonomous systems operating in mission-relevant environments; will mature tagged dataset of real and synthetic images for training autonomous algorithms through M&S.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort completing in Fiscal Year 2023 with transition of technologies for demonstration to Program Element (PE) 0603462A (Next Generation Combat Vehicle Advanced Technology) / Project BG3 (Modeling and Simulation for MUMT Advanced Tech).</p>				
<p>Title: Autonomous Vehicle/Terrain Interactions</p> <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: Will develop complex obstacle detection and mobility predictions at tactically relevant speeds (high speed in complex terrain). Will develop M&S enabled analytical tools for operational effectiveness assessments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The increase provides for increased modeling and simulation to evaluate autonomous vehicle formation performance.</p>		-	-	2.246
<p>Title: FY 2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.245	-
Accomplishments/Planned Programs Subtotals		3.273	6.718	5.591
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BG6: <i>Advanced Concepts for Active Defense Technology</i>	-	44.894	30.524	33.656	-	33.656	33.021	32.815	37.553	33.777	0.000	246.240

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 2021	FY 2022	FY 2023
Title: Computational and Experimental Capability	6.532	-	-
Description: This effort will develop computational design tools as well as computational and experimental capabilities that support development of advanced protection systems. Such systems include passive, active and hybrid solutions for defeating (multiple) anti-armor threats and exploiting 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.			
Title: Multi-Threat Armor Technologies	7.213	7.763	8.477

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will validate and mature passive and reactive armor mechanisms and concepts to defeat kinetic and chemical energy threats in support of next generation combat vehicles; validate and mature active lightweight kinetic energy penetrator defeat mechanism; explore lightweight materials for defeat of medium caliber projectile threats.</p> <p>FY 2023 Plans: Will conduct experiments on a kinetic energy projectile defeat technology to counter multiple threats; will continue to mature a multi-hit projectile defeat mechanism; will conduct virtual experimentation studies to provide armor performance conceptualization, improvements, optimization, and mechanistic understanding to guide experimental programs.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.</p>				
<p>Title: Advanced Armor and Protection Technologies</p> <p>Description: This effort enables development of 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 ever-increasing protection. This effort funds research into the fundamental physics of new terminal effects concepts and provides a mechanistic understanding of threat platform interaction. The effort investigates the ability to analytically simulate complex threat interactions. Experiments will be conducted to validate the efficacy of the designs.</p>		7.216	-	-
<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 2022 Plans: Will validate adaptive protection threat interception concept experimentally with integrated sensors and control mechanisms; mature the adaptive armor mechanisms utilizing modeling, simulation, and experimental capabilities to ensure defeat of current</p>		10.768	5.836	6.570

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
and emerging threats; explore novel countermeasures to defeat threat Anti-Tank Guided Munitions (ATGMs) and top attack munitions; mature top attack protection mechanism to defeat emerging threats. FY 2023 Plans: Will assess a laser-based soft kill system; will 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; will mature an adaptive reactive armor mechanism to defeat Anti-Tank Guided Munitions and Rocket-Propelled Grenades; will mature a collaborative multi-platform defense mechanism. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increased to support assessment of laser-based soft kill system.				
Title: Emerging Overmatch Technologies 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 research will heavily leverage other efforts within PE 0602145A (Next Generation Combat Vehicle Advanced Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology). FY 2022 Plans: Will develop autonomous behaviors specific to perimeter defense and pursuit-evasion to adversarial threats, accounting for team maneuver relative to agents and anticipated attrition; develop autonomous tactical behaviors using simulation with cooperative teaming of up to seven friendly agents engaging a similarly sized adversarial team; validate autonomous behaviors in physical experiments with a minimum of three robotic vehicles. FY 2023 Plans: Will design, develop, and conduct experiments to validate technologies, coupled with autonomous behaviors, that illustrate concepts for autonomous ground combat, focused on lethality and protection; will 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; will generate and analyze effectiveness of concepts. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.		2.220	2.183	2.424
Title: Survivability/Lethality/Vulnerability Analysis Tools and Methodology		5.224	4.976	5.482

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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 2022 Plans: Will complete development of methodologies for a ballistic lethality analysis capability for NGCV Smart Munitions in Electronic Warfare (EW) congested environments, an Active Protection System soft kill analysis capability for Vehicle Protection Systems, and probabilistic analysis capabilities for teamed autonomous Unmanned Ground Vehicle systems in support of Robotic Combat Vehicle effectiveness performance trades. Will continue developing, refining and validation of multi-discipline analysis capabilities for Active Protection Systems in EW contested environments.</p> <p>FY 2023 Plans: Will mature capabilities to analyze and model the vulnerabilities of autonomous unmanned ground vehicle systems and teaming with other manned and unmanned systems; will develop methodology for assessing capabilities of active and adaptive armor mechanisms and protection systems against combined threats; will 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; will continue to design, develop and validate multi-discipline analysis capability and transition methodologies to computational models; will perform limited validation assessment of computational capabilities for the next generation combat vehicle smart munitions in electronic warfare congested environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Ground Systems Active Defense Technology Research</p> <p>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.</p> <p>FY 2022 Plans:</p>		5.721	5.570	6.682

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will investigate the integration of several novel survivability and protection technologies for emerging threats with complex defeat mechanisms. These technology concepts will be evaluated in advanced modeling and simulation (M&S) to create high fidelity integrated component concepts. The best performing concepts will be fabricated for physical testing to validate technology performance. Will leverage internal modelling and simulation capability to determine path forward for protection system and enhancements.</p> <p>FY 2023 Plans: Will 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. Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase is due to the need to validate the performance of the technology at the bench scale. The FY23 validation testing requires additional hardware and testing over what was done in FY22 in order to achieve statistical significance in the results in accordance with the project plan.</p>				
<p>Title: Advanced Threat APS Radar Technology</p> <p>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.</p> <p>FY 2022 Plans: Develop tools to support characterization of techniques. Perform study to identify and harness open RF and radar specific interfaces applicable to the APS mission. Perform study on timeline to counter stressing threats (KE rods) in support of developing radar resource management techniques to enable KE defeat and additional missions without increasing vehicle signature or adversely impacting the engagement timeline.</p> <p>FY 2023 Plans: Will 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. Will provide hard-kill active protection system impact analysis for addressing additional future armor piercing threats.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	3.087	3.400

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding change reflects planned lifecycle of this effort.				
Title: Detection Avoidance Applique Technology Research		-	-	0.621
FY 2023 Plans: Will investigate multiple passive signature management technologies and conduct experiments to characterize performance in spectrums of interest for new and existing ground combat vehicles. Will leverage modeling and simulation capabilities to define experimental plan.				
FY 2022 to FY 2023 Increase/Decrease Statement: The funding increase is due to the increase in effort for research of detection avoidance technology.				
Title: FY2022 SBIR/STTR Transfer		-	1.109	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		44.894	30.524	33.656
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BG8: <i>Obscuration Technology</i>	-	1.500	2.576	2.722	-	2.722	2.762	2.786	2.787	2.787	0.000	17.920

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 2021	FY 2022	FY 2023
Title: Obscuration Enabling Technologies	1.500	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 2022 Plans: Will investigate multi-spectral materials for obscuration use to defeat ground and aerial threats. Will develop and evaluate obscuration technologies for integration into the Air Domain (e.g., use obscuration to mask offensive aerial attacks, use obscuration to defend incoming aerial threats by masking/confusing guidance systems).			
FY 2023 Plans: Will mature risk factor mitigation technologies for bi-spectral materials that show promise to replace lower performing fielded bi-spectral obscurants. Will investigate improvements to advanced microwave obscuring materials. Will 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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding change reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer	-	0.094	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.500	2.576	2.722

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BH5: <i>Platform Electrification and Mobility Tech</i>	-	20.563	13.781	14.226	-	14.226	13.702	17.136	17.276	14.769	0.000	111.453

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.

This Project also continues the Advanced Vehicle Power Technology Alliance (AVPTA) between the Department of Energy and the Department of the Army with a focus on energy storage for electrification, 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 funds research energy storage 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 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 2021	FY 2022	FY 2023
Title: Scalable Electrification & Control Architecture	1.996	1.378	1.977
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 2022 Plans: Will mature high voltage power distribution component that enables electrified powertrains. Will validate the import/export power converter enabling fast vehicle charging from the grid.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will conduct experiments to optimize the design of the high voltage power converter enabling directed energy weapons, high voltage batteries, and fuel cells.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Increase reflects planned lifecycle of this effort, moving from early development to assembly and experimentation.</p>				
<p>Title: Platform Electrification Research</p> <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 2022 Plans: Will mature designs for internal components for electric generator. Will mature designs for electric drive motors. Will mature designs for final drive component of a modular electrification architecture. Will develop cells for increased energy storage systems. Will characterize module performance for modular high voltage energy storage system.</p> <p>FY 2023 Plans: Will validate the component level performance of the electric generator, electric drive motors, and final drive components of a modular electrification architecture. Will conduct experiments to quantify cell level performance of novel battery chemistry. Will design and develop a small integrated multi-cell module for high voltage storage system. Will develop concepts for plug-in hybrid combat vehicle technology focused on advanced batteries and compact electric sprocket drive systems. Will 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 2022 to FY 2023 Increase/Decrease Statement: This project was increased in order to investigate high speed battlefield charging that will be required for the Army to field battery dominant electrified vehicles.</p>		11.251	7.952	10.539
<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> <p>FY 2022 Plans: Will design and conduct experiments on critical track components, materials and joints to validate performance. Will also design and conduct experiments on critical suspension components to validate performance.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		3.322	1.979	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Research completed in Fiscal Year 2022 (FY22).				
Title: Advanced Distributed Power for Autonomous Systems		1.563	-	-
Description: This effort develops technologies for electrification of both manned and unmanned Next Generation Combat Vehicle platforms. Electrification of these platforms enables advanced lethality and protection systems, reduced battlefield fuel consumption, and provides new capabilities such as burst acceleration, extended silent mobility, and silent watch. This effort investigates 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 advanced artificial intelligence/machine learning (AI/ML) enabled autonomous control components and power management. Investigation of advanced control methods at the module and conversion component levels provides an understanding of the impact AI/ML and energy usage tracking can have on power optimization and mission effectiveness. The research enables the integration of components' status and behavior into system level management algorithms that support manned and autonomous operations while providing modular and scalable electrification architectures. This effort also investigates magnetic gear technologies that do not have physical connections connected to electrical motors and generators to reduce size and weight with increased reliability and performance providing increased torque, speed and range. Results of the research informs the Novel Propulsion Research effort in this Project.				
Title: Power Electronic Components and Materials		2.431	-	-
Description: This effort investigates 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 and packaging, and power switch module thermal management. Investigation high voltage/high frequency power semiconductor materials and devices concentrates on efficient power switching under military relevant temperature ranges. 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 will inform the Novel Propulsion Research effort in this Project.				
Title: Robotic Combat Vehicle Silent Watch and Mobility Range Extension		-	1.969	1.710
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.				
FY 2022 Plans:				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will mature metal supported solid oxide fuel cell technology and investigate approaches for increased density and faster start times on an integrated JP8 reformer and fuel cell technology.</p> <p>FY 2023 Plans: Will mature components for JP8 reformer with metal supported solid oxide fuel cell.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Decrease reflects planned lifecycle of this effort.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.503	-
Accomplishments/Planned Programs Subtotals		20.563	13.781	14.226
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 2023 Army	Date: April 2022
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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) BH9 / <i>Protection for Autonomous Systems Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BH9: <i>Protection for Autonomous Systems Tech</i>	-	0.146	-	-	-	-	-	-	-	-	0.000	0.146

A. Mission Description and Budget Item Justification

This Project analyzes the emerging requirements for the protection and survivability of future autonomous combat platforms. Studies will be conducted at both the platform and force level to identify unique survivability needs of these platforms. It will also mature component technologies to address identified capability gaps.

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.

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

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

	FY 2021	FY 2022	FY 2023
Title: Protection for Autonomous Systems	0.146	-	-
Description: This effort contributes to the Army's ground platform risk reduction efforts which that seek to address technical challenges of survivability and protection for autonomous systems. Specifically, this effort focuses on developing protection concepts for unique unmanned systems to ensure autonomous ground vehicles can continue their mission in contested environments.			
Accomplishments/Planned Programs Subtotals	0.146	-	-

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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BI2 / <i>Sensor Protection Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BI2: <i>Sensor Protection Technology</i>	-	7.390	5.829	6.229	-	6.229	5.508	5.922	8.407	7.677	0.000	46.962

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 2021	FY 2022	FY 2023
Title: Sensor Protection Technology	3.737	5.615	6.229
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 2022 Plans: Will conduct experiments with high transmission optical coatings on operationally equivalent sensor components to validate performance against metrics. Will mature out-of-band protective window coatings and validate performance against a selection			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>of emerging threats. Will develop protection approaches for uncooled sensors. Will investigate agile visible filter materials to determine protection thresholds.</p> <p>FY 2023 Plans: Will validate out-of-band longwave infrared (LWIR) window coatings against commercially available threats and begin to investigate coating performance against ultra-short pulsed lasers. Will conduct experiments validating the protection approaches of emerging high performance uncooled LWIR camera systems. Will determine capability gaps, and design and simulate mitigation techniques. Will validate effectiveness of visible filter materials against newly identified threats.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle for this effort.</p>				
<p>Title: Laser Protection Technologies</p> <p>Description: This effort develops new materials and devices for the protection of Army sensors and soldiers using day-view optical sights from a variety of laser threats. This research investigates 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 man-made 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.</p>		3.653	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.214	-
Accomplishments/Planned Programs Subtotals		7.390	5.829	6.229
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BL4: <i>Materials Application and Integration Tech</i>	-	4.378	7.648	7.722	-	7.722	7.941	7.466	7.001	6.999	0.000	49.155

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 2021	FY 2022	FY 2023
Title: Novel Armor Materials and Processes for Vehicle Protection	4.378	7.369	7.722
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 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will conduct microstructural assessments with load-state testing to characterize Aluminum-Magnesium alloy to correlate microstructural changes to meso- and macro-scale mechanical behavior for ballistic protection; examine potential for adhesively bonded multilayer composite structures to deflect incoming threats; develop a high toughness, low cost high hard steel alloy for weldable, bendable structural applications using in-house casting/processing capabilities and prior characterization and assessment of commercial alloys to; and optimize the engineering and manufacturing principles of high energy ball milling to effectively generate sufficient quantities of powders to fabricate oxide dispersion strengthened alloy plates for ground combat vehicle ballistic applications.</p> <p>FY 2023 Plans: Will design and develop novel aluminum-magnesium alloys based on microstructurally-informed models that meet Army objectives for ballistic performance without requiring additional processing. Will 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, will 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, will systematically investigate integration of shape changing molecules and dynamic bonding molecules into adhesively bonded multilayer composite structures for reducing damage under high rate impact. Will design and develop scalable chemical agent resistant coatings (CARC) that provide enhanced camouflage reflectance and chemical agent resistivity.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding reduced due to decrease in microstructural assessments of Aluminum-Magnesium alloys as part of the planned lifecycle of the effort.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.279	-
Accomplishments/Planned Programs Subtotals		4.378	7.648	7.722
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) BI4 / Materials Application and Integration Tech

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) B19 / <i>Vehicle System Security Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>B19: Vehicle System Security Technology</i>	-	2.676	2.359	-	-	-	-	-	-	-	0.000	5.035

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 2021	FY 2022	FY 2023
Title: Vehicle System Security Technology	2.676	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.			
FY 2022 Plans: Investigate and develop military vehicle resilient runtime hypervisor technology approaches to provide cyber-resiliency to military ground vehicles through the use of virtualized components to spin-up near instant replacements for compromised electronic control unit components. The hypervisor will provide full segmentation between operational and safety-critical vehicle databus messages.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) B19 / <i>Vehicle System Security Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
This project was ended to support higher Army priorities.			
Title: FY2022 SBIR/STTR Transfer	-	0.086	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.676	2.359	-

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 2023 Army **Date:** April 2022

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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BJ2: <i>Tactical and Navigation Lasers Sensors Technology</i>	-	5.372	5.364	5.673	-	5.673	5.765	5.818	5.816	5.814	0.000	39.622

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 2021	FY 2022	FY 2023
Title: Tactical and Navigation Lasers Sensors Technology	5.372	5.168	5.673
Description: This effort designs and develops novel low SWaP, compact, high peak power pulsed laser sources 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 2022 Plans: Will continue development of a brass-board, solid-state longwave infrared (LWIR) laser; mature the components to allow testing in field-relevant environment. Will conduct experiments to evaluate LWIR laser performance, when combined with pulse-detecting LWIR detector arrays, to determine effectiveness of detection of relevant threats, 3-dimensional imaging and targeting. Will demonstrate midwave infrared and LWIR pulse detection camera in laboratory environment.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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. Will mature LWIR laser sources combined with pulse-detecting LWIR detector arrays such as avalanche photodiodes to increase detection range and improve range resolution. Will design LWIR based three-dimensional (3-D) ranging components.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.196	-
Accomplishments/Planned Programs Subtotals		5.372	5.364	5.673
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BJ9: <i>Autonomous Mobility Tech</i>	-	2.407	3.811	-	-	-	-	-	-	-	0.000	6.218

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 2021	FY 2022	FY 2023
Title: Formation Control ? Novel Technique Investigation	2.407	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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Will improve and mature algorithms developed in FY21 that apply to formation control for autonomous maneuver in operationally relevant environments. Will conduct experiments to determine how well the ML data infrastructure and data sets support the autonomous system development and determine the applicability to NGCV.				
FY 2022 to FY 2023 Increase/Decrease Statement: This project completes in FY22 and transfers techniques to PE 0603462A / Next Generation Combat Vehicle Advanced Technology Project BK1: Autonomous Mobility Adv Tech to continue work in FY23				
Title: FY2022 SBIR/STTR Transfer		-	0.140	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		2.407	3.811	-
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK2: <i>Virtual Prototyping Technology</i>	-	5.191	8.169	9.622	-	9.622	9.866	9.878	10.579	10.577	0.000	63.882

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 analysis and requirements. 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, active protection systems, active blast, advanced lethality and robotic control and autonomy technologies. The NGCV Virtual Experiments (VEs) and System Integration Labs (SILs) provide an efficient means to give warfighters an up-front, virtual hands-on operational evaluation of next generation ground vehicle concepts, capabilities, and emerging technologies. The Virtual Prototyping results provide critical inputs to the Army's NGCV program by providing independent technical and operational performance results, as well as assessing trades for the Army's next generation of ground 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.

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 2021	FY 2022	FY 2023
Title: Virtual Prototyping	5.191	7.871	9.622
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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will use modeling and simulation to virtually design, develop, and assess new NGCV manned and unmanned systems that include projected far term lethality, mobility, sensing, and protection technologies. Will integrate these technologies into multiple optionally manned tank (OMT) and heavy robotic combat vehicle (RCV-H) trade analyses and NGCV requirements. Will use knowledge and analyses for investments and inform NGCV acquisition planning. Will implement a public private partnership with industry to generate additional OMT vehicle design concepts to expand the knowledge of enabling technologies, obtain innovative design approaches, and provide additional data analyses for multiple NGCV efforts. Will conduct Soldier-in-the-loop feedback to assess the government and industry OMT concepts for mission performance, Soldier OMT Tactics, Techniques, and Procedures (TTPs) for the new technologies and capabilities.</p> <p>FY 2023 Plans: Will 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. Will 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. Will 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. Will 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>FY 2022 to FY 2023 Increase/Decrease Statement: Increase in funding to investigate and develop experiments utilizing Soldier-in-the-loop and Hardware/Software-in-the-loop modeling and simulation technology. This effort will significantly reduce time/cost required by traditional physical demonstration programs and accelerating knowledge of emerging technologies.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.298	-
Accomplishments/Planned Programs Subtotals		5.191	8.169	9.622

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) BK2 / Virtual Prototyping Technology

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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>				Project (Number/Name) BK3 / <i>Next Gen Intelligent Fire Control (NG-IFC) Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK3: <i>Next Gen Intelligent Fire Control (NG-IFC) Tech</i>	-	16.676	0.962	-	-	-	-	-	-	-	0.000	17.638

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)

	FY 2021	FY 2022	FY 2023
<p>Title: Next Generation Intelligent Fire Control Technology</p> <p>Description: This effort investigates image sets for computer vision algorithms, target acquisition validation schemes and experimentation of large caliber armament systems.</p> <p>FY 2022 Plans: Will investigate various machine learning methods to process and prioritize target sets in a dynamic battlefield based on evolving mission objectives. Will conduct experiments to inform future fire control development, validation schemes, and evaluate platform components.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort completes in FY22 with transfer of technology to PE 0603462 Project BK4 Next Gen Intelligent Fire Control (NG- IFC) Adv Tech.</p>	4.043	0.926	-
<p>Title: FIRESTORM Applied Research</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>	12.633	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / <i>Next Generation Combat Vehicle Technology</i>	Project (Number/Name) BK3 / <i>Next Gen Intelligent Fire Control (NG-IFC) Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.036	-
Accomplishments/Planned Programs Subtotals	16.676	0.962	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) BK5 / Adv Direct In-Direct Armament Sys (ADIDAS) Tech
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BK5: Adv Direct In-Direct Armament Sys (ADIDAS) Tech	-	3.814	9.180	13.526	-	13.526	12.299	8.841	4.276	4.275	0.000	56.211

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)

Title: Advanced Lethality ? Kinetic Energy (AL-KE)	FY 2021	FY 2022	FY 2023
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.	1.432	1.390	1.671
FY 2022 Plans: Will investigate technologies to improve kinetic energy delivery at extended ranges to increase engagement distance and decrease engagement time, including work to investigate sensor fusion, real time processing and penetrator diversion techniques.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will Investigate direct fire kinetic energy cartridge technologies and novel kinetic energy lethal mechanisms to defeat future threat(s). Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: NGCV Penetrator Technology for Decisive Lethality</p> <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 2022 Plans: Will explore suitability of higher energy launchers for next generation armament systems; continue to identify and develop promising kinetic energy penetrator concepts to enable decisive lethality capabilities for the next generation of combat vehicles.</p> <p>FY 2023 Plans: Will investigate improvements in threat armor technology designed to protect against US systems. Will investigate attributes of promising penetrator concepts and identify suitable projectile technology to enable decisive lethality. Will refine attributes of high energy armaments and explore integration challenges.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects increase in research of projectile technologies.</p>		2.382	2.974	3.461
<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 2022 Plans:</p>		-	4.481	8.394

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Will investigate technologies for large caliber direct fire light-weight armament systems that exceed the performance of 120mm direct fire cannons. Will investigate technologies for rapid fire, on-the-move, compact ammunition design, accuracy and advanced recoil mitigation supporting future Army platforms.</p> <p>FY 2023 Plans: Will design and develop large caliber system and component technologies to increase direct fire lethal overmatch capabilities for current and future combat platforms. Will investigate system modeling and simulation techniques for assessing complex armament system component technologies including: fire control, weapon, and munition technologies. Will develop concepts to inform Army large caliber lethality.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: The program funding increase is part of the projected lifecycle for this effort to inform large caliber options for a range of Army platforms.</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.335	-
Accomplishments/Planned Programs Subtotals	3.814	9.180	13.526

<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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BP5: <i>Ground Vehicle Technology (CA)</i>	-	43.000	73.800	-	-	-	-	-	-	-	0.000	116.800

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 2021	FY 2022
<i>Congressional Add:</i> Program Increase - Modeling and Simulation <i>FY 2021 Accomplishments:</i> Conducted applied research in Modeling and Simulation. Work executed by Army Futures Command.	10.000	-
<i>Congressional Add:</i> Program Increase - Silicon Carbide Electronics <i>FY 2021 Accomplishments:</i> Conducted applied research in Silicon Carbide Electronics. Work executed by Army Futures Command.	6.000	5.500
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Silicon Carbide Electronics <i>Congressional Add:</i> Program Increase - Highly Electrified Vehicles <i>FY 2021 Accomplishments:</i> Conducted applied research in Highly Electrified Vehicles. Work executed by Army Futures Command.	5.000	5.000
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Highly Electrified Vehicles <i>Congressional Add:</i> Program Increase - Additive Metals Manufacturing <i>FY 2021 Accomplishments:</i> Conducted applied research in Additive Metals Manufacturing. Work executed by Army Futures Command.	10.000	-
<i>Congressional Add:</i> Program Increase - Prototyping Energy Smart Autonomous Ground Systems	12.000	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BP5 / <i>Ground Vehicle Technology (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<p>FY 2021 Accomplishments: Conducted applied research in Prototyping Energy Smart Autonomous Ground Systems.</p> <p>Work executed by Army Futures Command.</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Prototyping Energy Smart Autonomous Ground Systems</p>		
<p>Congressional Add: Advanced Materials Development for Survivability</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Advanced Materials Development for Survivability</p>	-	5.000
<p>Congressional Add: Advanced Optics Program</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Advanced Optics Program</p>	-	4.300
<p>Congressional Add: Digital Design and Simulated Testing</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Digital Design and Simulated Testing</p>	-	4.000
<p>Congressional Add: Fast-Refueling Fuel Cell Engines</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Fast-Refueling Fuel Cell Engines</p>	-	7.000
<p>Congressional Add: Hydrogen Technologies</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Hydrogen Technologies</p>	-	10.000
<p>Congressional Add: Machine Learning Optimized Power Electronics</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics</p>	-	3.000
<p>Congressional Add: Systems Engineering for Autonomous Ground Vehicles</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Systems Engineering for Autonomous Ground Vehicles</p>	-	9.000
<p>Congressional Add: Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms</p> <p>FY 2022 Plans: Congressional Interest Item funding provided for Vehicle Equivalency Framework Utilizing Multiple Additive Manufacturing Platforms</p>	-	5.000
<p>Congressional Add: Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles</p>	-	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BP5 / <i>Ground Vehicle Technology (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Virtual Experimentation of Autonomous and Non-Autonomous Combat Vehicles		
<i>Congressional Add:</i> Zero Emission Combat Vehicles	-	3.000
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Zero Emission Combat Vehicles		
Congressional Adds Subtotals	43.000	73.800

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology				Project (Number/Name) CU5 / Platform Agnostic Armaments Applied Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU5: Platform Agnostic Armaments Applied Technology	-	-	-	1.031	-	1.031	3.430	2.078	-	-	0.000	6.539

Note

This is a new start in FY 2023.

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 2021	FY 2022	FY 2023
Title: Platform Agnostic Armaments Technology	-	-	1.031
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.			
FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year (FY) 2023, this project is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	1.031

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602145A / Next Generation Combat Vehicle Technology	Project (Number/Name) CU5 / Platform Agnostic Armaments Applied 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 2023 Army											Date: April 2022	
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	202.256	164.804	64.115	-	64.115	81.095	78.963	70.347	69.293	0.000	730.873
AM6: Modular RF Communications Technology	-	3.810	-	-	-	-	5.960	8.271	-	-	0.000	18.041
AM8: Protected SATCOM Technology	-	4.813	1.703	-	-	-	6.570	11.930	3.628	2.218	0.000	30.862
AN3: Non Traditional Waveforms Technology	-	-	0.492	3.415	-	3.415	11.321	2.018	5.816	8.247	0.000	31.309
AN7: COE - Every Receiver is a Sensor Technology	-	2.976	2.492	2.543	-	2.543	1.039	-	-	2.104	0.000	11.154
AN9: UNT - Every Receiver is a Sensor Technology	-	1.925	1.963	2.074	-	2.074	2.106	2.103	2.104	-	0.000	12.275
AO2: Stand-In Advanced RF Effects (STARE)	-	4.223	1.972	-	-	-	-	-	-	-	0.000	6.195
AO4: Energy Efficient Devices Technology	-	5.454	5.710	5.480	-	5.480	5.564	5.613	5.615	5.614	0.000	39.050
AO5: Tag Track and Locate Small Satellites Technology	-	3.737	-	-	-	-	-	-	-	-	0.000	3.737
AP4: CEMA Camouflage Technology	-	9.559	-	-	-	-	-	-	-	-	0.000	9.559
AP5: Electronic Warfare Technology	-	2.878	2.928	5.246	-	5.246	5.331	5.359	2.854	2.853	0.000	27.449
AP7: Comms/Horiz Int for Army Mod Priorities Tech	-	2.914	-	-	-	-	-	-	-	-	0.000	2.914
AQ2: EW Techniques Technology	-	0.482	0.494	0.532	-	0.532	0.539	2.589	0.539	0.538	0.000	5.713
AQ7: High Tempo Data Driven Decision Tools Technology	-	2.701	-	1.289	-	1.289	1.300	2.338	2.339	4.126	0.000	14.093
AQ9: Expeditionary Data to Decisions Technology	-	2.760	-	-	-	-	-	-	-	-	0.000	2.760

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research					PE 0602146A / Network C3I Technology							
AR1: Robust, Resilient and Intelligent C3I Technology	-	13.599	10.510	-	-	-	-	-	-	-	0.000	24.109
AR3: Intelligent Environmental Battlefield Awareness	-	2.897	3.059	-	-	-	-	-	3.424	2.217	0.000	11.597
AR5: Understanding the Environment as a Threat Technolo	-	2.246	1.956	1.314	-	1.314	1.006	0.402	-	-	0.000	6.924
AR7: Sensing in Contested Environments Technology	-	1.820	1.192	-	-	-	-	-	-	-	0.000	3.012
AR9: Persistent Geophysical Sensing-Infrasound Tech	-	3.035	3.414	-	-	-	-	-	-	-	0.000	6.449
AT2: Subterranean Detection and Monitoring Technology	-	2.791	-	-	-	-	-	-	-	-	0.000	2.791
AT7: Network-Enabled GeoSpatial-GEOINT Services Tech	-	3.855	4.635	3.137	-	3.137	2.544	3.517	2.077	1.419	0.000	21.184
AT9: Tactical GeoSpatial Information Capabilities Techn	-	4.085	1.776	0.518	-	0.518	2.705	2.053	1.144	-	0.000	12.281
AU3: Geospatially Enabled Operational Design Technology	-	1.413	-	-	-	-	-	-	-	-	0.000	1.413
AV3: Foundational S&T for Network C3I Technology	-	1.927	4.657	0.743	-	0.743	1.467	2.555	11.323	10.216	0.000	32.888
AV5: Protective Technologies	-	7.411	7.549	6.428	-	6.428	6.524	6.583	6.585	6.583	0.000	47.663
AV6: Airborne Engineering Support Technology	-	0.866	-	-	-	-	-	-	-	-	0.000	0.866
AV7: Atmospheric Modeling and Meterological Technology	-	5.918	5.931	-	-	-	-	-	-	-	0.000	11.849
AV9: Advanced PNT for GPS Independent Environments Tech	-	6.656	10.117	8.850	-	8.850	8.982	8.747	8.697	8.694	0.000	60.743
AW1: Autonomous Navigation Technology	-	1.732	2.066	2.052	-	2.052	-	-	-	-	0.000	5.850

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity	R-1 Program Element (Number/Name)												
2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	PE 0602146A / <i>Network C3I Technology</i>												
AW3: <i>DoD PNT M&S Collaborative Initiative (CI) Technolo</i>	-	1.925	-	-	-	-	-	-	-	-	-	0.000	1.925
BP2: <i>Sensor and Electronic Network Initiatives (CA)</i>	-	90.500	80.300	-	-	-	-	-	-	-	-	0.000	170.800
BZ6: <i>Narrowband SATCOM Technology</i>	-	0.963	-	-	-	-	-	-	-	-	-	0.000	0.963
BZ8: <i>Aerial Teir Networking (High Altitude)</i>	-	0.385	-	-	-	-	-	-	-	-	-	0.000	0.385
CG3: <i>Assured PNT Communications Applied Research</i>	-	-	1.726	5.486	-	5.486	5.608	5.799	4.697	4.753	-	0.000	28.069
CI3: <i>Mobile and Survivable Command Post (MASCP) Tech</i>	-	-	6.236	5.728	-	5.728	3.254	0.607	0.607	0.607	-	0.000	17.039
CK1: <i>Assured PNT Enabling Technologies</i>	-	-	1.926	-	-	-	-	-	-	-	-	0.000	1.926
CU6: <i>Adaptive Information Mediation and Analytics</i>	-	-	-	7.089	-	7.089	7.194	7.232	7.235	7.233	-	0.000	35.983
CV4: <i>Pathfinder 3D Applied Technology</i>	-	-	-	2.191	-	2.191	2.081	1.247	1.663	1.871	-	0.000	9.053

Note

In Fiscal Year 2023 (FY23), Projects CU6 (Adaptive Information Mediation and Analytics) and CV4 (Pathfinder 3D Applied Technology) are New Starts.

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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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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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.

Research is 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.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	202.257	84.606	0.000	-	0.000
Current President's Budget	202.256	164.804	64.115	-	64.115
Total Adjustments	-0.001	80.198	64.115	-	64.115
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	80.300			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.001	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	64.115	-	64.115
• FFRDC Transfer	-	-0.102	-	-	-

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

Project: BP2: *Sensor and Electronic Network Initiatives (CA)*

Congressional Add: *Program Increase - Inertial Navigation Systems*

Congressional Add: *Program Increase - APNT for Autonomous Vehicles*

Congressional Add: *Program Increase - CHARM*

Congressional Add: *Program Increase - Energy Efficient Devices*

Congressional Add: *Program Increase - Integrating Energy and Computing Networks*

Congressional Add: *Program Increase - Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology*

	FY 2021	FY 2022
	10.000	-
	5.000	-
	5.000	-
	5.000	5.000
	10.000	-
	10.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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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<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>	FY 2021	FY 2022
Congressional Add: <i>Program Increase - APNT Distributed Antennae</i>	20.000	-
Congressional Add: <i>Program Increase: Urban Subterranean Mapping Technology</i>	4.000	4.000
Congressional Add: <i>Program Increase: Unmanned Sensors for Biological and Chemical Hazards</i>	2.000	-
Congressional Add: <i>Program Increase: Mobile Environmental Contaminant Sensors</i>	8.000	5.000
Congressional Add: <i>Program Increase: Multi-UAS Integrated ISR Technology</i>	3.000	-
Congressional Add: <i>Program Increase: Autonomous Platform Threat Detection Sensors</i>	6.000	-
Congressional Add: <i>Program Increase: Intelligent Electronic Protection Technology</i>	2.500	-
Congressional Add: <i>ALTNAV</i>	-	13.800
Congressional Add: <i>Anti-Tamper Technology</i>	-	5.000
Congressional Add: <i>Backpackable COMINT System</i>	-	5.000
Congressional Add: <i>Distributed Radio Frequency and Sensor Technology Development</i>	-	8.000
Congressional Add: <i>EW and Advanced Sensing</i>	-	6.500
Congressional Add: <i>Integrated Photonics for Contested RF Environments</i>	-	15.000
Congressional Add: <i>Mass-Distributed Acoustic Surveillance Network</i>	-	8.000
Congressional Add: <i>Social Network Analysis</i>	-	5.000
Congressional Add Subtotals for Project: BP2	90.500	80.300
Congressional Add Totals for all Projects	90.500	80.300

Change Summary Explanation

FY23 funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AM6 / Modular RF Communications Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AM6: Modular RF Communications Technology	-	3.810	-	-	-	-	5.960	8.271	-	-	0.000	18.041

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.

Research 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.

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

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

	FY 2021	FY 2022	FY 2023
Title: Modular Radio Frequency Communications Technology	3.810	-	-
Description: This effort investigates and develops techniques, methods, and standards for automation and intelligence to optimally route data among available radio frequency and networking technologies. This effort adds resiliency to the network through diversity and automation techniques to make automated network decisions, (e.g., automated PACE) for the tactical Army to maintain operation in continually changing environments.			
Accomplishments/Planned Programs Subtotals	3.810	-	-

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AM8: Protected SATCOM Technology	-	4.813	1.703	-	-	-	6.570	11.930	3.628	2.218	0.000	30.862

Note

In Fiscal Year 2023 (FY23) this Project transitions to Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AM9 (Protected SATCOM Advanced Technology).

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.

Research 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.

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

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

	FY 2021	FY 2022	FY 2023
<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> <p>FY 2022 Plans: Will investigate and design adaptive digital interference cancellation technology that adapts to changing contested environments for advanced fast moving waveforms, to improve satellite communications throughput.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort ends in FY22 and the work transitions to PE 0603463A (Network C3I Advanced Technology) / Project AM9 (Protected SATCOM Advanced Technology).</p>	4.813	1.639	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.064	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
<i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	4.813	1.703	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AN3 / Non Traditional Waveforms Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN3: Non Traditional Waveforms Technology	-	-	0.492	3.415	-	3.415	11.321	2.018	5.816	8.247	0.000	31.309

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, or anti-jam capabilities to tactical networks. This Project develops network resiliency for the dismounted and vehicular units through science & technology investigation.

Research 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.

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

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

	FY 2021	FY 2022	FY 2023
<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 2022 Plans: Will investigate the use of software-defined networking and virtualization techniques for the development of a modular networks architecture using techniques, such as distributed 5G; develop methods for device-to-device communications to minimize required infrastructure; and examine methods to improve low probability of intercept (LPI), low probability of detection (LPD), counter-geolocation, and anti-jam (AJ) performance of technologies, such as 5G cellular.</p> <p>FY 2023 Plans: Will 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. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding increase enables the study for tactical implementation of 5G technologies to deliver increased data rates and network capacities and increased anti-jam capability and reduced detectability and infrastructure demands in contested environment.</p>	-	0.474	3.415
<p>Title: SBIR/STTR Transfer</p>	-	0.018	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	0.492	3.415
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN7: COE - Every Receiver is a Sensor Technology	-	2.976	2.492	2.543	-	2.543	1.039	-	-	2.104	0.000	11.154

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.

Research 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.

Research in this Project is performed by the United States (U.S.) Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Data Analytics for Situational Awareness</p> <p>Description: This effort investigates and designs spectrum sensing, electronic sensing and intelligence collection technologies and analytics to enhance overall situational understanding within a contested battlespace. Efforts focus on developing the analytics necessary to taking advantage of the expanding number of data sources available by leveraging existing tactical receivers and other tactical data feeds.</p>	2.976	-	-
<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 2022 Plans:</p>	-	2.401	2.543

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Will investigate threat forecasting technologies needed to drive prioritization of ISR collections based on unit intelligence requirements and threat tactics, techniques, and procedures (TTPs); research sensor performance models necessary to predict sensor performance in real-world environments.</p> <p>FY 2023 Plans: Will investigate sensor scheduling optimization to include sensor selection and routing; will conduct experiment to support an initial capability to task full spectrum ISR sensor availability to units across the army; will investigate how to integrate national and Joint ISR capabilities via advanced sensor frameworks.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this task.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.091	-
Accomplishments/Planned Programs Subtotals	2.976	2.492	2.543

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 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AN9: UNT - Every Receiver is a Sensor Technology	-	1.925	1.963	2.074	-	2.074	2.106	2.103	2.104	-	0.000	12.275

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.

Research 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 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 2021	FY 2022	FY 2023
<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> <p>FY 2022 Plans: Will investigate high altitude, long, stand-off range Electronic Warfare capabilities to bring situational awareness and understanding to the tactical edge; and conduct laboratory experiments on advanced signal processing and antenna designs for use from high altitude, long-endurance platforms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned conclusion lifecycle of this task.</p>	1.925	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:</p>	-	-	2.074

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Will investigate and assess existing commercial investments in Simultaneous transmit and receive (STAR) technology for integration into EW/Cyber/SIGINT Army systems. FY 2022 to FY 2023 Increase/Decrease Statement: Funding for this effort begins in FY23			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.072	-
Accomplishments/Planned Programs Subtotals	1.925	1.963	2.074

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AO2: Stand-In Advanced RF Effects (STARE)	-	4.223	1.972	-	-	-	-	-	-	-	0.000	6.195

Note

In Fiscal Year 2023 (FY23) 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.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO3 (Stand-In Advanced RF Effects (STARE) 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.

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

<p>Title: STAND-IN Advanced RF Effects</p> <p>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.</p> <p>FY 2022 Plans: Will investigate hardware limitations at extremely high frequencies; design and develop a stable transceiver architecture with optimal component technologies; research scalable synchronization techniques for phase/clock/channel alignment between RF transceivers agnostic of use case; conduct RF transceiver synchronization experiments to explore the bounds of coherent multi-aperture beam forming; and investigate reconfigurable transceiver hardware to enable a widely-applicable architecture.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	FY 2021	FY 2022	FY 2023
	1.925	1.899	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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)

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding realigned to PE 0602146A (Network C3I Technology) / Project AP5 (Electronic Warfare Technology) to continue research into Combined and Distributed Electromagnetic Warfare.			
Title: Grey C3 Exploitation Technology Description: This effort investigates distributed EW techniques for grey-zone operations and designs algorithms for sparse detection and EW.	2.298	-	-
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.073	-
Accomplishments/Planned Programs Subtotals	4.223	1.972	-

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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AO4 / Energy Efficient Devices Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AO4: Energy Efficient Devices Technology	-	5.454	5.710	5.480	-	5.480	5.564	5.613	5.615	5.614	0.000	39.050

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.

Research 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 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 2021	FY 2022	FY 2023
Title: Energy Efficient Electronic and Photonic Components	5.454	5.501	5.480
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 2022 Plans:			
Will determine and resolve scale-up issues with fast charge anode materials; investigate tradeoffs in energy and rate capability for ultrafast charge graphite cells with high energy cathodes; explore additives and electrode coating techniques and improve power capability; design and develop batteries for fast charge systems to investigate concepts for Fast Efficient Energy Distribution; investigate coupled isotope/energy converter geometry and increased density packaging techniques to validate proof-of-principle isotope power source; explore the coupling of piezoelectric transformers with silicon integrated circuit envelope detectors and baseband electronics for wake-up receivers; design and develop two dimensional (2D) fabrication processes to reduce energy loss; investigate concepts to achieve responsivity for viable communications wavelength in the near-to-mid infrared (IR) regime			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
in topological materials based devices; develop energy efficient electronic components based on silicon, gallium nitride, and diamond semiconductor materials. FY 2023 Plans: Will investigate aluminum gallium nitride semiconductors as Ultraviolet (UV) sources for communications; Will investigate piezoelectric transformer performance with integrated circuit envelope detectors at 100-500 MHz frequencies; Will determine coupled magnetic acoustic matching for efficient wireless power transfer; Will investigate novel energy efficient transceiver architectures for radar applications; Will investigate novel silicon based field programmable neural array circuits for efficient computation close to the network edge. FY 2022 to FY 2023 Increase/Decrease Statement: Funding reduction due to decrease in 2D fabrication processes research.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.209	-
Accomplishments/Planned Programs Subtotals	5.454	5.710	5.480

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AO5 / Tag Track and Locate Small Satellites Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AO5: Tag Track and Locate Small Satellites Technology	-	3.737	-	-	-	-	-	-	-	-	0.000	3.737

A. Mission Description and Budget Item Justification

Tag, Track, and Locate Small Satellites Technology develops and adapts technologies for Space-Based and High Altitude applications for Army tactical ground forces. Efforts include the design and 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. Evaluations conducted leverage other Department of Defense (DoD) space science and technology applications to support Army space force enhancement and cooperative satellite payload development. Funds research in quantum sciences based communications, sensing, and data teleportation to mature current technologies for small spacecraft applications.

The research cited 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 Space and Missile Defense Command (USASMDC) in Huntsville, AL.

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

	FY 2021	FY 2022	FY 2023
Title: Tag Track and Locate Small Satellites	2.403	-	-
Description: This effort will design, develop, and adapt space-based technologies, components, and tools that lead to smaller, lighter, more responsive payloads and applications. These technologies allow for the rapid integration and development of tactical payloads in support of responsive space environments.			
Title: Space Components and Systems Assessment Technology	1.154	-	-
Description: This effort supports experimentation and validation of hardware and software components and models to further anchor laboratory capabilities enabling small spacecraft and payload design and development.			
Title: Starlink	0.180	-	-
Accomplishments/Planned Programs Subtotals	3.737	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AO5 / <i>Tag Track and Locate Small Satellites Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) AP4 / <i>CEMA Camouflage Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AP4: <i>CEMA Camouflage Technology</i>	-	9.559	-	-	-	-	-	-	-	-	0.000	9.559

A. Mission Description and Budget Item Justification

This Project develops and characterizes hardware and software to enable 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 our troops and put indirect fires onto our positions. This effort develops a holistic cross-domain analysis and assessment methodology for network and communication technologies faced with advanced 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.

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 2021	FY 2022	FY 2023
Title: Radio Frequency/Cyber Sensing and Deception Description: This effort develops technologies to avoid geolocation of blue force radio frequency (RF) emissions by peer/near-peer adversaries. Research will focus on developing low probability of detection (LPD) communications and decoys to increase freedom of maneuver while maintaining effective communications.	2.998	-	-
Title: Dynamic Intelligent Networks and Cyber Camouflage and Decoy for CEMA Description: This effort investigates techniques and develops methods for combining the physical RF and network (cyber) layers for enhanced effects when coupled with electromagnetic camouflage and decoy methods.	2.398	-	-
Title: Understanding, Protecting, and Enabling CEMA Effects 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 threats on operational networks; anechoic chamber, laboratory, and field measurements; 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 capabilities to anticipate 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.	2.145	-	-
Title: Vulnerability Analysis Methodology for CEMA Threats	2.018	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) AP4 / <i>CEMA Camouflage Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
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 methodology will be developed to investigate vulnerabilities of specific configurations of complex future networks with multiple communications modalities, advanced decoy techniques in the cyber and electromagnetic areas, and advanced Positioning, Navigation, and Timing (PNT) systems.			
Accomplishments/Planned Programs Subtotals	9.559	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AP5: <i>Electronic Warfare Technology</i>	-	2.878	2.928	5.246	-	5.246	5.331	5.359	2.854	2.853	0.000	27.449

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).

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 2021	FY 2022	FY 2023
<p>Title: Electronic Warfare Technology Research</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 2022 Plans: Will implement hardware-in-the-loop capability for multi-channel experiments with low-cost, distributed hardware; investigate spectrum analysis algorithms for Size, Weight, and Power (SwaP) constrained platforms; investigate techniques to characterize radio frequency (RF) emitter behavior; investigate implementation of cognitive radar threats in the hardware-in-the-loop laboratory environment; and develop tools to automate scenario generation in hardware-in-the-loop laboratory environment.</p> <p>FY 2023 Plans: Will validate concepts with multi-channel hardware-in-the-loop (HIL) experiments using low-cost distributed hardware; will implement algorithms for spectrum analysis for low SWaP platforms; will validate techniques for dynamic RF emitter characterization; will design experiments and validate complex and cognitive radar threats with research HIL environment; implement distributed and complex scenario generation tools with research HIL environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports additional experiments to validate radar threats.</p>	2.231	2.206	2.432
<p>Title: Electronic Warfare Assessment Technologies</p> <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</p>	0.647	0.615	0.675

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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 2022 Plans: Will converge EW and Cyber techniques into a comprehensive CEMA capability for assessment and analysis of advanced electromagnetic technologies. Apply advanced CEMA analytical capabilities to applicable network and horizontal integrated technologies and systems to assess defensive and cognitive EW in controlled environments, including hardware in the loop and linkage to operational mission simulations.</p> <p>FY 2023 Plans: Will initiate development of distributed EA within hardware-in-the-loop capability to analyze distributed EA operation and measures of effectiveness; will investigate and develop EW capabilities for assessment and analysis of advanced electromagnetic attack; will 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; will use AFC sponsored events such NetModX and PC to execute developed EA techniques and identify candidates for distributed EA operation.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<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: Will investigate, develop and assess stable transceiver architecture designs suitable for high carrier frequency and large signal bandwidth with optimal component technologies; Will validate techniques for scalable synchronization and multi-aperture beamforming from RF transceivers agnostic of use case; Will research methods for rapid technique generation and design reconfigurable transceiver hardware to enable a widely-applicable architecture; Will validate modeling and simulation framework with hardware experiments for scalability and synchronization for large-scale effects.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort commences in Fiscal Year 2023 (FY23).</p>		-	-	2.139
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>		-	0.107	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i>			
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.878	2.928	5.246

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AP7 / Comms/Horiz Int for Army Mod Priorities Tech
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AP7: Comms/Horiz Int for Army Mod Priorities Tech</i>	-	2.914	-	-	-	-	-	-	-	-	0.000	2.914

A. Mission Description and Budget Item Justification

This Project investigates the communication architectures of each of the Army's modernization priorities and determines technologies and components to enable assured and resilient communications and horizontal integration.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AP8 (Comms/Horiz Int for Army Mod Priorities 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.

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

	FY 2021	FY 2022	FY 2023
Title: Communications Support to Army Modernization Priorities / Horizontal Integration Fields Technology	2.914	-	-
Description: This effort investigates the communication architectures of each of the Army's modernization priorities and determines technologies and components to enable assured and resilient communications.			
Accomplishments/Planned Programs Subtotals	2.914	-	-

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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ2: <i>EW Techniques Technology</i>	-	0.482	0.494	0.532	-	0.532	0.539	2.589	0.539	0.538	0.000	5.713

A. Mission Description and Budget Item Justification

This Project develops countermeasures against adversarial counter-fire systems that obscure and create distractive blue force locations.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AO7 (EW for Maneuver Operations (EMO) 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 Army Futures Command (AFC).

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

	FY 2021	FY 2022	FY 2023
<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 2022 Plans: Will further investigate and experiment against modeled or representative threats to validate technical approach feasibility for EW effects against adversary counter-fire sensors and Intelligence, Surveillance, and Reconnaissance (ISR).</p> <p>FY 2023 Plans: Will validate electronic decoy techniques using advanced signal apertures via modeling and simulation. Will research techniques and waveforms for counter radar applications.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of project.</p>	0.482	0.476	0.532
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	0.018	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	0.482	0.494	0.532

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 2023 Army **Date:** April 2022

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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ7: High Tempo Data Driven Decision Tools Technology	-	2.701	-	1.289	-	1.289	1.300	2.338	2.339	4.126	0.000	14.093

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.

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 supports the Network Command, Control, Communications and intelligence (C3I) Army Modernization Priority.

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

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

	FY 2021	FY 2022	FY 2023
<p>Title: High Tempo Data Driven Decision Tools</p> <p>Description: Develops data driven decision tools that help develop cyber Situational Understanding (SU) for commanders and staff that will enable them to more quickly and accurately assess and integrate cyber impacts with all of the domains in Multi-Domain Operations (MDO) and to thereby enhance mission effectiveness by improving decision cycles.</p>	2.701	-	-
<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: Will 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. Will research and develop digital battle damage assessments and after action reports to automatically update proposed force structures and operations. Will 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 2022 to FY 2023 Increase/Decrease Statement:</p>	-	-	1.289

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
In FY23 this effort will build upon the High Tempo Data Driven Decision Tools effort to include the fusion of intelligence and operations information that enable faster decision making process.			
Accomplishments/Planned Programs Subtotals	2.701	-	1.289

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AQ9 / Expeditionary Data to Decisions Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AQ9: Expeditionary Data to Decisions Technology	-	2.760	-	-	-	-	-	-	-	-	0.000	2.760

A. Mission Description and Budget Item Justification

This Project investigates, codes and designs software, and algorithms that improve Mission Command by increasing situational understanding, via the intelligent sharing of data in degraded networks during high op-tempo missions or while under cyber-attack. This Project includes researching artificial intelligence techniques to improve decision making capacity across the battlefield by using software knowledge representation to model the mission, automate staff tasks, correlate and analyze information, and provide recommendations. These capabilities allow forces to maximize op-tempo and maintain strategic advantage.

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 2021	FY 2022	FY 2023
Title: Mission Command Technologies	0.890	-	-
Description: This effort investigates and designs components and technologies for agile, survivable, modular, non-traditional Command Post platforms to enable decentralized and distributed mission command operations in the future operating environment.			
Title: Camouflage, Concealment and Decoys	1.870	-	-
Description: This effort investigates 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. Designs 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.			
Accomplishments/Planned Programs Subtotals	2.760	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AQ9 / <i>Expeditionary Data to Decisions Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR1: Robust, Resilient and Intelligent C3I Technology	-	13.599	10.510	-	-	-	-	-	-	-	0.000	24.109

Note

This project is Terminated starting in Fiscal Year 2023 (FY23).

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.

Research 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 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 2021	FY 2022	FY 2023
Title: Intelligent Signal and Image Analytics for C3I	6.282	3.132	-
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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will develop artificial intelligence and machine learning (AI & ML) based analytics to process multi-modal data, both imaging based (electro-optical, infrared) and non-imaging based (acoustic, seismic, electric, and magnetic field sensing), for automated detection, classification, and tracking of targets from both ground and airborne platforms; develop synthetic data generation techniques for algorithm training to augment limited availability of real world data for robust signal and image analytics in operationally-relevant settings; understand three-dimensional (3-D) electric and magnetic-field sensors and sensing arrays for extremely low frequency imaging and electric power grid analysis for pattern of life analysis; continue research of infrasound through audible frequency sensors, algorithmic, and hardware solutions to automate target detection, tracking, and localization; and validate advanced seismic sensing for enhanced detection and localization of ground targets.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 the effort is Terminated</p>				
<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 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.</p> <p>FY 2022 Plans: Will implement real-time scene perception based algorithms for optimal relocation of sensor assets for robust target detection, classification, and tracking; design approaches for optimally determining sensor modality, parameters, and energy requirements for carrying out scene perception tasks in resource-constrained distributed network environments; implement light-weight machine learning architectures for real-time inference at the edge on low size, weight, and power (SWaP) computing devices utilizing both centralized and distributed processing frameworks; research and validate novel adaptive real-time multimodal sensing and processing methods using low-SWaP edge processing and mobile user interfaces and controls; validate deep sensing concepts by characterizing remote employment of sensors in a strategic and tactical scenario to enable autonomous threat detection, localization, and high confidence classification.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 the effort is Terminated</p>		5.336	5.067	-
<p>Title: Information Processing and Analysis</p>		1.981	1.928	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will investigate and conduct experiments that explore methods for intelligent information mediation and adaptive information representation; identify methods for accelerating decision support and information synthesis in SWaP and time constrained systems and adversarial environments; determine feasibility, viability, and limitations of data-driven, physics-guided information interaction and its impact on situational awareness in multi-modal, multi-perspective information representations in two-dimensional (2-D) and immersive adaptive interfaces; continue to examine quantitative information recommendation and filtering approaches such as Vol/QoI for policy-based and continuously-learned multi- sensor and multi-domain battlefield information-interaction.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 the effort is Terminated</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.383	-
Accomplishments/Planned Programs Subtotals		13.599	10.510	-
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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) AR3 / <i>Intelligent Environmental Battlefield Awareness</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR3: <i>Intelligent Environmental Battlefield Awareness</i>	-	2.897	3.059	-	-	-	-	-	3.424	2.217	0.000	11.597

Note

In Fiscal Year 2023 (FY23), this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).

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.

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 Engineer Research and Development Center and coordinated with the United States Army Futures Command.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AR4 (Intelligent Env Battlefield Awareness Adv Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Arctic Threat	1.442	0.856	-
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.			
FY 2022 Plans: Generate new input parameters for geospatial overlays that represent soil mechanics representing thaw effects based on terrain conditions and temperature extremes.			
FY 2022 to FY 2023 Increase/Decrease Statement: This effort ends in Fiscal Year 2022 with transition of applied technologies to Advanced Technology Development for demonstrating terrain state changes such as freeze/thaw, snowmelt, and ice vulnerability.			
Title: Geo-Forensics	0.675	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AR3 / Intelligent Environmental Battlefield Awareness		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Description: This effort generates data to develop the data mining framework and software tools to generate geo-referenced predictive map layers to inform mission planning and operational assessments for area denied sites.				
Title: Predictive Geographic Information System (GIS) Mapping (physical) 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. FY 2022 Plans: Consolidate geophysical data and begin parameterization for data input into unified geospatial framework. FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).		0.780	0.760	-
Title: Hydrology Mapping 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 2022 Plans: Develop predictions of soil moisture state, infiltration, and runoff that better reflect the high degree of spatial and temporal variability in ground and surface water. FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) Project CX3 (Intelligent Env Battlefield Awareness Apl Tech).		-	1.331	-
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement:		-	0.112	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AR3 / <i>Intelligent Environmental Battlefield Awareness</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	2.897	3.059	-

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 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR5: <i>Understanding the Environment as a Threat Technolo</i>	-	2.246	1.956	1.314	-	1.314	1.006	0.402	-	-	0.000	6.924

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 to Program element (PE) 0603463A (Network C3I Advanced Technology) / Project AR6 (Understanding the Environment as a Threat 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 Engineer Research and Development Center and coordinated with the United State Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: Predictions of Lethal Environments/ Computational Prediction of Threats in the Operational Environment	1.156	-	-
Description: This effort develops tools and models for the Soldier providing critical information of the operational environment allowing the Soldier to operate in, avoid, or prepare for contaminated battlefields.			
Title: Subsurface Forensics	1.090	1.884	1.314
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 2022 Plans: Consolidate candidate sensor technologies based on effectiveness and form/fit design constraints that detect and characterize hazards including water quality, explosive constituents, and non-weaponized radiological hazards.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Will develop techniques to achieve ultra-low detection levels of explosive constituents and non-weaponized radiological hazards for reverse-point sourcing threats. FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects the planned lifecycle of this effort to realign resources to PE 0603463A (Network C3I Advanced Technology) / Project AR6 (Understanding the Environment as a Threat Adv Tech) as applied technologies are transitioned for maturation and demonstration in the final years of the effort.				
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.072	-
Accomplishments/Planned Programs Subtotals		2.246	1.956	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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AR7: Sensing in Contested Environments Technology</i>	-	1.820	1.192	-	-	-	-	-	-	-	0.000	3.012

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX5 (Sensing in Contested Environments Technologies).

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.

Research in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AR8 (Sensing in Contested Environments 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 Engineer Research and Development Center and coordinated with the United States Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
<p>Title: Non-Traditional Threat Detection in Contested Environment</p> <p>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.</p> <p>FY 2022 Plans: Consolidate candidate sensor technologies based on effectiveness and form/fit design constraints that detect and characterize hazards including water quality, explosive constituents, and non-weaponized radiological hazards.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX5 (Sensing in Contested Environments Technologies).</p>	1.820	1.149	-
<p>Title: FY 2022 SBIR/STTR Transfer</p>	-	0.043	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AR7 / <i>Sensing in Contested Environments Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.820	1.192	-

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AR9: <i>Persistent Geophysical Sensing-Infrasound Tech</i>	-	3.035	3.414	-	-	-	-	-	-	-	0.000	6.449

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX4 (Persistent Geophysical Sensing-Infrasound Apl Tech).

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.

Research in this Project complements PE 0603463A (Network C3I Advanced Technology) / Project AS9 (Persistent Geophysical Sensing-Infrasound 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 conducted at United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	3.035	3.290	-
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 2022 Plans: Focus on algorithm research and development based on down-selected sources of interest as prioritized by stakeholders/ transition partners and complete a sensor placement optimization tool to evaluate alternate array geometries/sensor configurations.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
In FY23 this effort is realigned to PE 0602182A (C3I Applied Research) / Project CX4 (Persistent Geophysical Sensing-Infrasound Apl Tech).			
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.124	-
Accomplishments/Planned Programs Subtotals	3.035	3.414	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) AT2 / Subterranean Detection and Monitoring Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT2: Subterranean Detection and Monitoring Technology	-	2.791	-	-	-	-	-	-	-	-	0.000	2.791

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CX6 (Subterranean Detection and Monitoring Apl Tech).

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.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AT3 (Subterranean Detection and Monitoring Adv Tech).

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

Research in this Project is conducted at the United States Army Engineer Research and Development Center and coordinated with the United States Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: Subterranean Threat Assessment by Real-time Sensing	2.791	-	-
Description: This effort designs and develops an integrated suite of tunnel detection and persistent surveillance technologies to detect, track, and identify subsurface activities; expedient underground municipal infrastructure detection system; urban source characterization and modeling algorithms; expedient void detection systems in urban areas, and vulnerability assessment tools for the urban subterranean domain.			
Accomplishments/Planned Programs Subtotals	2.791	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AT2 / <i>Subterranean Detection and Monitoring Technology</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT7: Network-Enabled GeoSpatial-GEOINT Services Tech	-	3.855	4.635	3.137	-	3.137	2.544	3.517	2.077	1.419	0.000	21.184

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.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial and GEOINT Services AdvTech).

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United States Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: Geo-registration, Analytical Tool Development and Visualization	2.897	2.326	-
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.			
FY 2022 Plans: Advance the investigation of automated 3D data geo-registration techniques, and advance the development co-registration software algorithms applied to multi-temporal 3D terrain data sets.			
FY 2022 to FY 2023 Increase/Decrease Statement: This effort ends in FY22 with the transfer of applied technologies to PE 0603463A (Network C3I Advanced Technology) / Project AT8 (Network-Enabled GeoSpatial-GEOINT Services AdvTech).			
Title: Geospatial Data for Tactical Visualization	0.958	2.140	1.057

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<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 2022 Plans: Develop lightweight tools consistent with the Common Operating Environment computing environments for analytics, tiling, and streaming of 3D data. Investigate the integration of new geospatial data models that support 3D visualization, analysis and localization from a single source on tactical computing devices.</p> <p>FY 2023 Plans: Will develop the geospatial extraction and protocols to allow position-navigation self-localization capability on end-user systems. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease reflects planned lifecycle progression of transitioning work to advanced technology development 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: Will 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 2022 to FY 2023 Increase/Decrease Statement: New task will support focused development of integration of intelligence community databases.</p>	-	-	1.062
<p>Title: Geospatially Relevant Intuitive Propagation Services Technology</p>	-	-	1.018

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<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: Will investigate workflows within common operating environment to enable automated extraction of physical and operational parameters used in sensor performance analyses.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: New task will support optimized collection assets for enhanced situational awareness and targeting.</p> <p>Title: SBIR/STTR Transfer</p>			
<p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.169	-
Accomplishments/Planned Programs Subtotals	3.855	4.635	3.137

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AT9: Tactical GeoSpatial Information Capabilities Techn	-	4.085	1.776	0.518	-	0.518	2.705	2.053	1.144	-	0.000	12.281

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.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United State Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: 3D Terrain Analysis	2.654	1.711	-
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.			
FY 2022 Plans: Develop improved collection and processing of complex 3D urban terrain increasing processing time and accuracy, leveraging evolutionary improvements to airborne, ground-level, and interior, subterranean mapping collection capabilities.			
FY 2022 to FY 2023 Increase/Decrease Statement: This effort ends in Fiscal Year 2022 with the transfer of applied technologies to PE 0603463A (Network C3I Advanced Technology) / Project AU1 (Tactical GeoSpatial Information Capabilities ATech).			
Title: Airborne Light Detection and Ranging (LiDAR)	1.431	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Description: This effort investigates and develops enhanced Geiger-mode LiDAR hardware/software, for advanced testing of protocols, equipment, and products for improved high-altitude/wide area terrain data collection, to support tactical operations.</p> <p>Title: Geospatial Analytics and Prediction Technology</p>	-	-	0.518
<p>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.</p> <p>FY 2023 Plans: Will investigate optimized workflows for 3-Dimensional data from collection through product generation for building interiors and subterranean spaces.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: New task will support development of enhanced automated/semi-automated analysis tools.</p>	-	0.065	-
<p>Title: FY 2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.065	-
Accomplishments/Planned Programs Subtotals	4.085	1.776	0.518

<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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AU3 / Geospatially Enabled Operational Design Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AU3: <i>Geospatially Enabled Operational Design Technology</i>	-	1.413	-	-	-	-	-	-	-	-	0.000	1.413

A. Mission Description and Budget Item Justification

This Project investigates, advances and develops a geospatially enabled collaborative planning environment, accessible across echelons, with capabilities that support Army Design Methodology (ADM) by providing the ability to perform conceptual planning and problem framing, supporting a greater understanding and visualization of the dynamic operational environment, a shared understanding of the operations purpose across echelons, and enhanced products to drive detailed planning (Military Decision Making Process - (MDMP) and the operational assessment process, enhancing the collaborative interaction between commanders, staffs, and unified action partners.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AU4 (Geospatially Enabled Operational Design 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 Engineer Research and Development Center (ERDC).

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

	FY 2021	FY 2022	FY 2023
Title: Virtual Collaborative Operational Design (GEOD) Research	1.413	-	-
Description: This effort investigates automation technologies to digitally visualize, create and assess critical elements of the Operational Environment required to inform the Operational Design functions, including collaborative conceptual framing of the problem by examining the differences between the current state of an operational environment and the desired end state.			
Accomplishments/Planned Programs Subtotals	1.413	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV3: Foundational S&T for Network C3I Technology	-	1.927	4.657	0.743	-	0.743	1.467	2.555	11.323	10.216	0.000	32.888

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 2021	FY 2022	FY 2023
<p>Title: Development of Foundational technologies for holistic network integration</p> <p>Description: This effort develops underlying technologies applicable to next generation networks and integration of the same.</p>	1.927	-	-
<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 2022 Plans: Will investigate and research innovative emerging technologies focusing on network resiliency, artificial intelligence, and autonomy enabled machine learning technologies that will be integrated into a holistic network in support a Multi-Domain Operations (MDO) enabled environment.</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 2022 to FY 2023 Increase/Decrease Statement:</p>	-	4.487	0.743

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AV3 / <i>Foundational S&T for Network C3I Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Decrease in funding due to fewer requirements needed to complete identified efforts during the Fiscal Year 2022 (FY22) search process.			
Title: SBIR/STTR Transfer	-	0.170	-
FY 2022 Plans: Funding transferred in accordance with Title 15 USC 2638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC 2638			
Accomplishments/Planned Programs Subtotals	1.927	4.657	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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AV5: Protective Technologies	-	7.411	7.549	6.428	-	6.428	6.524	6.583	6.585	6.583	0.000	47.663

A. Mission Description and Budget Item Justification

This Project develops tools, devices, and techniques to protect acquisition program systems and Critical Program Information (CPI) from adversarial threats.

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 2021	FY 2022	FY 2023
<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 2022 Plans: Will develop additional technologies focused on the latest adversarial threats being faced by Army programs. Evaluate the technology protection requirements of Army and Department of Defense (DoD) programs; and develop technologies to assist those programs in maintaining their technological overmatch capabilities.</p> <p>FY 2023 Plans: Will develop advanced packaging microelectronics security solutions for anti-tamper application through continued rigor development and analysis. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort programmed in coordination with the DoD Executive Agent for Anti-Tamper.</p>	7.411	7.273	6.428
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	0.276	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	7.411	7.549	6.428

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) AV6 / Airborne Engineering Support Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AV6: Airborne Engineering Support Technology</i>	-	0.866	-	-	-	-	-	-	-	-	0.000	0.866

A. Mission Description and Budget Item Justification

This Project supports advanced Command, Control, Communications, Intelligence, Surveillance and Reconnaissance (C3ISR) research and development technologies for airborne, and air-to-ground based testing of emerging Radio Frequency (RF) 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.

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

	FY 2021	FY 2022	FY 2023
Title: Airborne Engineering Support Technology	0.866	-	-
Description: This effort supports the experimentation of new and emerging C3ISR technologies. This venue performs technology assessments by evaluating candidate technologies in support of the Army Modernization Priorities. Events are determined by the maturity of the tech base programs across the Army's Science and Technology (S&T) C3ISR portfolio.			
Accomplishments/Planned Programs Subtotals	0.866	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AV7: Atmospheric Modeling and Meteorological Technology</i>	-	5.918	5.931	-	-	-	-	-	-	-	0.000	11.849

Note

In Fiscal Year 2023 (FY23) this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CW2 (Exploitation of Atmospheric Impacts across Domains)

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 research 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 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)

Title: Atmospheric Characterization, Modeling, and Impacts	FY 2021	FY 2022	FY 2023
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.	5.918	5.714	-
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will conduct validation study of Atmospheric Boundary Layer Environment Lattice-Boltzmann Method (ABLE-LBM) in urban domains and mature Light Detection and Ranging (LiDAR) and radar assimilation methods building from initial Perdigo, Portugal field experiment data; develop and implement improved atmospheric acoustic propagation model with range dependence; investigate applicability of machine learning modeling based on heterogeneous sensor input to inform situational awareness; investigate machine algorithms to characterize and assess aerosols; experiment with the use of surrogate models to quantify uncertainty of impactful environmental conditions for autonomous flight of unmanned aerial systems (UASs); and investigate assimilation of multi-UAS sensing as constraints in simplified-physics or other surrogate models designed for low-resource platforms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding administratively realigned to PE 0602182A (C3I Applied Research) / Project CW2 (Exploitation of Atmospheric Impacts across Domains).</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.217	-
Accomplishments/Planned Programs Subtotals		5.918	5.931	-
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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AV9: Advanced PNT for GPS Independent Environments Tech</i>	-	6.656	10.117	8.850	-	8.850	8.982	8.747	8.697	8.694	0.000	60.743

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 research 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.

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 2021	FY 2022	FY 2023
Title: Precision Measurement Technology for Contested Environments	3.054	2.968	3.260
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 2022 Plans: Will iterate designs, fabricate, and validate performance of novel MEMS IMUs using advanced MEMS materials and micro-structures to develop path to low cost navigation grade MEMS IMUs accuracy and improved drift correction techniques in representative operational environments (temperature and vibration); study performance of chip-scale, low-noise stabilized frequency sources and integrated electro-optic frequency combs for low SWAP-C atomic clock designs to assess improved clock stability over relevant operating environments; develop algorithms to implement RF sources of opportunity and multi-sensor/multi-			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>waveband vision-based geo-localization and validate their performance on the PNT testbed; perform laboratory and relevant environment performance validation of low SWAP multi-node, anti-jam reception/operations of both GPS and 5G operations.</p> <p>FY 2023 Plans: Will develop chip embodiment of the self-stabilization circuitry for frequency stabilization of linked micro-resonator optical frequency combs; Will mature and optimize novel MEMS inertial sensors using advanced MEMS materials and micro-structures to develop path to low-cost, navigation-grade MEMS IMU accuracy and improved drift correction techniques tested over temperature; Will continue to validate performance of chip-scale, low-noise stabilized frequency sources and integrated frequency combs for low SWAP-C clocks; Will validate and optimize algorithms to process RF signals of opportunity and multi-sensor/multi-waveband vision-based geo-localization.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects 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 2022 Plans: Will assess high performance and reasonable SWAP atomic clock for platform and increased performance network applications and iterate design to increase hardening and manufacturability; will validate initial designs of low cost (<\$300 per unit) SWAP Chip-Scale Atomic Clock 2.0 (CSAC 2.0) for Soldier and small platform and munition applications; will iterate design, fabricate, and validate performance of first low cost SWAP CSAC 2.0; will investigate transition of government gyro designs (sub-component of high performance IMUs) to commercial partners to accelerate maturity of advanced government gyro capability; will validate a minimum of three heterogeneous sensor modalities into an embedded hybrid multi-sensor fusion engine with continuous Inertial Navigation System (INS) calibration capable of interfacing with the Department of Defense PNT Open Architecture standards; will validate multi-sensor fusion engine and perform continuous INS calibration in a relevant environment using the additional capability of the high performance and reasonable SWAP atomic clock to assess potential performance improvements of PNT calculations during GPS contested events.</p> <p>FY 2023 Plans: Will assess rackmount atomic clock under relevant environments and optimize design for ruggedization and clock manufacturing considerations; Will assess and optimize gyro and accelerometer performance with novel self-calibration techniques; Will validate</p>		3.602	6.779	5.590

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding reduction reflects decrease in research of heterogeneous sensor modalities that are embedded into a hybrid multi-sensor fusion engine.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.370	-
Accomplishments/Planned Programs Subtotals		6.656	10.117	8.850
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AW1: Autonomous Navigation Technology</i>	-	1.732	2.066	2.052	-	2.052	-	-	-	-	0.000	5.850

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

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AV8 (Navigation Warfare (NAVWAR) 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 2021	FY 2022	FY 2023
Title: Intelligent Electronic Protect (IEP)	1.732	1.990	2.052
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.			
FY 2022 Plans: Will continue to investigate assured access to PNT in contested electromagnetic environments; and validate unhindered access to military GPS level of accuracy. Will develop techniques to detect and identify radio frequency (RF) signals on a PNT system with minimal additional hardware. Will begin algorithm development to enhance integrity and graceful degradation in challenged environments.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
Will continue to mature techniques to detect and identify RF signals. Will conduct lab based experiments to validate the maturity and feasibility of algorithmic approach in GPS challenged environments. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.076	-
Accomplishments/Planned Programs Subtotals	1.732	2.066	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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AW3 / <i>DoD PNT M&S Collaborative Initiative (CI) Technolo</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AW3: <i>DoD PNT M&S Collaborative Initiative (CI) Technolo</i>	-	1.925	-	-	-	-	-	-	-	-	0.000	1.925

A. Mission Description and Budget Item Justification

This Project designs and develops Positioning, Navigation and Timing (PNT) modeling and simulation (M&S) frameworks and tools to provide Department of Defense (DoD) with the capability to conduct analysis and create quantifiable data on the impact of PNT technologies on warfighters and missions operating in a denied or degraded Global Positioning System (GPS) environment. Additionally, it provides senior leadership with the information required to understand the value of PNT investment versus the improvement in mission performance and operational effectiveness. This Project also assess the effectiveness and maturity of complementary PNT systems/sensors.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AW4 (DoD PNT M&S Collaborative Initiative (CI) 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.

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

	FY 2021	FY 2022	FY 2023
Title: DoD PNT M&S Collaborative Initiative	1.925	-	-
Description: This effort designs and develops PNT M&S frameworks and tools to provide DoD with the capability to conduct analysis and create quantifiable data on the impact of PNT technologies on warfighters and missions operating in a denied or degraded GPS environment. Additionally, it provides Senior leadership with the information required to understand the value of PNT investment versus the improvement in mission performance and operational effectiveness. This effort also assess the effectiveness and maturity of complementary PNT systems/sensors.			
Accomplishments/Planned Programs Subtotals	1.925	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) AW3 / <i>DoD PNT M&S Collaborative Initiative (CI) Technolo</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BP2: Sensor and Electronic Network Initiatives (CA)	-	90.500	80.300	-	-	-	-	-	-	-	0.000	170.800

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 2021	FY 2022
Congressional Add: Program Increase - Inertial Navigation Systems FY 2021 Accomplishments: Conducted applied research in Inertial Navigation Systems. Work executed by Army Futures Command.	10.000	-
Congressional Add: Program Increase - APNT for Autonomous Vehicles FY 2021 Accomplishments: Conducted applied research in APNT for Autonomous Vehicles. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - CHARM FY 2021 Accomplishments: Conducted applied research in CHARM. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase - Energy Efficient Devices FY 2021 Accomplishments: Conducted applied research in Energy Efficient Devices.	5.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022
Work executed by Army Futures Command.		
FY 2022 Plans: Congressional Interest Item funding provided for Energy Efficient Devices		
Congressional Add: Program Increase - Integrating Energy and Computing Networks FY 2021 Accomplishments: Conduct applied research in Integrating Energy and Computing Networks.	10.000	-
Work executed by Army Futures Command.		
Congressional Add: Program Increase - Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology FY 2021 Accomplishments: Conducted applied research in Artificial Intelligence and Machine Learning Electronic Warfare Sensor Technology.	10.000	-
Work executed by Army Futures Command.		
Congressional Add: Program Increase - APNT Distributed Antennae FY 2021 Accomplishments: Conduct applied research in APNT Distributed Antennae.	20.000	-
Work executed by Army Futures Command.		
Congressional Add: Program Increase: Urban Subterranean Mapping Technology FY 2021 Accomplishments: Conduct applied research in Urban Subterranean Mapping Technology.	4.000	4.000
Work executed by Army Futures Command.		
FY 2022 Plans: Congressional Interest Item funding provided for Urban Subterranean Mapping Technologies		
Congressional Add: Program Increase: Unmanned Sensors for Biological and Chemical Hazards FY 2021 Accomplishments: Conduct applied research in Unmanned Sensors for Biological and Chemical Hazards.	2.000	-
Work executed by Army Futures Command.		
Congressional Add: Program Increase: Mobile Environmental Contaminant Sensors FY 2021 Accomplishments: Conduct applied research in Mobile Environmental Contaminant Sensors.	8.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>	Project (Number/Name) BP2 / <i>Sensor and Electronic Network Initiatives (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Mobile Environmental Contaminant Sensors		
Congressional Add: Program Increase: Multi-UAS Integrated ISR Technology FY 2021 Accomplishments: Conduct applied research in Multi-UAS Integrated ISR Technology.	3.000	-
Work executed by Army Futures Command. Congressional Add: Program Increase: Autonomous Platform Threat Detection Sensors FY 2021 Accomplishments: Conducted applied research in Autonomous Platform Threat Detection Sensors.	6.000	-
Work executed by Army Futures Command. Congressional Add: Program Increase: Intelligent Electronic Protection Technology FY 2021 Accomplishments: Conducted applied research in Intelligent Electronic Protection Technology.	2.500	-
Work executed by Army Futures Command. Congressional Add: ALTNAV FY 2022 Plans: Congressional Interest Item funding provided for ALTNAV	-	13.800
Congressional Add: Anti-Tamper Technology FY 2022 Plans: Congressional Interest Item funding provided for Anti-Tamper Technology	-	5.000
Congressional Add: Backpackable COMINT System FY 2022 Plans: Congressional Interest Item funding provided for Backpackable COMINT System	-	5.000
Congressional Add: Distributed Radio Frequency and Sensor Technology Development FY 2022 Plans: Congressional Interest Item funding provided for Distributed Radio Frequency and Sensor Technology Development	-	8.000
Congressional Add: EW and Advanced Sensing FY 2022 Plans: Congressional Interest Item funding provided for EW and Advanced Sensing	-	6.500
Congressional Add: Integrated Photonics for Contested RF Environments	-	15.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) BP2 / <i>Sensor and Electronic Network Initiatives (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Integrated Photonics for Contested RF Environments		
<i>Congressional Add:</i> Mass-Distributed Acoustic Surveillance Network	-	8.000
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Mass-Distributed Acoustic Surveillance Network		
<i>Congressional Add:</i> Social Network Analysis	-	5.000
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Social Network Analysis		
Congressional Adds Subtotals	90.500	80.300

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / <i>Network C3I Technology</i>				Project (Number/Name) BZ6 / <i>Narrowband SATCOM Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BZ6: Narrowband SATCOM Technology</i>	-	0.963	-	-	-	-	-	-	-	-	0.000	0.963

A. Mission Description and Budget Item Justification

This Project designs and develops technologies to enable Army Narrowband Satellite Communications (SATCOM) networks to control traditional military tactical SATCOM along with non-traditional networks, such as commercial networks, to enable adaptability of the narrowband SATCOM network in a contested environment.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project AN2 (Narrowband SATCOM 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 2021	FY 2022	FY 2023
Title: Narrowband Satellite Communication Technology	0.963	-	-
Description: This project designs and develops technologies to enable Army Narrowband SATCOM networks to control traditional military tactical SATCOM along with non-traditional networks, such as commercial networks, to enable adaptability of the narrowband SATCOM network in a contested environment.			
Accomplishments/Planned Programs Subtotals	0.963	-	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) BZ8 / Aerial Teir Networking (High Altitude)			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BZ8: Aerial Teir Networking (High Altitude)	-	0.385	-	-	-	-	-	-	-	-	0.000	0.385

A. Mission Description and Budget Item Justification

This Project designs and develops technologies for aerial networking to establish line of sight and beyond line of sight communications.

The cited research 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 2021	FY 2022	FY 2023
Title: Aerial Tier Networking (High Altitude)	0.385	-	-
Description: Develop a Wideband Global Satellite Communications (WGS) surrogate payload for usage on a High Altitude Platform (HAP) with seamless transition to existing ground terminals by modifying existing solutions to support Network Modernization Capability Sets (CS) beginning with CS23 - Capacity & Resiliency.			
Accomplishments/Planned Programs Subtotals	0.385	-	-

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CG3: Assured PNT Communications Applied Research	-	-	1.726	5.486	-	5.486	5.608	5.799	4.697	4.753	0.000	28.069

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 (MDO). Space and High Altitude 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.

This Program Element (PE) designs and develops technologies for Space-Based and High Altitude 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.

Research complements 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.

Research in this Project is performed by the United States Army Space and Missile Defense Command (USASMDC) in Huntsville, AL.

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

	FY 2021	FY 2022	FY 2023
Title: Assured PNT Communications Applied Research	-	1.709	5.486
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 2022 Plans: Validate payload technologies in the lab to provide tactical land component forces with Space and High Altitude capabilities for force projection and maneuver during Multi-Domain Operations.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Maturation of quantum science-based crosslink communications, sensing, and data teleportation. Conduct a series of progressive tests assessing and verifying photonic information components for Space/HA sensor or Deep Sensing capabilities.</p> <p>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 transmission supporting moving platforms (ground, air, and space vehicles). Extend quantum science technologies to warfighter needs such as opportunities in ground launched systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase will support assessments of high altitude platforms and classified capabilities which support Tactical Land Component Forces with APNT capabilities; and component developments in the laboratory including the testing necessary for Army APNT payloads to be compatible with the high altitude platforms and classified capabilities.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC 638.</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC 7638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC 638.</p>	-	0.017	-
Accomplishments/Planned Programs Subtotals	-	1.726	5.486

<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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CI3: Mobile and Survivable Command Post (MASCP) Tech	-	-	6.236	5.728	-	5.728	3.254	0.607	0.607	0.607	0.000	17.039

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.

Research in this Project complements Program Element (PE) 0603463A (Network C3I Advanced Technology) / Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

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 (AFC).

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

	FY 2021	FY 2022	FY 2023
<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 2022 Plans: Will conduct gap and threat analysis of peer competitors; initiate market survey?s across the technology sectors applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution).</p> <p>FY 2023 Plans: Will research concepts refined from gap and threat analysis of peer competitors; will investigate technology solutions applicable to CP survivability (e.g., resilient communications, adaptable computing infrastructure, advanced energy sources and smart distribution); will conduct analysis and begin development of component level technologies to increase resiliency of Command Post specific communications systems.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	3.994	2.641

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Decrease in FY23 due to reduction in the development of component level technologies.				
<p>Title: Signature Management and Reduction Technology</p> <p>Description: Investigates and develops electromagnetic spectrum (EMS) management tools to model CP signatures and optimize the employment of CP nodes and communication assets.</p> <p>FY 2022 Plans: Will validate threat capability and develop electromagnetic spectrum models of threat and friendly emissions. Implement a software model that visualizes CP emissions and conduct user design workshops that inform EMS signature management options.</p> <p>FY 2023 Plans: Will continue validation of the software model for visualizing CP emissions to incorporate automatic recognition and learning of CP radio frequency signatures.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Increase in funding to support the development of software model for RF Signals due to new requirement from Cyber Center of Excellence (CCoE)</p>		-	1.341	2.491
<p>Title: Technology Supporting Camouflage, Concealment, and Deception</p> <p>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.</p> <p>FY 2022 Plans: Will investigate the use of natural fibers for use in camouflage materials; investigate the use of various materials for use in the physical assets to achieve more accurate signatures; conduct a feasibility study of active sensor identification systems; and investigate improvements to current CP infrastructure through the development of material solutions that will enable rapid set-up/tear down times, allow for longer loiter times and provide greater protection of command post structures and enclosures.</p> <p>FY 2023 Plans:</p>		-	0.673	0.596

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding in this effort reflects planned lifecycle of this effort.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.228	-
Accomplishments/Planned Programs Subtotals		-	6.236	5.728
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CK1: Assured PNT Enabling Technologies	-	-	1.926	-	-	-	-	-	-	-	0.000	1.926

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.

Research complements 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.

Research in this Project is performed by the United States Army Space and Missile Defense Command (USASMDC) in Huntsville, AL.

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

	FY 2021	FY 2022	FY 2023
Title: Assured PNT Enabling Technologies	-	1.855	-
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.			
FY 2022 Plans: Will design and develop an advanced laboratory testbed with the Mult-Axis Simulator (MAS) system that will be utilized to mature payloads for APNT, and optical/quantum secure communications on multiple simulated platforms simultaneously with hardware and software in the loop. Flight hardware will be designed to support delivery in early 2024 and for launch in 2025 to conduct			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) CK1 / <i>Assured PNT Enabling Technologies</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
experiments of the first US Army quantum entanglement transmission of data across free space for satellite-to-satellite and/or satellite-to-ground communications.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> In FY23 funding is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CZ6 (Assured PNT Enabling Applied Technology).			
<i>Title:</i> SBIR/STTR Transfer	-	0.071	-
<i>Description:</i> Funding transferred in accordance with Title 15 USC 638.			
<i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with title 15 USC 638.			
Accomplishments/Planned Programs Subtotals	-	1.926	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CU6 / Adaptive Information Mediation and Analytics
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU6: Adaptive Information Mediation and Analytics	-	-	-	7.089	-	7.089	7.194	7.232	7.235	7.233	0.000	35.983

Note

This is a new start in FY 2023.

In Fiscal Year 2023 (FY23) this Project is a New Start.

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.

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

Title: Adaptive Cross Reality Information Mediation	FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2023 Plans: Will 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 (Vol/QoI); Will investigate the utilization of ubiquitous Internet of Things (IoT) (smart) sensors to augment situational awareness and understanding and hence, increase effectiveness of military operations; Will investigate methods for resilient information network and processing which integrate 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</p>	-	-	2.115

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
constrained tactical networks; Will explore methods for improving an immersive Common Operating Picture (COP) by designing cross reality technology to support synthetic data.				
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is a New Start				
Title: Multi-Domain Information Analytics (MDIA)		-	-	4.974
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.				
FY 2023 Plans: Will 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); Will 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; Will validate the AiTR algorithms using collected field data; Will investigate algorithm-architecture co-optimization frameworks with Field Programmable Gate Arrays (FPGAs) to increase neural network inference speed through optimal algorithm mapping to hardware; Will 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-PNT) uses; Will 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; Will research techniques to develop and characterize synthetic data sets that include novel synthetic objects and backgrounds; Will experiment with larger and more varied synthetic augmentations to traditional training data sets; Will identify and correlate effects of synthetic training data augmentation to trained object classifier performance; Will develop methodologies to enhance classification performance against uncommon targets with synthetic training data augmentation; Will develop methods for incorporating synthetic scenes, real scenes, and SA in AI-driven multi-echelon C2 simulations.				
FY 2022 to FY 2023 Increase/Decrease Statement:				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
In FY23 this effort is a New Start			
Accomplishments/Planned Programs Subtotals	-	-	7.089

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology				Project (Number/Name) CV4 / Pathfinder 3D Applied Technology			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CV4: Pathfinder 3D Applied Technology	-	-	-	2.191	-	2.191	2.081	1.247	1.663	1.871	0.000	9.053

Note

This is a new start in FY 2023.

In Fiscal Year 2023 (FY23) this Project is a New Start.

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.

The research cited 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 Engineer Research and Development Center (ERDC) and coordinated with the United State Army Futures Command.

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

	FY 2021	FY 2022	FY 2023
Title: PATHFINDER 3-D Navigation Technology	-	-	2.191
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: Will 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; will investigate routing capabilities, sensors and a basic inertial accuracy for VTRAN Geospatial solutions.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is a New Start			
Accomplishments/Planned Programs Subtotals	-	-	2.191

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army Date: April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602146A / Network C3I Technology	Project (Number/Name) CV4 / Pathfinder 3D Applied Technology
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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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	119.007	93.785	43.029	-	43.029	39.089	30.354	38.136	49.951	0.000	413.351
<i>AE7: Land-Based Anti-Ship Missile (LBASM) Technology</i>	-	21.849	14.053	-	-	-	-	-	-	-	0.000	35.902
<i>AF1: Long Range Maneuverable Fires (LRMF) Technology</i>	-	-	5.033	2.595	-	2.595	-	-	-	-	0.000	7.628
<i>AF3: Extended Range Propulsion Technology</i>	-	6.354	9.886	8.834	-	8.834	11.152	-	4.135	14.297	0.000	54.658
<i>AF8: Affordable Extended Range Precision Technology</i>	-	8.181	8.684	9.609	-	9.609	9.885	9.082	9.285	9.594	0.000	64.320
<i>AG4: Extended Range Artillery Munition Suite Technology</i>	-	8.351	11.151	6.434	-	6.434	5.562	9.289	12.884	14.440	0.000	68.111
<i>AG6: Energetic Materials and Advanced Processing Techno</i>	-	3.430	3.468	3.664	-	3.664	-	-	-	-	0.000	10.562
<i>AH4: Precision and Coop Weapons in a Denied Env Tech</i>	-	9.277	9.427	9.163	-	9.163	8.911	9.189	9.037	8.826	0.000	63.830
<i>BN5: Fuze and Power for Munitions</i>	-	1.065	2.583	2.730	-	2.730	3.579	2.794	2.795	2.794	0.000	18.340
BO9: WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)	-	60.500	29.500	-	-	-	-	-	-	-	0.000	90.000

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 2023 Army **Date:** April 2022

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 Assistant 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	119.007	64.285	0.000	-	0.000
Current President's Budget	119.007	93.785	43.029	-	43.029
Total Adjustments	0.000	29.500	43.029	-	43.029
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	29.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	43.029	-	43.029

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

Project: BO9: *WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)*

Congressional Add: *Program Increase - Precision Strike Munitions*

Congressional Add: *Program Increase - Extended Range Hybrid and Precision Gun Launched Projectiles*

Congressional Add: *Program Increase - Novel Printed Armament Components*

Congressional Add: *Program Increase: Advanced Materials for Missile Applications*

Congressional Add: *Program Increase - Phase Changing Hydrogen Fuel Program*

Congressional Add: *Extended Range Propulsion Technology*

Congressional Add: *High Speed Structures for Advanced Materials*

Congressional Add Subtotals for Project: BO9

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	4.000	-
	15.000	10.000
	6.500	3.000
	20.000	-
	15.000	-
	-	6.500
	-	10.000
Congressional Add Subtotals for Project: BO9	60.500	29.500
Congressional Add Totals for all Projects	60.500	29.500

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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*

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AE7: Land-Based Anti-Ship Missile (LBASM) Technology	-	21.849	14.053	-	-	-	-	-	-	-	0.000	35.902

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 Assistant 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 2021	FY 2022	FY 2023
<p>Title: Land Based Anti-Ship Missile Technology</p> <p>Description: Investigate and develop critical technologies that enable High Mobility Artillery Rocket System (HIMARS) and Multiple Launch Rocket System (MLRS) rocket/missile artillery systems to destroy enemy air defenses in the land and the maritime domains.</p>	9.710	-	-
<p>Title: Precision Strike Missile Modular Payload Technology</p> <p>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.</p> <p>FY 2022 Plans: Will advance the designs for payload subsystems including ISR sensor, signal processing, datalink, propulsion, and deployment mechanization; will initiate hardware fabrication of payload subsystems including ISR sensor, signal processing, datalink,</p>	12.139	13.540	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
propulsion, and deployment mechanization; and will develop system and subsystem level high fidelity modeling and simulations to assess integrated performance. FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned into PE 0603464A (Long Range Precision Fires Advanced Technology) in support of the long range fires required under MDO.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.513	-
Accomplishments/Planned Programs Subtotals		21.849	14.053	-
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 2023 Army **Date:** April 2022

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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AF1: Long Range Maneuverable Fires (LRMF) Technology	-	-	5.033	2.595	-	2.595	-	-	-	-	0.000	7.628

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 Assistant 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 2021	FY 2022	FY 2023
<p>Title: Long Range Maneuverable Fires (LRMF) Technology</p> <p>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.</p> <p>FY 2022 Plans: Will determine system level technical requirements for next generation Precision Strike Missile capability; will develop system concepts; will identify subsystem functional and technical requirements; will determine critical technology requirements; and will investigate subsystem/component designs.</p> <p>FY 2023 Plans: Will design and develop critical combined cycle propulsion technologies for integration into the Precision Strike Missile (PrSM) and assess autonomy technologies for unmanned launcher operation.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to PE 0603464A 0603464A (Long Range Precision Fires Advanced Technology) / AF2 (Long Range Maneuverable Fires (LRMF) Advanced Tech).</p>	-	4.849	2.595
<p>Title: FY2022 SBIR/STTR Transfer</p>	-	0.184	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	5.033	2.595
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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AF3: Extended Range Propulsion Technology	-	6.354	9.886	8.834	-	8.834	11.152	-	4.135	14.297	0.000	54.658

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 Assistant 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 2021	FY 2022	FY 2023
Title: Extended Range Propulsion Technology	6.354	9.526	8.834
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 2022 Plans: Will conduct experiments and ground testing of semi-free jet air-breathing propulsion subsystems alternatives that can dramatically increase the range of rocket/missile artillery systems in the same form factor as traditional solid propellant rocket motor subsystems; will determine the viability of advanced propellant processing techniques via actual composite and minimum smoke propellant processing and static motor testing; will determine plume signature management technologies through static motor testing.			
FY 2023 Plans: Will complete flight weight combined cycle air-breathing propulsion subsystem design and begin fabrication and integration for follow-on experiments and assessments. Will expand and validate a propulsion modeling toolkit that allows rapid motor			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
development; will continue developing new mixing techniques to produce higher performance propellants; will determine optimized parameters for advanced, high energy propellants that will improve long range performance capability. FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease due to reduced flight weight experimentation and assessments for the development of the air-breathing propulsion subsystem technology.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.360	-
Accomplishments/Planned Programs Subtotals		6.354	9.886	8.834
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 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AF8: Affordable Extended Range Precision Technology	-	8.181	8.684	9.609	-	9.609	9.885	9.082	9.285	9.594	0.000	64.320

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 Assistant 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 2021	FY 2022	FY 2023
Title: LRPF High Payoff Missile Technology	8.181	8.367	9.609
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 2022 Plans: Will continue to develop and mature integrated board level sensor-on-a-chip utilizing advanced thermal management techniques; will develop advanced materials modeling/optimization techniques and evaluate emerging high temperature materials to reduce weight and further extend the range of long range missiles; will design and develop advanced navigation and alternate navigation approaches; will refine concepts and evaluate through modeling and simulation long range, low altitude datalink technologies and communication architectures.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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 2022 to FY 2023 Increase/Decrease Statement: Funding increase required to broaden investigation of advancements in high temperature materials and technologies required for future missile efforts in the Long Range Precision Fires Army Modernization Priority area.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.317	-
Accomplishments/Planned Programs Subtotals	8.181	8.684	9.609

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AG4: <i>Extended Range Artillery Munition Suite Technology</i>	-	8.351	11.151	6.434	-	6.434	5.562	9.289	12.884	14.440	0.000	68.111

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 Assistant 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 2021	FY 2022	FY 2023
<p>Title: Precision At Range Technologies</p> <p>Description: Investigates technologies that provide affordable precision capabilities for projectiles fired into Global Positioning System (GPS) denied environments.</p> <p>FY 2022 Plans: Will investigate Electro-Optical/Infra-Red (EO/IR) Seeker performance including imaging detectors, optics trains, and supporting electronics for processing target recognition software integrated into a 155mm precision guided munition. Will conduct target data collections to inform algorithm development in advanced precision seekers. Will validate seeker sensor and algorithm modeling and simulation (M&S) performance against real world data. Will design and develop component technologies such as tactical grade Inertial Measurement Unit (IMU) hardware to ensure gun-launch survivability.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Effort is complete in FY22</p>	3.151	3.087	-
<p>Title: Extended Range Artillery Munition Suite Enabling Technologies</p>	1.997	1.935	2.133

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will mature component technologies for extended range artillery projectiles through novel and improved algorithms using refined guidance and navigation system design concepts; conduct component level experiments to validate modeled performance to determine Size, Weight, and Power (SWaP) allocations required for future munition systems; will investigate solutions to enable in-flight, intra-munition communications, enhancing performance against targets in highly cluttered environments.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding reflects planned lifecycle for this effort.</p>				
<p>Title: Optionally Manned Artillery Platform Technology</p> <p>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</p> <p>FY 2022 Plans: Will investigate sensing technologies to improve spatial awareness for optionally manned artillery loading operations. Will investigate and design solutions to increase the speed of automated fuze setting for artillery autoloader applications. Will design solutions for prognostic systems to unburden the soldier during artillery loading operations and investigate an open architecture to enable connection to an optionally manned hull. Will design automated resupply component technologies and conduct experiments to define requirements for automated resupply.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Efforts in support of 6.2 activities are complete in FY22.</p>		3.203	2.786	-
<p>Title: Large Caliber Cannon Technologies</p>		-	2.936	3.198

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will investigate technologies to improve the life and performance of large caliber cannons. Will investigate: novel materials and impacts on dynamic strain using multiscale modeling, residual stress through triaxial stress/strain measurements of cannon tubes, novel refractory coating technologies, and barrel cooling techniques to reduce temperature rise at high rates of fire. Will conduct experiments and modeling to mature component technologies for future armament systems.</p> <p>FY 2023 Plans: Will continue to investigate and develop technologies to improve the life and performance of large caliber cannons. Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding reflects planned life cycle for this effort.</p>				
<p>Title: Precision Munitions Technology</p> <p>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.</p> <p>FY 2023 Plans: Will design munition precision technology enablers including: RF converged seeker technologies, gun hardened inertial navigation systems, and on-board targeting algorithms. Will investigate small form factor gun hardened systems to evaluate performance against aerial and ground targets. Will validate modeling and simulation results of Integrated Aerial Defense System (IADS) penetration by precision artillery munitions.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	-	1.103

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Increase in funding to develop technologies necessary for large caliber armaments to reach with enhanced precision aerial and ground targets in degraded and contested environments.			
Title: FY2022 SBIR/STTR Transfer	-	0.407	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	8.351	11.151	6.434

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AG6: <i>Energetic Materials and Advanced Processing Techno</i>	-	3.430	3.468	3.664	-	3.664	-	-	-	-	0.000	10.562

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 Assistant 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 2021	FY 2022	FY 2023
Title: Scale-up of Insensitive Energetic Materials	3.430	3.341	3.664
Description: Conduct research to advance the maturity of disruptive energetic materials.			
FY 2022 Plans: Will develop synthesis processes and fabrication of energetic materials applicable to a wide range of additive manufacturing technologies, and conduct experiments of additive energetic components; will develop embedded ignition concepts for additively manufactured gun propulsion charges and conduct advanced ignition experiments; will continue to conduct experiments of Electrically Controlled Energetic Materials (ECEM) formulations; will design and develop next generation post launch propulsion on gun launched concepts for extended range.			
FY 2023 Plans: Will validate the synthesis and fabrication of energetic materials applicable to a wide range of additive manufacturing technologies; . Will conduct experiments of additive energetic components and novel energetic materials initiated with additive energetic component materials to reduce sensitivity; . Will design energetic processing technologies for advanced energetic materials.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.			
Title: FY2022 SBIR/STTR Transfer	-	0.127	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		3.430	3.468	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 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AH4: Precision and Coop Weapons in a Denied Env Tech	-	9.277	9.427	9.163	-	9.163	8.911	9.189	9.037	8.826	0.000	63.830

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 2021	FY 2022	FY 2023
Title: Munition Navigation Technology in Contested Environments	4.919	4.817	-
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).			
FY 2022 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>localization (UMAL), UMAL-Aided anchored localization, formation control, multi-agent tracking, and weapon-target assignment; will conduct experiments on mid-course navigation technologies and data collection for terminal guidance algorithms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to ?Foundational Weapons Flight and Guidance Technology in Extreme Environments? in this Project.</p>				
<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 loads encountered during high speed/long time flights). These technologies include the maneuvering airframe, control actuation, and flight control algorithms.</p> <p>FY 2022 Plans: Will conduct experiments to validate spiral technologies for long range precision fires airframe design concepts and characterization, control actuation, guidance and flight control algorithms; will conduct analysis of unique ballistic launch and flight system simulations to characterize hypersonic flight behaviors.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to ?Foundational Weapons Flight and Guidance Technology in Extreme Environments? in this Project.</p>		4.358	4.266	-
<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: Will 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</p>		-	-	9.163

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from ?Munition Navigation Technology in Contested Environments? and ?Munition Maneuvering Technology in Extreme Environments? within this Project.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.344	-
Accomplishments/Planned Programs Subtotals		9.277	9.427	9.163
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BN5: Fuze and Power for Munitions	-	1.065	2.583	2.730	-	2.730	3.579	2.794	2.795	2.794	0.000	18.340

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 Assistant 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 2021	FY 2022	FY 2023
<p>Title: Advanced Energetics</p> <p>Description: This effort develops advanced fuze and power technologies for future munition applications that enable an increase in range and lethality, of ammunitions.</p> <p>FY 2022 Plans: Will conduct experiments to mature components and algorithms for tracking proximity sensors; will design fuze breadboards for wireless setting and advanced multi-point initiation architectures; will conduct power source performance predictions and investigations of experimental materials. This effort will continue to leverage the Office of the Secretary of Defense (OSD) Joint Munitions Program TCG-3 and the OSD Joint Fuze Technology Program.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	1.065	2.488	2.730
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>	-	0.095	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		1.065	2.583	2.730
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 2023 Army **Date:** April 2022

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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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BO9: WEAPONS & MUNITIONS TECH PROGRAM INITIATIVE (CA)	-	60.500	29.500	-	-	-	-	-	-	-	0.000	90.000

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 2021	FY 2022
Congressional Add: Program Increase - Precision Strike Munitions FY 2021 Accomplishments: Conducted applied research in Precision Strike Munitions. Work executed by Army Futures Command.	4.000	-
Congressional Add: Program Increase - Extended Range Hybrid and Precision Gun Launched Projectiles FY 2021 Accomplishments: Conducted applied research in Extended Range Hybrid and Precision Gun Launched Projectiles. Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Extended Range and Hybrid Gun Launched Unmanned Aerial System	15.000	10.000
Congressional Add: Program Increase - Novel Printed Armament Components FY 2021 Accomplishments: Conducted applied research in Novel Printed Armament Components.	6.500	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
Work executed by Army Futures Command.		
FY 2022 Plans: Congressional Interest Item funding provided for Novel Printed Armament Components		
Congressional Add: Program Increase: Advanced Materials for Missile Applications	20.000	-
FY 2021 Accomplishments: Conducted applied research in Advanced Materials for Missile Applications.		
Work executed by Army Futures Command.		
Congressional Add: Program Increase - Phase Changing Hydrogen Fuel Program	15.000	-
FY 2021 Accomplishments: Conducted applied research in Phase Changing Hydrogen Fuel Program.		
Work executed by Army Futures Command.		
Congressional Add: Extended Range Propulsion Technology	-	6.500
FY 2022 Plans: Congressional Interest Item funding provided for Extended Range Propulsion Technology		
Congressional Add: High Speed Structures for Advanced Materials	-	10.000
FY 2022 Plans: Congressional Interest Item funding provided for High Speed Structures for Advanced Materials		
Congressional Adds Subtotals	60.500	29.500

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	169.536	133.158	69.348	-	69.348	70.393	54.454	54.510	64.216	0.000	615.615
AI5: Next Gen Tactical UAS TD Technology	-	7.518	-	-	-	-	-	-	-	-	0.000	7.518
AI9: Future UAS Engine Technology	-	2.939	3.129	-	-	-	-	-	-	-	0.000	6.068
AJ2: Next Generation Rotorcraft Transmission Technology	-	3.971	4.153	-	-	-	-	1.503	2.449	1.503	0.000	13.579
AJ4: Digital Vehicle Management and Control Technology	-	6.222	-	-	-	-	-	-	-	-	0.000	6.222
AJ6: Advanced Rotors Technology	-	2.377	2.447	-	-	-	-	-	-	-	0.000	4.824
AJ8: Experimental and Computational Aeromechanics Techn	-	5.076	5.977	-	-	-	-	-	-	-	0.000	11.053
AK2: Aviation Survivability Technology	-	21.158	2.161	1.236	-	1.236	-	-	-	-	0.000	24.555
AK4: Multi-Role Small Guided Missile Technology	-	7.463	3.736	-	-	-	-	-	-	-	0.000	11.199
AK9: Adv Teaming for Tactical Aviation Operations Tech	-	13.531	13.978	14.546	-	14.546	14.798	14.785	14.786	14.782	0.000	101.206
AL2: High Performance Computing for Rotorcraft App Tech	-	1.148	1.169	-	-	-	-	-	-	-	0.000	2.317
AL4: High Speed and Efficient VTOL Vehicle Technology	-	1.444	1.466	-	-	-	-	-	-	-	0.000	2.910
AL5: Air Vehicle Structures and Dynamics Technology	-	2.792	2.799	-	-	-	-	-	-	-	0.000	5.591

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602148A / Future Vertical Lift Technology
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AL8: Holistic Situational Awareness and Dec Making Tech	-	1.757	0.889	-	-	-	-	-	-	-	0.000	2.646
AM4: Opt Energy Stg & Therm Mgmt for FVL Survivability	-	8.531	-	-	-	-	-	-	-	-	0.000	8.531
BP7: Future Vertical Lift Air Platform Tech (CA)	-	75.000	42.000	-	-	-	-	-	-	-	0.000	117.000
BZ7: Future Vertical Lift Medical Technologies	-	7.911	7.818	7.503	-	7.503	7.494	7.249	7.237	7.347	0.000	52.559
CC3: FVL Radar Technologies	-	0.698	0.444	-	-	-	-	5.159	3.570	3.569	0.000	13.440
CG9: Adapt & Resilnt Tact Autnmy Cont & Struct Tech	-	-	6.507	-	-	-	-	-	-	-	0.000	6.507
CH2: Air Launched Effects Technology	-	-	7.567	4.168	-	4.168	4.293	3.464	3.361	3.256	0.000	26.109
CH3: Holistic Team Survivability Technology	-	-	11.217	10.819	-	10.819	10.992	10.982	10.986	3.461	0.000	58.457
CH4: Power & Thermal Management for FVL Tech	-	-	7.175	7.613	-	7.613	7.713	7.721	7.697	7.694	0.000	45.613
CI4: Adaptive Avionics Technologies*	-	-	-	-	-	-	1.001	3.591	3.592	3.591	0.000	11.775
CI5: High Speed Maneuverable Missile (HSMM) Tech	-	-	8.526	23.463	-	23.463	24.102	-	0.832	19.013	0.000	75.936

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

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).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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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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).

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	169.536	91.411	0.000	-	0.000
Current President's Budget	169.536	133.158	69.348	-	69.348
Total Adjustments	0.000	41.747	69.348	-	69.348
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	42.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	69.348	-	69.348
• FFRDC Transfer	-	-0.253	-	-	-

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 - Additive Manufacturing of Multifunctional Composite Aerospace Components*

Congressional Add: *Program Increase: Advanced Rotary Wing Materials and Structures*

Congressional Add: *Program Increase: Adaptive Flight Control Technology*

Congressional Add: *Program Increase: Lightweight Hybrid Composite Medium Caliber Barrels*

Congressional Add: *Program Increase: Technology Transfer and Innovation*

Congressional Add: *Program Increase - Self-Sealing Fuel Tanks 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*

	FY 2021	FY 2022
	5.000	5.000
	5.000	-
	5.000	-
	4.000	7.000
	20.000	-
	5.000	-
	6.000	-
	15.000	15.000
	10.000	5.000
	-	5.000
	-	5.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 0602148A / <i>Future Verticle Lift Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2021	FY 2022
Congressional Add Subtotals for Project: BP7	75.000	42.000
Congressional Add Totals for all Projects	75.000	42.000

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) A15 / <i>Next Gen Tactical UAS TD Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>A15: Next Gen Tactical UAS TD Technology</i>	-	7.518	-	-	-	-	-	-	-	-	0.000	7.518

A. Mission Description and Budget Item Justification

This Project utilizes improved computer modeling fidelity to investigate the effects that potential Future Unmanned Aircraft System (FUAS) 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 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 UAS from the cockpit or a crew station. This Project will assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios.

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 2021	FY 2022	FY 2023
Title: Systems Concepts Studies for Air Launched Effects	7.518	-	-
Description: Investigates and models air vehicle concepts to understand the effects that potential operational Air Launched Effects capabilities will have on air vehicle properties.			
Accomplishments/Planned Programs Subtotals	7.518	-	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) A19 / <i>Future UAS Engine Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>A19: Future UAS Engine Technology</i>	-	2.939	3.129	-	-	-	-	-	-	-	0.000	6.068

Note

In Fiscal Year 2023 (FY23) funding is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CW6 (Future UAS Propulsion Technology).

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)

Title: Multi-fuel Capable Hybrid Electric Propulsion	FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will combine robust ignition assistant, non-intrusive ignition sensing method, and real-time fuel property sensor to prove the concept of external energy assisted ignition of low ignition quality jet fuels; will complete reduced-order design tool for aviation turbocharger and design of aviation turbocharger, will investigate the major components for lightweight compact aviation electrified turbocharger; will validate the hybrid-electric optimization tool with experimentally obtained data.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	2.939	3.014	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) A19 / <i>Future UAS Engine Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding administratively realigned to PE 0602183A (Air Platform Applied Research) / Project CW6 (Future UAS Propulsion Technology) in FY23.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.115	-
Accomplishments/Planned Programs Subtotals	2.939	3.129	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) AJ2 / <i>Next Generation Rotorcraft Transmission Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AJ2: Next Generation Rotorcraft Transmission Technology</i>	-	3.971	4.153	-	-	-	-	1.503	2.449	1.503	0.000	13.579

Note

In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research / Project CW8 (Next Generation Aviation Transmission Apl Tech)).

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 2021	FY 2022	FY 2023
<p>Title: High Reduction Ratio Transmission 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 2022 Plans: Will develop and fabricate corrosion resistant steel transmission components and advanced seals that improve reliability for High Reduction Ratio Transmission (HRT) design. Will begin testing of components to verify material performance under high loads, high speeds, and corrosive environments</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding is administratively realigned to PE 0602183A (Air Platform Applied Research) / Project CW8 (Next Generation Aviation Transmission Apl Tech) in FY23.</p>	3.971	4.001	-
<p>Title: FY2022 SBIR/STTR Transfer</p>	-	0.152	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AJ2 / <i>Next Generation Rotorcraft Transmission Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		3.971	4.153	-
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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AJ4 / Digital Vehicle Management and Control Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AJ4: Digital Vehicle Management and Control Technology</i>	-	6.222	-	-	-	-	-	-	-	-	0.000	6.222

A. Mission Description and Budget Item Justification

This Project investigates potential manned Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) fly-by-wire & fly-by-light rotor/flight control and autonomy for active rotor and compound concepts. It also investigates, matures, and harmonizes leap-ahead autonomy, structures, controls technologies, concepts, and capabilities which enable combat mission success across the family of manned/unmanned FVL platforms.

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 2021	FY 2022	FY 2023
Title: Adaptive and Resilient Tactical Autonomy, Controls, and Structures Tech	6.222	-	-
Description: Develop autonomy, controls, and structures technologies to ensure mission success for manned/unmanned, multiple capability set Future Vertical Lift platforms in the contested environment of multi-domain operations.			
Accomplishments/Planned Programs Subtotals	6.222	-	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AJ6 / Advanced Rotors Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AJ6: Advanced Rotors Technology	-	2.377	2.447	-	-	-	-	-	-	-	0.000	4.824

Note
In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CW3 (Advanced Rotors Applied Technology).

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 2021	FY 2022	FY 2023
<p>Title: Advanced Rotors Technology</p> <p>Description: Investigate advanced rotor blade and hub technologies to support goals of increased speed and reduced drag by developing low weight rotors and hub configurations that increase hover and cruise efficiency.</p>	2.377	-	-
<p>Title: Advanced Hubs</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 2022 Plans: Will conduct design trades to start technology down-selection for advanced rotor system hubs; and will commence conceptual design studies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	2.358	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
In FY23, this effort is administratively realigned to Program Element 0602183A / Air Platform Applied Research, project CW3 / Advanced Rotors Applied Technology.			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.089	-
Accomplishments/Planned Programs Subtotals	2.377	2.447	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AJ8: Experimental and Computational Aeromechanics Techn</i>	-	5.076	5.977	-	-	-	-	-	-	-	0.000	11.053

Note

In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CW5 (Experimental and Computational Aeromechanics Tech).

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 2021	FY 2022	FY 2023
<p>Title: Experimental Aeromechanics for FVL</p> <p>Description: Develop and explore new methods to simulate aerodynamic effects for future FVL configurations.</p> <p>FY 2022 Plans: Will conduct test of new winged compound rotorcraft configurations at high speed with auxiliary propulsion to provide fundamental understanding and validation data for computational tools; will investigate state of the art of measurement & diagnostics techniques for rotorcraft; will test rotor blade structural deformation and boundary layer transition using embedded sensor.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is administratively realigned to PE 0602183A (Air Platform Applied Research) / Project CW5 (Experimental and Computational Aeromechanics Tech).</p>	2.909	3.632	-
<p>Title: Computational Aeromechanics for FVL</p>	2.167	2.121	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AJ8 / <i>Experimental and Computational Aeromechanics Techn</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Description: Investigate experimental aeromechanics technologies and test methods for FVL.</p> <p>FY 2022 Plans: Will verify and validate new high-fidelity computational tools for aeromechanics analysis of FVL rotorcraft with a focus on interactional aerodynamics problems that are seen in these new FVL designs. Will automate the application of these computational tools in order to maximize their impact on FVL aircraft development.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is administratively realigned to PE 0602183A (Air Platform Applied Research) / Project CW5 (Experimental and Computational Aeromechanics Tech).</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.224	-
Accomplishments/Planned Programs Subtotals		5.076	5.977	-
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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol</i> <i>ogy</i>				Project (Number/Name) AK2 / <i>Aviation Survivability Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AK2: Aviation Survivability Technology</i>	-	21.158	2.161	1.236	-	1.236	-	-	-	-	0.000	24.555

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.

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 2021	FY 2022	FY 2023
<p>Title: Cognitive Countermeasures Technology Development</p> <p>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 (CM) capability for target defeat, regardless of threat characteristics or guidance mode.</p>	1.991	-	-
<p>Title: Reconfigurable Transformational Optics/Task based Display</p> <p>Description: This effort will deliver reconfigurable micro- and nano-scale filtering devices enabling frequency agile multi-task sensors. This will permit enhanced survivability of the FVL platforms with restored visual overmatch in any (day/night) environment. This will allow visual penetration of natural obscurants (e.g. brownout, white out) or custom man-made obscurants (e.g. engineered smokescreens) from a single sensor, as well as narrowband filtering for active imaging through obscurants. Improved detection and identification capability will result from filtering out scattered light and enabling 3-dimensional ranging through environmental obscurants. Wavelength agile imaging systems will be delivered that are capable of penetrating and imaging through a variety of obscurants and that are compatible with the FVL platforms.</p>	5.283	-	-
<p>Title: Multispectral Threat Warning and Countermeasures</p>	0.997	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Description: This effort investigates and evaluates software and warning sensor/counter measure components to increase probability to detect and defeat current and evolving small arms and man-portable air defense system (MANPADS) type threats for FVL platforms using modeling and simulation (M&S) and hardware in the loop (HWIL) simulations.</p>			
<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 2022 Plans: Will design and develop novel miniaturized Radio Frequency Countermeasure (CM) components. Will conduct experiments to verify radio frequency output from pyrotechnic sub-component. Will design and develop new pyrotechnic formulations, validate existing models through simulations, and update models as required for Advanced Seeker Countermeasures.</p> <p>FY 2023 Plans: Will conduct experiments on miniaturized electronics and antenna for active Radio Frequency countermeasure technologies. Will design and develop modeling and simulation techniques supporting countermeasure development and future applications.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease due to realignment to PE 0602141A (Lethality Technology) / Project AH9 (Advanced Warheads Technology) for exploration of novel pyrotechnics technologies for application across all Army priorities.</p>	2.612	2.081	1.236
<p>Title: Advanced Survivability Concepts</p> <p>Description: This effort will provide analysis of the rapidly evolving and emerging threat environment and impacts to FVL platforms. This effort will also provide advanced teaming algorithms for survivability.</p>	4.148	-	-
<p>Title: Electronic Warfare Air Sensors / Countermeasure</p> <p>Description: This effort investigates and develops Electronic Warfare (EW) survivability technologies to enable the detection and defeat of advanced threats. It provides algorithms, sensors, and effectors that are robust to advanced threat characteristics and operate effectively across the distributed team of FVL aircraft.</p>	6.127	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>	-	0.080	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i>				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		21.158	2.161	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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) AK4 / <i>Multi-Role Small Guided Missile Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AK4: <i>Multi-Role Small Guided Missile Technology</i>	-	7.463	3.736	-	-	-	-	-	-	-	0.000	11.199

Note

In Fiscal Year 2023 (FY23) funding for this effort is realigned to Project Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / Project AK5 (Multi-Role Small Guided Missile Advanced Tech).

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 2021	FY 2022	FY 2023
Title: Multi-Role Guided Missile - Extended Range Technology	4.362	-	-
Description: Identify, demonstrate, analyze, and assess key component technologies to support non-line-of-sight missile development providing man-in-the-loop situational awareness, targeting, and high value target defeat for Aviation platforms that can successfully operate in Anti-Access/Area Denial / Integrated Air Defense System (A2AD/IADS) environments.			
Title: Multiple Simul Engagement Technologies (MSET)	3.101	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.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AK4 / <i>Multi-Role Small Guided Missile Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Will combine lower-level component simulations to form system-level simulation. Will verify component performance predictions to aid in design refinement and overall performance predictions. Will mature component designs based on simulation results. FY 2022 to FY 2023 Increase/Decrease Statement: Effort continues in PE 0603465A (Future Vertical Lift Advanced Technology) / Project AK5 (Multi-Role Small Guided Missile Advanced Tech) for maturation and demonstration of component technologies.				
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.137	-
Accomplishments/Planned Programs Subtotals		7.463	3.736	-
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 2023 Army **Date:** April 2022

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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AK9: Adv Teaming for Tactical Aviation Operations Tech</i>	-	13.531	13.978	14.546	-	14.546	14.798	14.785	14.786	14.782	0.000	101.206

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 2021	FY 2022	FY 2023
Title: Advanced Teaming Concepts	9.643	8.052	8.495
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 2022 Plans: Will further develop and enhance technologies that provide UAS team of teams coordinated mission planning and execution, fused team situational awareness for autonomous mission adaptation, and electronic warfare employment all while operating in GPS denied and communications degraded conditions.			
FY 2023 Plans: Will 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. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: Intelligent Unmanned Aerial System Teaming Technologies	3.888	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022	
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 2021	FY 2022
<p>Description: Enables the establishment of component technologies to support resilient, multi-modal, survivable 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.</p>			
<p>Title: Enhanced Optics for Long Range Targeting</p> <p>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.</p> <p>FY 2022 Plans: Will investigate materials and efficiency of non-traditional off-axis style optical systems for range performance; will design and develop field-selectable spectral bandpass filters for operation near cryogenic dewars to penetrate obscurants while minimizing photon noise, enabling multi-task sensing (e.g. long range targeting, brownout penetration, disturbed earth detection) from a single sensor; will investigate active sensor components for three-dimensional (3-D) Imaging; will conduct experiments on the material growth process for a new optical lens for multi-band targeting sensors to enable greater sensitivity and range performance.</p> <p>FY 2023 Plans: Will conduct experiments on the efficacy, performance, and durability of newly available optical materials. Will validate optical performance of field-selectable spectral bandpass filters to determine impacts to multiple tasks needed in a dynamic airborne environment. Will mature optical lens material manufacturability of novel dual-band crystalline materials for use in advanced targeting applications. Will conduct experiments to determine the range resolution achievable for day/night airborne active 3-D imaging.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	5.416
<p>Title: FY2022 SBIR/STTR Transfer</p>		-	0.510
			6.051

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) AK9 / <i>Adv Teaming for Tactical Aviation Operations Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	13.531	13.978	14.546

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AL2: High Performance Computing for Rotorcraft App Tech	-	1.148	1.169	-	-	-	-	-	-	-	0.000	2.317

Note

In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project DC2 (High Performance Computing for Rotorcraft Apl Tech).

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 2021	FY 2022	FY 2023
Title: High Performance Computing for Rotorcraft App Tech	1.148	1.126	-
Description: Investigate new high performance and parallel computing efforts in support of FVL platforms.			
FY 2022 Plans: Will develop new computational software tools for rotorcraft aeromechanics analysis that leverage the power of high-performance computers to produce high-accuracy results for vehicles with complex aerodynamic interactions among their component parts. Will improve the computational speed of these high-fidelity simulations so that they can be routinely used in rotorcraft design and optimization processes for FVL vehicles.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is administratively realigned to PE 0602183A (Air Platform Applied Research) / Project DC2 (High Performance Computing for Rotorcraft Apl Tech).			
Title: FY2022 SBIR/STTR Transfer	-	0.043	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AL2 / <i>High Performance Computing for Rotorcraft App Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		1.148	1.169	-
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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) AL4 / <i>High Speed and Efficient VTOL Vehicle Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AL4: High Speed and Efficient VTOL Vehicle Technology</i>	-	1.444	1.466	-	-	-	-	-	-	-	0.000	2.910

Note

In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CW7 (High Speed and Efficient VTOL Vehicle Tech).

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 2021	FY 2022	FY 2023
Title: High Speed & Efficient Vertical Take-off and Landing	1.444	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.			
FY 2022 Plans: Will apply deep learning methods to build a diagnostic analytical tool for UH-60 Black Hawk; will select materials and design for a half-weight hybrid transmission gear.			
FY 2022 to FY 2023 Increase/Decrease Statement: Administrative realignment to PE 0602183A (Air Platform Applied Research) / Project CW7 (High Speed and Efficient VTOL Vehicle Tech) in FY23.			
Title: FY2022 SBIR/STTR Transfer	-	0.054	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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) AL4 / <i>High Speed and Efficient VTOL Vehicle Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	1.444	1.466	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AL5: Air Vehicle Structures and Dynamics Technology	-	2.792	2.799	-	-	-	-	-	-	-	0.000	5.591

Note

In Fiscal Year 2023 (FY23) this Project is administratively realigned to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CW4 (Air Vehicle Structures and Dynamics Tech).

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 2021	FY 2022	FY 2023
Title: Aeromechanics and Aeroelasticity of Future Air Vehicle Platforms	2.792	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.			
FY 2022 Plans: Will investigate fluid-structure interaction models to inform the structural design of an adaptive unmanned aerial system (UAS) with enhanced aerodynamic performance; will develop tools and methods for multi-disciplinary and multi-dimensional design optimization of future and non-traditional UAS and assessment of emergent technologies; will conduct wind tunnel experiments to investigate the effects of hinge-less rotor and control parameters on tiltrotor aircraft stability to enable faster, more efficient,			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) AL5 / <i>Air Vehicle Structures and Dynamics Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
and sustainable tiltrotor aircraft; will perform analysis and wind-tunnel experimentation to assess passive and active whirl-flutter mitigation technologies; will perform high-fidelity computational aeromechanics modeling of novel blade concepts to enable rotor with improved performance and noise characteristics; will couple acoustics prediction models with the comprehensive analysis codes to enable acoustics characterization of rotorcraft configurations at conceptual design stage.				
FY 2022 to FY 2023 Increase/Decrease Statement: Administrative realignment to PE 0602183A (Air Platform Applied Research) / Project CW4 (Air Vehicle Structures and Dynamics Tech) in FY23.				
Title: FY2022 SBIR/STTR Transfer		-	0.103	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		2.792	2.799	-
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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AL8: Holistic Situational Awareness and Dec Making Tech</i>	-	1.757	0.889	-	-	-	-	-	-	-	0.000	2.646

Note

In Fiscal Year (FY) 2023, funding is realigned to Program Element (PE) 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts and Technologies).

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 2021	FY 2022	FY 2023
Title: Wideband RF Sensors	0.892	-	-
Description: This effort develops the technical underpinnings of radar and other active and passive radio frequency (RF) sensing modalities for several key Army requirements, with a focus on cost effective radar concepts to enhance the situational awareness and navigation capabilities of US Army rotorcraft to operate safely in a Degraded Visibility Environment (DVE). This research uses a combination of advanced computational electromagnetic models and algorithms, radar measurements, active and passive RF sensing technologies, and advanced signal processing.			
Title: Situational Awareness Radar for DVE mitigation	0.865	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.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Will investigate forward looking synthetic aperture radar (FLSAR) technology to assess capabilities for terrain navigation in DVE; will conduct experiments in relevant field conditions using laboratory radar testbed; develop and implement signal processing for creating three-dimensional imagery of ground obstacles.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding reprioritized to support the creation of Distributed Radar Architectures in PE 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts and Technologies) in FY23.</p>			
<p><i>Title:</i> FY2022 SBIR/STTR Transfer</p> <p><i>Description:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638</p>	-	0.032	-
Accomplishments/Planned Programs Subtotals	1.757	0.889	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AM4 / Opt Energy Stg & Therm Mgmt for FVL Survivability
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AM4: Opt Energy Stg & Therm Mgmt for FVL Survivability	-	8.531	-	-	-	-	-	-	-	-	0.000	8.531

A. Mission Description and Budget Item Justification

This Project investigates emerging power generation, energy storage, and thermal management technologies needed for future Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR), and survivability equipment that could be incorporated onto Future Vertical Lift (FVL) and other Army platforms. Provides power capability for advanced electric aeromechanical effectors, advanced mission systems algorithms for route planning and teaming and advanced electronic warfare devices.

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 2021	FY 2022	FY 2023
Title: Optimized Energy for C5ISR Platforms	4.867	-	-
Description: This effort investigates 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 power architectures, while also researching ways to eliminate platform thermal constraints. This effort will also investigate very high density power sources and energy storage for high rate pulsed power, power management, and thermal management for dynamic high rate pulsed power.			
Title: Power & Thermal Management Components	3.664	-	-
Description: This effort develops 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.			
Accomplishments/Planned Programs Subtotals	8.531	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) AM4 / Opt Energy Stg & Therm Mgmt for FVL Survivability

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BP7: Future Vertical Lift Air Platform Tech (CA)	-	75.000	42.000	-	-	-	-	-	-	-	0.000	117.000

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 2021	FY 2022
Congressional Add: Program Increase - High Strength Functional Composites FY 2021 Accomplishments: Conducted applied research in High Strength Functional Composites. Work executed by Army Futures Command.	5.000	5.000
FY 2022 Plans: Congressional Interest Item funding provided for High Strength Functional Composites		
Congressional Add: Program Increase - Additive Manufacturing of Multifunctional Composite Aerospace Components FY 2021 Accomplishments: Conducted applied research in Additive Manufacturing of Multifunctional Composite Aerospace Components. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase: Advanced Rotary Wing Materials and Structures FY 2021 Accomplishments: Conducted applied research in Advanced Rotary Wing Materials and Structures. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program Increase: Adaptive Flight Control Technology FY 2021 Accomplishments: Conducted applied research in Adaptive Flight Control Technology.	4.000	7.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for Adaptive Flight Control Technology		
Congressional Add: Program Increase: Lightweight Hybrid Composite Medium Caliber Barrels FY 2021 Accomplishments: Conducted applied research in Lightweight Hybrid Composite Medium Caliber Barrels.	20.000	-
Work executed by Army Futures Command. Congressional Add: Program Increase: Technology Transfer and Innovation FY 2021 Accomplishments: Conducted applied research in Technology Transfer and Innovation.	5.000	-
Work executed by Army Futures Command. Congressional Add: Program Increase - Self-Sealing Fuel Tanks Technology FY 2021 Accomplishments: Conducted applied research in Self-Sealing Fuel Tanks Technology.	6.000	-
Work executed by Army Futures Command. Congressional Add: Program Increase - High Density eVTOL Power Source FY 2021 Accomplishments: Conducted applied research in High Density eVTOL Power Source.	15.000	15.000
Work executed by Army Futures Command. FY 2022 Plans: Congressional Interest Item funding provided for High Density eVOTL Power Source Congressional Add: Program Increase - Individual Blade and Higher Harmonic Control FY 2021 Accomplishments: Conducted applied research in Individual Blade and Higher Harmonic Control.	10.000	5.000
Work executed by Army Futures Command. FY 2022 Plans: 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 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Missile Technology Transfer and Innovation		
<i>Congressional Add:</i> Rotor Blade Operational Readiness	-	5.000
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Rotor Blade Operational Readiness		
Congressional Adds Subtotals	75.000	42.000

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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Vertical Lift Technology</i>				Project (Number/Name) BZ7 / <i>Future Vertical Lift Medical Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>BZ7: Future Vertical Lift Medical Technologies</i>	-	7.911	7.818	7.503	-	7.503	7.494	7.249	7.237	7.347	0.000	52.559

A. Mission Description and Budget Item Justification

This Project involves research to prevent injury and performance degradation in Aviators, Unmanned Aerial 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 2021	FY 2022	FY 2023
Title: Medical Standards to Support Future Vertical Lift (FVL)	7.911	7.818	7.503
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.			
FY 2022 Plans: Will develop the holistic medical aspects of a Situational Awareness and Decision-Making (HAS-DM) Program. Will evaluate transcranial stimulation to enhance alertness and situational awareness in extended operations. Will determine medical optimal feedback modes to FVL operators for use in scalable autonomy. Will assess medical impacts of FVL scalable autonomy at system level in degraded operator modes. Will evaluate composite workload for real time operator state monitoring. Will develop aircraft and human medical indicators of operator workload and state. Will develop helmet stability and dynamic retention standards for aviation helmets. Will evaluate aviation survivability development and tactics (ASDAT) in a retrospective study on combat-related injury.			
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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>	Project (Number/Name) BZ7 / <i>Future Vertical Lift Medical Technologies</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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 2022 to FY 2023 Increase/Decrease Statement: Decrease related to funding realigned to Program Element 0603465A (Future Vertical Lift Advanced Technology / Project CJ5 (Future Vertical Lift Medical Advanced Technology) to support advanced technology research in this topic area.</p>				
Accomplishments/Planned Programs Subtotals		7.911	7.818	7.503
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CC3: <i>FVL Radar Technologies</i>	-	0.698	0.444	-	-	-	-	5.159	3.570	3.569	0.000	13.440

Note
In Fiscal Year 2023 (FY23), funding is decreased to reflect completion of radar functionality study.

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 2021	FY 2022	FY 2023
<p>Title: Battlefield Surveillance & Targeting Radar Technology</p> <p>Description: Advanced Reconnaissance, Surveillance and Target Acquisition Waveform Designs for advanced multi-beam Ground Moving Target Indicator (GMTI) and Synthetic Aperture Radar (SAR) systems.</p> <p>FY 2022 Plans: Will conduct radar functionality study to investigate frequency, power/duty cycle, timing and aperture allocation requirements to inform and prioritize radar mode development strategy</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease in FY23 reflects completion of radar functionality study in FY22.</p>	0.698	0.428	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	0.016	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	0.698	0.444	-

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CG9: Adapt & Resilnt Tact Autnmy Cont & Struct Tech</i>	-	-	6.507	-	-	-	-	-	-	-	0.000	6.507

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 2021	FY 2022	FY 2023
<p>Title: Adaptive and Resilient Engineered Structures (ARES) Technologies</p> <p>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.</p> <p>FY 2022 Plans: Will develop weight-efficient unitized structural assembly concepts. Will develop innovative weight-efficient blast-tolerant structural concepts. Will apply advanced material systems to develop strong, resilient rotor blade spar designs. Will develop weight-efficient multifunctional structural concepts with integral electromagnetic shielding.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is administratively realigned to PE: 0602183A (Air Platform Applied Research) / Project CU7 (Control & Autonomy for Tactical Superiority Tech) and Project CU8 (Structures Tech for Enduring Efficient Resilience).</p>	-	1.501	-
<p>Title: Adaptive Tactical Autonomy and Control (ATAC) Technologies</p>	-	4.769	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will collaborate with Original Equipment Manufacturers (OEM) using flight data from extended Joint Multi-Role Technology Demonstrator (JMR-TD) flight tests to validate Army?s flight-dynamics modeling techniques for modern configurations. Will apply lessons learned to improve Army models of Future Attack Reconnaissance Aircraft (FARA) and Future Long Range Assault Aircraft (FLRAA) and help validate/improve OEM models. Will correlate JMR-TD flight and simulation data with new and existing handling qualities criteria to expand requirements to high speed. Will continue developing Damage Tolerant Control (DTC) technologies and state-of-the-art autonomy algorithms for advanced configurations and military Unmanned Aerial Vehicles (UAV) / Air-Launched Effects (ALE).</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is administratively realigned to PE: 0602183A (Air Platform Applied Research) / Project CU7 (Control & Autonomy for Tactical Superiority Tech) and Project CU8 (Structures Tech for Enduring Efficient Resilience).</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.237	-
Accomplishments/Planned Programs Subtotals		-	6.507	-
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 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CH2: <i>Air Launched Effects Technology</i>	-	-	7.567	4.168	-	4.168	4.293	3.464	3.361	3.256	0.000	26.109

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 2021	FY 2022	FY 2023
Title: Systems Concepts Studies for Air Launched Effects	-	7.291	4.168
Description: Investigates and models air vehicle concepts to understand the effects that potential operational Air Launched Effects capabilities will have on air vehicle properties.			
FY 2022 Plans: Will conduct configuration trade and analysis studies to develop novel UAS concepts that will serve to inform Air Launched Effects system specification. Will investigate critical design attributes to inform UAS system performance, weight, and cost. Will develop analytic modeling capabilities to improve timeliness, accuracy, and detail of conceptual design for unmanned systems.			
FY 2023 Plans: Will conduct assessment of vehicle concepts and technology for Versatile Air Launched Effects. Will develop UAS component models to improve propulsion architecture modeling, aircraft weight prediction, and improve performance and cost assessment.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
In Fiscal Year 2023 (FY23), funding was partially realigned from this effort administratively to Program Element (PE) 0602183A (Air Platform Applied Research) / Project CU9 (Systems Design Technology).			
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.276	-
Accomplishments/Planned Programs Subtotals	-	7.567	4.168

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CH3: <i>Holistic Team Survivability Technology</i>	-	-	11.217	10.819	-	10.819	10.992	10.982	10.986	3.461	0.000	58.457

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, 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 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 2021	FY 2022	FY 2023
Title: Advanced Survivability Concepts	-	4.036	3.402
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 2022 Plans: Will begin development of full spectrum susceptibility and vulnerability reduction component technologies that enhance holistic end-to-end survivability. Development of algorithms, behaviors, and human machine interface for team-based survivability.			
FY 2023 Plans: Will investigate damage prediction algorithms given a threat/ballistic impact. Will investigate RF materials development for durability improvement and weight reduction. Will continue development of algorithms, behaviors, and human machine interface			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
for team-based survivability. Will begin investigation and analysis of Electro Optical/ Infrared coatings for FVL applications, leveraging new coatings technologies.				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding reflects planned reduction of survivability modeling, simulation and analysis tool development efforts				
Title: Distributed Electronic Warfare Effects		-	6.772	7.417
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.				
FY 2022 Plans: Will develop novel algorithms to incorporate distributed sensor data into threat declaration algorithms; will develop methodology to optimize decision-making behaviors of sensor and countermeasure technologies to counter advanced threats; will investigate novel methods to adaptively update behavior of sensor and countermeasure technologies to react to changing threats and environmental conditions; will analyze impact of threat progression on measured performance.				
FY 2023 Plans: Will conduct single node bench experimentation of hardware performance and software algorithm functionality to inform further development and optimization. Will validate software technology readiness level assessments. Will optimize operational capability of a payload based on technology maturation and EW technical community inputs.				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY2022 SBIR/STTR Transfer		-	0.409	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	11.217	10.819
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / Future Verticle Lift Technol ogy	Project (Number/Name) CH3 / Holistic Team Survivability Technology

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CH4: <i>Power & Thermal Management for FVL Tech</i>	-	-	7.175	7.613	-	7.613	7.713	7.721	7.697	7.694	0.000	45.613

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 2021	FY 2022	FY 2023
Title: Optimized Energy for C5ISR Platforms	-	4.726	5.185
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 2022 Plans: Will apply models based on size, weight, and power requirements of air platforms to inform design and development of energy storage components needed to support high power, short duration bursts. Will design and develop phase change material and pumped two-phase based thermal management components to support rejection of waste heat due to inefficiencies in power conversion. Will conduct experiments on both energy storage and thermal management components to determine performance			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>against advanced C5ISR devices such as advanced radars and sensors. Will conduct experiments to determine the effectiveness of power electronic components and power management strategies.</p> <p>FY 2023 Plans: Will investigate intrinsically safe chemistries for energy storage components able to deliver light weight, high energy power to support aviation electronic warfare capabilities. Will mature thermal management components to support rejection of waste heat generated by platform mission equipment. Will conduct experiments on real world thermal management components in order to validate models. Will investigate advanced cold plate designs for two-phase heat rejection to reduce size, weight, and power draw. Will conduct experiments on thermal energy storage using phase change materials to better manage waste heat from high heat flux loads. Will investigate efficient power electronics which will further reduce the waste heat generated by the aircraft.</p> <p>FY 2022 to FY 2023 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 2022 Plans: Will perform design and fabrication of efficient, distributed, and adaptable cooling systems enabling increased electrical power capability while reducing weight and cost to Future Vertical Lift aircraft electrical power and thermal management systems.</p> <p>FY 2023 Plans: Will 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. Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	2.187	2.428
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans:</p>		-	0.262	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i>				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	7.175	7.613
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 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / <i>Future Verticle Lift Technol ogy</i>				Project (Number/Name) CI5 / <i>High Speed Maneuverable Missile (HSMM) Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CI5: <i>High Speed Maneuverable Missile (HSMM) Tech</i>	-	-	8.526	23.463	-	23.463	24.102	-	0.832	19.013	0.000	75.936

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 2021	FY 2022	FY 2023
Title: High Speed Maneuverable Missile (HSMM) Technology	-	8.215	23.463
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 2022 Plans: Will continue component maturation based on PE 0602148A (Future Vertical Lift Technology) / Project AK4 (Multi-Role Small Guided Missile Technology) efforts. Will investigate options for multi-mode propulsion to increase range and speed with desired trajectory for effectiveness and survivability. Will determine appropriate missile test bed. Will validate preliminary design accurately reflects platform interfaces and requirements to include maneuverability, long range precision strike capability in degraded/contested environments, and reduced time to target.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will continue component development and evolve critical component designs including navigation sensors, warheads, fire control, and digital missile datalinks. Will advance the design and development of a missile test bed. Will develop detailed design of the advanced propulsion system to increase range and speed with desired trajectory for effectiveness and survivability. Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this project funding was increased to accelerate FVL CFT lethality capabilities.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.311	-
Accomplishments/Planned Programs Subtotals		-	8.526	23.463
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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	107.584	93.549	27.016	-	27.016	29.409	30.907	36.632	40.364	0.000	365.461
AC9: High Energy Laser Tactical Vehicle Demonstrator Te	-	9.008	-	-	-	-	-	-	-	-	0.000	9.008
AD2: High Energy Laser (HEL) Enabling and Support Techn	-	9.744	5.991	-	-	-	-	-	-	-	0.000	15.735
AD3: Maneuver Air Defense Technology	-	12.744	7.893	-	-	-	-	-	-	-	0.000	20.637
AD5: Next Generation Fires Radar Technology	-	5.336	1.488	-	-	-	-	-	-	-	0.000	6.824
AD9: Close Combat High Energy Laser Technology	-	8.467	-	-	-	-	-	-	-	-	0.000	8.467
AE2: Unconventional Countermeasures-Survivability Tech	-	6.347	3.927	3.947	-	3.947	3.369	2.751	3.745	3.744	0.000	27.830
AE4: Collaborative ISR Sensors Technology	-	2.938	-	-	-	-	-	-	-	-	0.000	2.938
BN6: Advanced Weapons Components (CA)	-	53.000	74.250	-	-	-	-	-	-	-	0.000	127.250
CV7: High Energy Laser Direct Diode Apl Tech	-	-	-	2.902	-	2.902	6.034	5.716	7.278	12.472	0.000	34.402
CV8: Vulnerability Modules for Multi-Domain Operations	-	-	-	8.083	-	8.083	8.947	7.691	7.901	8.627	0.000	41.249
DA9: Radar Survivability through Dis Sensing Tech	-	-	-	5.803	-	5.803	4.682	4.053	3.743	2.287	0.000	20.568
DC1: Next Generation DE Concept Development & Analysis	-	-	-	6.281	-	6.281	6.377	10.696	13.965	13.234	0.000	50.553

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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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Note
In Fiscal Year 2023 (FY23), the following Projects are New Starts: Project CV7 (High Energy Laser Direct Diode Apl Tech); Project CV8 (Vulnerability Modules for Multi-Domain Operations); and Project DA9 (Radar Survivability through Dis Sensing Tech).

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 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).

<u>B. Program Change Summary (\$ in Millions)</u>	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	107.584	19.316	0.000	-	0.000
Current President's Budget	107.584	93.549	27.016	-	27.016
Total Adjustments	0.000	74.233	27.016	-	27.016
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	74.250			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.016	-	27.016
• FFRDC Transfer	-	-0.017	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology
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Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: BN6: <i>Advanced Weapons Components (CA)</i>		
Congressional Add: <i>Program Increase - Beam Control Systems and Industry Grade Optical Fiber Fabrication for Energy Laser</i>	12.000	12.000
Congressional Add: <i>Program Increase - High Energy Laser Enabling and Support Technology</i>	7.000	-
Congressional Add: <i>Program Increase - Army missile supply chain risk management</i>	15.000	-
Congressional Add: <i>Program Increase - Close Combat High Energy Laser Technology</i>	8.500	-
Congressional Add: <i>Program Increase - Fires Center of Excellence</i>	1.500	-
Congressional Add: <i>Program Increase - Cyber Resiliency in Weapon Systems</i>	1.500	-
Congressional Add: <i>Program Increase - Countermeasures Based on Artificial Intelligence Enabled Material Analysis and Design</i>	6.000	-
Congressional Add: <i>Program Increase - Counter-UAS Center of Excellence</i>	1.500	5.000
Congressional Add: <i>Program Increase: High Energy Laser Testing and Expansion</i>	-	10.000
Congressional Add: <i>Program Increase: High Energy Laser Optical Technology</i>	-	6.000
Congressional Add: <i>Program Increase: High Energy Laser Technology Integration</i>	-	10.000
Congressional Add: <i>Army Missile Risk-Based Mission Assurance</i>	-	15.000
Congressional Add: <i>Kill Chain Automation</i>	-	8.000
Congressional Add: <i>Machine Learning Optimized Power Electronics</i>	-	3.000
Congressional Add: <i>Precision Long Range Integrated Strike</i>	-	5.250
Congressional Add Subtotals for Project: BN6	53.000	74.250
Congressional Add Totals for all Projects	53.000	74.250

Change Summary Explanation

FY23 funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology				Project (Number/Name) AC9 / High Energy Laser Tactical Vehicle Demonstrator Te			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AC9: High Energy Laser Tactical Vehicle Demonstrator Te	-	9.008	-	-	-	-	-	-	-	-	0.000	9.008

A. Mission Description and Budget Item Justification

This Project investigates component technologies for mobile high energy laser (HEL) weapon systems in solid state lasers (SSL) for use in protecting fixed and semi-fixed sites from Rocket, Artillery, and Mortars (RAM), Unmanned Aerial Systems (UAS) and advanced Air Defense threats. The Project researches advanced technologies for HEL weapon systems to enable more efficient laser systems with significantly greater power output for future HEL weapons to augment current kinetic Air Defense Artillery (ADA) systems and address additional missions with a low cost-per-kill exchange ratio. This includes technologies to support development of alternate laser sources, precision optical pointing and tracking components and adaptive optics to overcome laser degradation due to atmospheric effects to gain great lethality permitting expansion of threats set. Additionally development of compact and lighter weight energy generation and storage devices, and more efficient thermal management systems to remove excess heat will permit integrating laser weapons on additional combat platforms.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD1 (High Energy Laser Tactical Vehicle Demo 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 and supports the Army's future capability opportunities for leap-ahead technology for directed energy.

Research is performed by the United States (US) Army Rapid Capabilities and Critical Technologies Office (RCCTO).

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

	FY 2021	FY 2022	FY 2023
Title: High Energy Laser Tactical Vehicle Demonstrator Technology	9.008	-	-
Description: This effort develops technologies for robust beam control and SSL subsystems in the HEL Tactical Vehicle Demonstrator (TVD). Technologies developed under this effort will enable lighter, more agile beam control systems for tactical Army platform development and SSL technologies that enhance effectiveness against emerging air defense threats and increase efficiencies, enabling reductions in size, weight and power (SWaP) and improving the ability to integrate SSL systems into multiple Army weapon platforms.			
Accomplishments/Planned Programs Subtotals	9.008	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / <i>Air and Missile Defense Technology</i>	Project (Number/Name) AC9 / <i>High Energy Laser Tactical Vehicle Demonstrator Te</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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AD2: High Energy Laser (HEL) Enabling and Support Techn	-	9.744	5.991	-	-	-	-	-	-	-	0.000	15.735

Note

In Fiscal Year 2023 (FY23), this Project is realigned to Program Element (PE) 0602150A (Air and Missile Defense Technology) / Project DC1 (Next Generation DE Concept Development & Analysis).

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 2021	FY 2022	FY 2023
Title: High Energy Laser Enabling and Support Technology	7.739	5.866	-
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.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will conduct lethality studies and analysis of new/evolving threats and sustain core competency in HEL Lethality. Will advance Advanced Optics (AO) studies and analysis to compensate for deep turbulence atmospheric conditions. Will fund research to show proof of concept of a tapered amplifier phased array laser system concept that compensates for atmospheric turbulence.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Decreased funding in FY 2023 is due to an administrative realignment to PE 0602150A (Air and Missile Defense Technology) / Project DC1 (Next Generation DE Concept Development & Analysis).</p>				
<p>Title: High Energy Laser Enabling Technologies for Tactical Directed Energy Weapons</p> <p>Description: Research novel solid-state laser concepts, architectures, and components in support of the Army's HEL weapons strategy; exploit breakthroughs in laser technology, develop and employ innovative laser gain material, and utilize photonics to meet the stringent weight/volume requirements for Army platforms, especially to enhance and improve the generation, transmission, and reception of lasers.</p>		2.005	-	-
<p>Title: SBIR/STTR Tax</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.125	-
Accomplishments/Planned Programs Subtotals		9.744	5.991	-
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 2023 Army **Date:** April 2022

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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AD3: <i>Maneuver Air Defense Technology</i>	-	12.744	7.893	-	-	-	-	-	-	-	0.000	20.637

Note

In Fiscal Year 2023 (FY23), this Project is Eliminated and funding is realigned to Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense Advanced Technology).

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)

Title: Maneuver Air Defense Technology	FY 2021	FY 2022	FY 2023
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.	10.586	7.604	-
FY 2022 Plans: Will continue component maturation and software integration of seeker, guidance electronics, and control subsystems, then will integrate and validate performance of those subsystems in a dynamic HWIL environment; will conduct warhead lethality experiments to validate ability achieve an immediately observable kill against emulated threats.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Efforts continue in PE 0603466A (Air and Missile Defense Advanced Technology) / Project AD4 (Maneuver Air Defense Advanced Technology) through maturation and demonstration of technologies and components.				
Title: Future Air Defense Missile Enabling Technology		2.158	-	-
Description: Designs and develops reduced cost advanced Air Defense missile critical components essential to maintain overmatch against Mid/Far term Maneuver-Short Range Air Defense threats.				
Title: FY2022 SBIR/STTR Transfer		-	0.289	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		12.744	7.893	-
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AD5: Next Generation Fires Radar Technology	-	5.336	1.488	-	-	-	-	-	-	-	0.000	6.824

Note

In Fiscal Year 2023 (FY23), this Project is Eliminated and funding is realigned to Program Element (PE) 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts and Technologies).

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)

Title: Multi-Mode Air Defense Radar	FY 2021	FY 2022	FY 2023
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.	1.522	1.433	-
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Will leverage digital radar algorithms and modeling to evolve enhanced concepts for distributed and passive RF Sensing; validate and apply algorithms to distributed sub-array architectures and model system-level requirements for expanding battlefield sensing through distributed architectures. FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to PE 0602141A (Lethality Technology) / Project CG4 (Advanced Radar Concepts and Technologies) in FY 2023.				
Title: Antennas and RF Device Components for Advanced Electronic Systems Description: This effort designs, characterizes, and validates high performance antennas, microwave components, and software for multifunction radar, RF sensing, and communication and position/timing systems. Research areas include scanning techniques, broadbanding, beamforming, polarization, platform integration, and affordability. For microwave components, research areas include software defined radios, analog-to-digital conversion rates, bandwidth resolution, bit accuracy, circuit design and affordability.		3.814	-	-
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.055	-
Accomplishments/Planned Programs Subtotals		5.336	1.488	-
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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AD9 / Close Combat High Energy Laser Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AD9: Close Combat High Energy Laser Technology	-	8.467	-	-	-	-	-	-	-	-	0.000	8.467

A. Mission Description and Budget Item Justification

This Project investigates and develops technologies for compact, highly efficient lasers, and compact beam control for close-combat platforms. This Project investigates and develops advanced technologies for High Energy Laser (HEL) weapon systems to enable more efficient laser systems with greater power output, which in-turn enables laser weapons on smaller vehicles for additional missions. This includes technologies to support development of alternate laser sources, precision optical pointing and tracking components, adaptive optics to overcome laser degradation due to atmospheric effects, more compact and lighter weight energy generation and storage devices, and more efficient thermal management systems to remove excess heat.

Work in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AE1 (Close Combat High Energy Laser 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, and supports the Army's future capability opportunities for leap-ahead technology for directed energy.

Research is performed by the United States (US) Army Rapid Capabilities and Critical Technologies Office (RCCTO).

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

	FY 2021	FY 2022	FY 2023
Title: Close Combat High Energy Laser Technology	8.467	-	-
Description: This effort develops laser and beam control technologies with extremely low size, weight, and power (SWaP) requirements enabling high energy lasers in small, agile close combat platforms. Extremely low SWaP laser systems will expand the laser weapons mission set. Reduction in SWaP also provides for higher power systems on the large tactical vehicles that enable countering the current threat set at longer ranges as well as laser-hardened threats.			
Accomplishments/Planned Programs Subtotals	8.467	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AE2: Unconventional Countermeasures-Survivability Tech</i>	-	6.347	3.927	3.947	-	3.947	3.369	2.751	3.745	3.744	0.000	27.830

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.

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 is conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

Research in this Project complements Program Element (PE) 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).

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

	FY 2021	FY 2022	FY 2023
Title: Development of Unconventional Countermeasures for Enhanced Survivability (DeUCES)	4.075	-	-
Description: This effort designs and develops countermeasures to defeat near-peer advanced weapons through computational modeling and enhanced tonedown measures.			
Title: Model-Based Assessment of Sensors and Countermeasures	2.272	2.400	1.903
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 2022 Plans: Integrate Electro-Optic / Infrared (EO/IR) sensor models and generated synthetic, physics based imagery into a computational testbed for the evaluation of unconventional countermeasure designs.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort ending in Fiscal Year 2023 (FY23).				
Title: Advanced Integrated Unconventional Countermeasures Applications 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. FY 2022 Plans: Conduct experiments to develop materials and techniques for hyperspectral camouflage and thermal tonedown utilizing novel waste heat rejection and recovery methods integrated into critical assets. FY 2023 Plans: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort reflecting an emphasis in research focus to integrated applications.		-	1.383	2.044
Title: FY 2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.144	-
Accomplishments/Planned Programs Subtotals		6.347	3.927	3.947
C. Other Program Funding Summary (\$ in Millions) N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602150A / Air and Missile Defense Technology	Project (Number/Name) AE4 / Collaborative ISR Sensors Technology
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AE4: Collaborative ISR Sensors Technology	-	2.938	-	-	-	-	-	-	-	-	0.000	2.938

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by designing and developing Intelligence, Surveillance, Reconnaissance (ISR) sensors with extended range threat detection and enhanced survivability by cooperative sensing while on-the-move.

Research 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 2021	FY 2022	FY 2023
Title: Collaborative ISR Sensors Technology	2.938	-	-
Description: Design and develop ISR sensors with extended range threat detection and enhanced survivability by cooperative sensing while on-the-move.			
Accomplishments/Planned Programs Subtotals	2.938	-	-

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BN6: <i>Advanced Weapons Components (CA)</i>	-	53.000	74.250	-	-	-	-	-	-	-	0.000	127.250

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 2021	FY 2022
<p>Congressional Add: Program Increase - Beam Control Systems and Industry Grade Optical Fiber Fabrication for Energy Laser</p> <p>FY 2021 Accomplishments: Program increase supporting applied research in beam control systems and industry grade optical fiber fabrication for energy laser.</p> <p>This effort has developed Army capability to characterize and optimize a diverse set of fiber laser systems, optics, and photonics to support technology development and maturation for high energy laser weapon systems.</p> <p>Started development of a Fiber Amplifier Laser Characterization and Optimization lab for evaluating kW class laser modules; the lab will be an open architecture design that facilitates the capability to provide independent Army evaluation and verification of high energy laser source components.</p> <p>Conducted laboratory and field experiments to validate performance of the 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 2022 Plans: Work in FY 2022 is a continuation of and furthers efforts executed under FY 2021.</p>	12.000	12.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022	
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 2021	FY 2022	
<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>Congressional Add: Program Increase - High Energy Laser Enabling and Support Technology</p> <p>FY 2021 Accomplishments: Program increase supporting applied research in high energy laser enabling and support technology.</p> <p>This effort supported the design and development of agile and lightweight beam control system technology including gimbals and telescopes for High Energy Lasers (HEL). Researching innovative design solutions to revolutionize technology for improved size, weight, and power (SWaP), and cost in next generation HEL weapon systems. Researching and developing HEL platform Enhanced Tracking (ET) capabilities to improve current acquisition tracking and clutter, and fine tracking in deep turbulence in adverse weather conditions. Researching and developing improved HEL beam propagation techniques to achieve a higher laser power on target and improve the effectiveness of a HEL weapon system.</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>	7.000	-	
<p>Congressional Add: Program Increase - Army missile supply chain risk management</p> <p>FY 2021 Accomplishments: Conduct applied research in Army Missile Supply Chain Risk Management.</p> <p>Work executed by Army Futures Command.</p>	15.000	-	
<p>Congressional Add: Program Increase - Close Combat High Energy Laser Technology</p> <p>FY 2021 Accomplishments: Program increase supporting applied research in close combat high energy laser technology.</p>	8.500	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022	
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 2021	FY 2022	
This effort has focused on integrating a 300 kW-class laser into a U.S. Army combat vehicle. This High Energy Laser platform will be capable of performing a wide variety of missions including air and missile defense as well as lethal engagement of enemy ground targets such as armored vehicles, artillery and rocket systems, logistics, and communications systems.			
Work performed by the Rapid Capabilities and Critical Technologies Office (RCCTO), in Huntsville, Alabama.			
Congressional Add: Program Increase - Fires Center of Excellence FY 2021 Accomplishments: Conduct applied research in Fires Center of Excellence.	1.500	-	
Work executed by Army Futures Command.			
Congressional Add: Program Increase - Cyber Resiliency in Weapon Systems FY 2021 Accomplishments: Conduct applied research in Cyber Resiliency in Weapon Systems.	1.500	-	
Work executed by Army Futures Command.			
Congressional Add: Program Increase - Countermeasures Based on Artificial Intelligence Enabled Material Analysis and Design FY 2021 Accomplishments: Conduct applied research in Countermeasures Based on Artificial Intelligence Enabled Material Analysis and Design.	6.000	-	
Work executed by Army Futures Command.			
Congressional Add: Program Increase - Counter-UAS Center of Excellence FY 2021 Accomplishments: Program increase supporting applied research in Counter-Unmanned Aerial Systems (C-UAS) Center of Excellence.	1.500	5.000	
This effort supports the development of enhancements for High Energy Laser modeling and simulation capabilities to improve current force-on-force models for Counter-small Unmanned Aerial Systems (C-sUAS). Enables C-sUAS force planning, experimentation, and Tactics, Techniques, and Procedures development.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022	
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 2021	FY 2022
Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command.			
FY 2022 Plans: Congressional Interest Item funding provided for Counter UAS Center for Excellence			
Congressional Add: Program Increase: High Energy Laser Testing and Expansion		-	10.000
FY 2022 Plans: Program increase supporting applied research in high energy laser lethality testing and expansion.			
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.			
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: High Energy Laser Optical Technology		-	6.000
FY 2022 Plans: Program increase supporting applied research in high energy laser optical technology.			
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 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.			
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: High Energy Laser Technology Integration		-	10.000
FY 2022 Plans: Program increase supporting applied research in high energy laser technology integration.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022
<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>		
<p>Congressional Add: Army Missile Risk-Based Mission Assurance FY 2022 Plans: Congressional Interest Item funding provided for Army Missile Risk-Based Mission Assurance</p>	-	15.000
<p>Congressional Add: Kill Chain Automation FY 2022 Plans: Congressional Interest Item funding provided for Kill Chain Automation</p>	-	8.000
<p>Congressional Add: Machine Learning Optimized Power Electronics FY 2022 Plans: Congressional Interest Item funding provided for Machine Learning Optimized Power Electronics</p>	-	3.000
<p>Congressional Add: Precision Long Range Integrated Strike FY 2022 Plans: Congressional Interest Item funding provided for Precision Long Range Integrated Strike</p>	-	5.250
Congressional Adds Subtotals	53.000	74.250

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 2023 Army **Date:** April 2022

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 Applied Tech
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CV7: High Energy Laser Direct Diode Applied Tech	-	-	-	2.902	-	2.902	6.034	5.716	7.278	12.472	0.000	34.402

Note

This is a new start in FY 2023.

This Project is a new Start in Fiscal Year 2023 (FY23)

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 compliments 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 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).

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

	FY 2021	FY 2022	FY 2023
Title: High Energy Laser Direct Diode Applied Technology	-	-	2.902
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; validate 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:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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 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.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This is a new Start Project in FY23.			
Accomplishments/Planned Programs Subtotals	-	-	2.902

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CV8: Vulnerability Modules for Multi-Domain Operations	-	-	-	8.083	-	8.083	8.947	7.691	7.901	8.627	0.000	41.249

Note

This is a new start in FY 2023.

This is a New Start Project in Fiscal Year 2023 (FY23).

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 VM's will enable real time threat feature detection and targeting, increasing the lethality of the HEL weapon systems through optimizing aimpoint selection. Developed smart Vulnerability Modules 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 compliments 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 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).

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

	FY 2021	FY 2022	FY 2023
Title: Vulnerability Modules for Multi Domain Operations	-	-	8.083
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.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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 2022 to FY 2023 Increase/Decrease Statement: This is a New Start Project in FY23.				
Accomplishments/Planned Programs Subtotals		-	-	8.083
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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DA9: Radar Survivability through Dis Sensing Tech	-	-	-	5.803	-	5.803	4.682	4.053	3.743	2.287	0.000	20.568

Note

This is a new start in FY 2023.

This Project is a new Start in Fiscal Year 2023 (FY23)

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)

Title: Radar Survivability through Dis Sensing (RSDS) Tech	FY 2021	FY 2022	FY 2023
	-	-	5.803

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Description: Investigates and develops critical radar capability enhancements to defeat advanced Air and Missile threats and protect Army maneuver forces and critical assets</p> <p>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 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 2022 to FY 2023 Increase/Decrease Statement: This Project is a new Start in Fiscal Year 2023 (FY23)</p>				
Accomplishments/Planned Programs Subtotals		-	-	5.803
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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DC1: Next Generation DE Concept Development & Analysis	-	-	-	6.281	-	6.281	6.377	10.696	13.965	13.234	0.000	50.553

Note

In Fiscal Year 2023 (FY23), this Project is an Administrative Realignment from Program Element (PE) 0602150A (Air and Missile Defense Technology) / Project AD2 (High Energy Laser (HEL) Enabling and Support Techn).

A. Mission Description and Budget Item Justification

This Project funds research and investigates adaptive optics, beam control, laser diodes, target and beacon illuminator lasers, laser diagnostics and new tracking algorithms to increase future High Energy Laser weapon system lethality 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 2021	FY 2022	FY 2023
Title: Next Generation Direct Energy Concept Development and Analysis	-	-	6.281
Description: This effort funds research for future High Energy Laser weapons to effectively engage an array of threats. Research includes prioritized aim points on identified threats and time to defeat the threats for each aim point. In addition, this effort investigates the full spectrum of target lethality engagements of flying targets in relevant scenarios. Effort 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 2022 to FY 2023 Increase/Decrease Statement: This Project is an Administrative Realignment from Program Element (PE) 0602150A (Air and Missile Defense Technology) / Project AD2 (High Energy Laser (HEL) Enabling and Support Techn).			
Accomplishments/Planned Programs Subtotals	-	-	6.281

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	15.034	16.454	-	16.454	17.906	17.236	15.703	15.698	0.000	98.031
CL2: <i>AI Enhanced Intel Operations Technologies</i>	-	-	3.725	2.132	-	2.132	2.025	2.196	1.119	1.118	0.000	12.315
CL7: <i>ATR Using Multiple Cooperative Sensors App Tech</i>	-	-	7.645	6.685	-	6.685	7.597	6.648	6.189	6.187	0.000	40.951
CN7: <i>Predictive Maintenance Applied Research</i>	-	-	3.664	4.727	-	4.727	5.683	5.794	5.796	5.795	0.000	31.459
DA5: <i>AI Enabled Talent Management Applied Research</i>	-	-	-	0.319	-	0.319	-	-	-	-	0.000	0.319
DA6: <i>AI-Enabled Command and Coordination Apl Research</i>	-	-	-	2.591	-	2.591	2.601	2.598	2.599	2.598	0.000	12.987

Note

In Fiscal Year 2023 (FY23), Project DA5 (AI Enabled Talent Management Applied Research) and Project DA6 (AI-Enabled Command and Coordination Apl Research) are New Starts.

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 Joint Artificial Intelligence Center (JAIC).

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 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	15.034	0.000	-	0.000
Current President's Budget	0.000	15.034	16.454	-	16.454
Total Adjustments	0.000	0.000	16.454	-	16.454
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	16.454	-	16.454

Change Summary Explanation

FY23 funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CL2: AI Enhanced Intel Operations Technologies</i>	-	-	3.725	2.132	-	2.132	2.025	2.196	1.119	1.118	0.000	12.315

A. Mission Description and Budget Item Justification

This Project will design and develop various technologies to augment human intelligence analysts using artificial intelligence (AI)-enabled decision support and recommendation tools to change the way the Army fights and modernize how the Intelligence Warfighting Function supports Multi-Domain Operations and Joint All Domain Command and Control (JADC2). This Project will also bridge the research and technology gap within intelligence support to operations and the sensor to shooter thread.

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 Joint Artificial Intelligence Center (JAIC)

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

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

	FY 2021	FY 2022	FY 2023
Title: Synthetics and Low Level Detection	-	0.800	-
Description: This effort will design and develop AI and machine learning (ML) technology for low-level object detection and recognition. Low level object detection and recognition is a key ML challenge because objects presented in such problems have significant variation and limited amounts of available training data, making it difficult to build high performing AI models to address these challenges.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>This effort will leverage feature invariance from multi-class classification using data that is readily available to develop an AI network to predict class representatives from the samples themselves. Using such a model, we can then predict representation for novel object classes from very few novel class samples, improving AI algorithm learning and reducing the need for manual data input. In a separate approach to low level detection, we propose to enable the few-shot detector to learn novel objects from both the visual information and using semantic relations. This will promote knowledge propagation from base classes to novel classes, speeding up the time it takes to train AI algorithms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Planned effort will be completed in FY 2022.</p>				
<p>Title: AI Enhancements for Prometheus</p> <p>Description: Prometheus is an umbrella of capabilities 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 2022 Plans: This effort will augment Military Intelligence and Operations (Intel/Ops) with computer vision and deep learning capabilities to automatically triage data collection and automate AI-driven indications and warning (I&W) to support targeting. This effort will also develop better AI collection management and tasking capability to allow Military Intelligence soldiers to automate AI workflows. Lastly, we will document repeatable process for deploying AI capabilities to meet Army needs.</p> <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 2022 to FY 2023 Increase/Decrease Statement: Funding decrease due to planned completion of effort in Fiscal Year (FY) 2023.</p>		-	1.189	0.550
<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</p>		-	1.100	1.082

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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.				
FY 2022 Plans: 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. Smart ?agents? will enable automated, machine intelligence-enabled course of action analysis integrated with the broader mission command enterprise. Given these knowns about the operational environment, the effort will conduct automated real-time strategy war gaming between synthetic agents representing friendly and adversary forces at the Division echelon.				
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.				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Foundation for AI Intelligence Support to Operations (ARCANE SERIES)		-	0.500	0.500
Description: Design and develop an AI infrastructure/pipeline for training, integrating, and sustaining computer vision algorithms to inform requirements for enterprise production systems and edge systems for the Army Military Intelligence and Operations (Intel/Ops) community.				
FY 2022 Plans: Will develop an algorithm development kit with standardized deep learning model architectures that simplify training and deploying computer vision-based AI models; will create a machine learning model library with registered models, training datasets, and near real-time diagnostics from deployed models, that can be used for monitoring, alerting, and accelerating transfer learning and recalibration; will develop containerized packaging for the algorithm development kit and machine learning model library, reducing the digital scope of these assets so they can more easily be deployed on edge applications and cloud-accessible servers; will deploy the development kit and library on various edge devices and cloud-accessible servers.				
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.				
Title: SBIR/STTR Transfer		-	0.136	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	3.725	2.132

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CL7: ATR Using Multiple Cooperative Sensors App Tech</i>	-	-	7.645	6.685	-	6.685	7.597	6.648	6.189	6.187	0.000	40.951

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 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 2021	FY 2022	FY 2023
Title: Collaborative Target Detection and Tracking	-	5.466	4.865
Description: This effort will design and develop the capability to automatically detect and track targets using the electro-optical, thermal, and electromagnetic sensors and constrained computing hardware onboard the air and ground vehicles, which process the sensor data using AI/ML algorithms and share threat perception across the unmanned team.			
FY 2022 Plans: Develop the ability for unmanned vehicles to self-identify and geo-locate targets, share target data among the unmanned and manned team for verification, and then serve as autonomous forward observers to auto-correct indirect fire.			
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 2022 to FY 2023 Increase/Decrease Statement: Funding for this effort was realigned to PE 0603040A (Artificial Intelligence and Machine Learning Advanced Technologies) / Project CL6 (ATR Using Multiple Cooperative Sensors Adv Tech).			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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 to passively perceive the terrain so that air and ground vehicles can 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 2022 Plans: Develop AI algorithms that enable autonomous maneuver of air and ground platforms that collaboratively coordinate their movement within an assigned zone and passively sense the terrain and surroundings to avoid obstacles.</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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned life cycle of effort.</p>		-	0.950	1.035
<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 2022 Plans: Develop the intuitive relay of reconnaissance intent to the autonomous team of air and ground vehicles. Develop the ability for rapid validation of targets and activation of recommended effects (e.g., indirect fire) using TAK and IVAS.</p> <p>FY 2023 Plans: Investigate AI algorithms that recommend courses of action for mission activities of the autonomous sensors.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding for this effort was realigned to PE 0603040A (Artificial Intelligence and Machine Learning Advanced Technologies) / Project CL6 (ATR Using Multiple Cooperative Sensors Adv Tech). Funding change reflects planned life cycle of effort.</p>		-	0.950	0.470
<p>Title: Coeus</p> <p>FY 2023 Plans:</p>		-	-	0.315

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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 2022 to FY 2023 Increase/Decrease Statement: This is a new effort in FY 2023.				
Title: SBIR/STTR Transfer		-	0.279	-
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	7.645	6.685
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN7: <i>Predictive Maintenance Applied Research</i>	-	-	3.664	4.727	-	4.727	5.683	5.794	5.796	5.795	0.000	31.459

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 predictive 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 2021	FY 2022	FY 2023
Title: Predictive Maintenance	-	3.531	4.727
Description: This effort investigates AI technologies, deep learning techniques, and predictive analytics to forecast major issues on current and future platforms which enables the Army to respond to upcoming failures. Focus will be to determine component failure relationships to principal end items for prediction of critical failure prior to corrective maintenance and reactive supply chain requisitions. Research will increase efficiency, decrease fleet operating and sustainment costs for equipment platforms, and reduce the time and costs associated with repair part requisition, management and transportation.			
FY 2022 Plans: Will investigate and develop new capabilities of a standardized end-to-end pipeline for gathering data from maintenance sensors in ground platforms (both manned and unmanned) and improve performance failure prediction models for critical components.			
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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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 2022 to FY 2023 Increase/Decrease Statement: FY 2023 funding increase to expand efforts to ground platforms and additional aviation platforms of interest. Funding change reflects planned life cycle of effort.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.133	-
Accomplishments/Planned Programs Subtotals		-	3.664	4.727
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>DA5: AI Enabled Talent Management Applied Research</i>	-	-	-	0.319	-	0.319	-	-	-	-	0.000	0.319

Note

This is a new start in FY 2023.

This is a New Start Project in Fiscal Year 2023 (FY23).

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 2021	FY 2022	FY 2023
Title: Artificial Intelligence (AI)-Enabled Skill Identification for Job Matching and Team Building	-	-	0.319
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.			
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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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.				
FY 2022 to FY 2023 Increase/Decrease Statement: This effort is a new start in FY23.				
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DA6: <i>AI-Enabled Command and Coordination Apl Research</i>	-	-	-	2.591	-	2.591	2.601	2.598	2.599	2.598	0.000	12.987

Note

This is a new start in FY 2023.

This is a New Start Project in Fiscal Year 2023 (FY23).

A. Mission Description and Budget Item Justification

This Project designs and develops solutions that enable Artificial Intelligence (AI)-Enabled Command. This Project will also conduct experiments to investigate approaches to improve sensor-to-shooter and course of action development timelines. Will investigate and develop hardware, software and algorithm technologies and investigate various mission command related areas such game theory, decision-making, network usage, data collection, processing, and human interfaces to mature AI and machine learning technologies for Army applications.

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 2021	FY 2022	FY 2023
<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 2022 to FY 2023 Increase/Decrease Statement: This effort is a new start in FY23.</p>	-	-	1.555
<p>Title: AI-Enhanced Battle Damage Assessment</p>	-	-	1.036

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Description: Design and develop algorithms to optimize the relationships between known blue sensors and shooters and assign them to available targets.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: This effort is a new start in FY23.</p>			
Accomplishments/Planned Programs Subtotals	-	-	2.591

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>	R-1 Program Element (Number/Name) PE 0602181A / <i>All Domain Convergence Applied Research</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017
CM7: <i>Collaborative Convergence Applied Research</i>	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	25.967	0.000	-	0.000
Current President's Budget	0.000	25.967	27.399	-	27.399
Total Adjustments	0.000	0.000	27.399	-	27.399
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.399	-	27.399

Change Summary Explanation

FY 2023 funding increase reflects the fact that the FY 2022 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CM7: Collaborative Convergence Applied Research	-	-	25.967	27.399	-	27.399	25.884	15.752	10.639	10.376	0.000	116.017

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.

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 Next Generation Combat Vehicle, Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.

This work is done in coordination with PE 0603041A (All Domain Convergence Advanced Technology).

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

	FY 2021	FY 2022	FY 2023
Title: AI-Enabled Decision Support in Distributed Networks	-	5.390	3.627
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 2022 Plans: Will collect Machine Learning (ML) training data such as imagery, quantitative confidence, speed, accuracy, and process data from sensor to shooter experimental tactical engagements for curation and distribution; develop tactical engagement models and training data sets for AI-enabled decision support tools in complex, multi-domain tactical networks.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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 2022 to FY 2023 Increase/Decrease Statement: Funding reduced due to decrease in synthetic training data being decrease in experiments with synthetic training data with tactical network engagement models.				
Title: Synthetic Data for AI-Enabled Decision Support 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. FY 2022 Plans: Will investigate techniques to develop and characterize state-of-the-art synthetic data sets; research methods to incorporate synthetic data into target classification algorithm training sets and understand its effects on target classification performance against uncommon high priority MDO targets; experiment with artificially augmented data sets to enable classification of rare targets and cost-effective enterprise-level data generation. FY 2023 Plans: Will 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. FY 2022 to FY 2023 Increase/Decrease Statement: Funding reduced due to decrease in experiments with artificially augmented data sets.		-	6.065	5.326
Title: Data Characterization for AI-Enabled Decision Support 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 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.		-	5.193	4.663

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>FY 2022 Plans: Will explore and assess methodologies for efficient, effective training data set development, characterization, and curation; develop and deploy Army?s curated training data sets on network-enabled development platforms for joint collaborative research on training methods for object classifiers, AI-enabled decision support tools, and autonomy.</p> <p>FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding reduced due to decrease in training data set methodology research.</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 2022 Plans: Will develop an architecture to support time and space synchronization of fires and distributed lethality. Will determine required communications, data interfaces, and digital sensor to shooter planning for fires execution. Will also de-conflict between various sensors and weapon systems in combined arms maneuver to reduce sensor to shooter timelines. Will develop methods to use local distributed world model coordinates for input to decision aids when network is degraded and when network bandwidth is optimal.</p> <p>FY 2023 Plans: Will validate time and space synchronization of fires and distributed lethality capabilities in role-based architecture. Will continue to develop architecture to interface with additional Joint and international partner systems. Will conduct experiments to validate de-confliction between various sensors and weapons systems to achieve reduced sensor to shooter timelines. Will mature methods and algorithms for decision aids to operate in degraded environments.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase to support research of sensor architectures and interfaces to reduce kill chain in order to meet planned program requirements.</p>	-	6.022	8.083
<p>Title: Algorithms and Environment</p>	-	0.482	2.073

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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/ground platforms; and designs decentralized data structures and hybrid databases that can scale to echelons and user selectable input.</p> <p>FY 2022 Plans: Will investigate simulation requirements for tactical fires of multiple company formations, which will include coordinating decentralized operations in different terrain models.</p> <p>FY 2023 Plans: Will design simulation capability for integrated direct and indirect fires decision aids, including coordinating decentralized operations. Will conduct experiments for automated decision aids and target handoff capability for simultaneous engagement to air/ground platforms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase to support maturation of data models to study commander decision aid algorithms applicable in multi-domain operations in order to meet planned program requirements.</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 2022 Plans: Will investigate and validate AI based algorithms process design for Fires synchronization. Will design and validate courses of analysis integrated capability using AI based approaches. Will investigate algorithms for predicting adversary behaviors and investigate how these patterns can impact recommendations for optimal shooter scenarios.</p> <p>FY 2023 Plans: Will design and develop Fires coordination measures integrated at the platform level for both air and ground platforms. Will design and develop enhanced decision aids and effects coordination algorithms capability to execute Fires synchronization. Will conduct experiments for course of action analysis integrated capability using enemy intel data. Will design and develop enhanced algorithms for predicting adversary behaviors to optimize recommendations to the commander.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	1.867	3.627

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602181A / <i>All Domain Convergence A plied Research</i>	Project (Number/Name) CM7 / <i>Collaborative Convergence Applied Research</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
Funding increase to support research and experimentation of enhanced algorithms to support fires synchronization and coordination in multi-domain operations in order to meet planned program requirements.			
Title: FY2022 SBIR/STTR Transfer	-	0.948	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	25.967	27.399

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	12.406	27.892	-	27.892	29.518	23.735	29.288	29.852	0.000	152.691
CM9: Convergent CEMA Deception	-	-	5.626	-	-	-	-	-	-	-	0.000	5.626
CN4: Network Enabling University Applied Research	-	-	2.578	2.655	-	2.655	2.663	2.507	2.254	2.253	0.000	14.910
CN5: Network Vuln/ Effectiveness Assess Methods (N-VEAM)	-	-	4.202	4.418	-	4.418	4.458	4.453	4.455	4.454	0.000	26.440
CW2: Exploitation of Atmospheric Impacts across Domains	-	-	-	3.051	-	3.051	1.507	-	-	-	0.000	4.558
CX3: Intelligent Env Battlefield Awareness Apl Tech	-	-	-	3.141	-	3.141	2.191	0.613	3.161	3.561	0.000	12.667
CX4: Persistent Geophysical Sensing-Infrasound Apl Tech	-	-	-	2.761	-	2.761	2.565	2.069	3.116	2.595	0.000	13.106
CX5: Sensing in Contested Environments Technologies	-	-	-	1.007	-	1.007	1.023	-	1.259	2.063	0.000	5.352
CX6: Subterranean Detection and Monitoring Apl Tech	-	-	-	1.587	-	1.587	1.681	1.524	1.524	1.026	0.000	7.342
CZ6: Assured PNT Enabling Applied Technology	-	-	-	3.661	-	3.661	3.332	2.306	2.257	2.121	0.000	13.677
CZ7: Convergent CEMA Technical Effects	-	-	-	5.611	-	5.611	5.448	5.542	5.544	5.543	0.000	27.688
DA8: Quantum PNT & Radio Frequency Sensing*	-	-	-	-	-	-	2.601	3.637	5.198	5.197	0.000	16.633
DB4: Enabling Long Standoff 3D (ELS3D) Tech*	-	-	-	-	-	-	2.049	1.084	0.520	1.039	0.000	4.692

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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 / <i>C3I Applied Research</i>
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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 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	0.000	12.406	0.000	-	0.000
Current President's Budget	0.000	12.406	27.892	-	27.892
Total Adjustments	0.000	0.000	27.892	-	27.892
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.892	-	27.892

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CM9: <i>Convergent CEMA Deception</i>	-	-	5.626	-	-	-	-	-	-	-	0.000	5.626

Note

In Fiscal Year 2023 (FY23), this Project is realigned to Program Element (PE) 0602182A (C3I Applied Research) / Project CZ7 (Convergent CEMA Technical Effects).

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 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 2021	FY 2022	FY 2023
<p>Title: Radio Frequency/Cyber Sensing and Effects</p> <p>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.</p> <p>FY 2022 Plans: Will investigate synchronization techniques for a heterogeneous set of distributed transmitters; design and develop signals and waveforms for RF emissions on wideband reconfigurable transceivers; investigate interoperability for wideband reconfigurable RF transceiver hardware, including compact antennas, RF frontend hardware, and data converters; further develop materials, device designs, and components for non-RF communication techniques.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to PE 0602182A (C3I Applied Research) / Project CZ7 (Convergent CEMA Technical Effects).</p>	-	3.017	-
<p>Title: Dynamic Intelligent Networks and Cyber Technical Effects for CEMA</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.</p> <p>FY 2022 Plans:</p>	-	2.404	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / C3I Applied Research	Project (Number/Name) CM9 / Convergent CEMA Deception
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Will explore methods for employing unconventional spectrum and communication modalities for enhanced robustness and reduced signature; investigate the combination of low signature networking methods with advanced technical effects; research and develop algorithms and methodologies in a rigorous approach to cyber security such as game theory; model attacker-defender interaction and scalable algorithms for cyber security application and verify algorithms by mathematical proofs, simulation, and experiment; develop and examine adaptive cyber approaches, involving network emulators and camouflaging systems, to bolster network security and resilience; using game theory and machine learning, develop and assess an adaptive honeynet to monitor and study unauthorized network users? exploits; introduce and examine dynamic honeynet processes to incorporate what is learned about the adversaries? network behaviors and intended network targets; investigate advanced methods to model approaches for the prediction of frequency and occurrence of network attacks by type for effectively implementing adaptive honeynets; research impact of Software Defined Networking (SDN) for mobile network architectures on implementation of adaptive honeynets for tactical networks.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned to PE 0602182A (C3I Applied Research) / Project CZ7 (Convergent CEMA Technical Effects).</p>			
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.205	-
Accomplishments/Planned Programs Subtotals	-	5.626	-

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN4: <i>Network Enabling University Applied Research</i>	-	-	2.578	2.655	-	2.655	2.663	2.507	2.254	2.253	0.000	14.910

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.

Research in this Project complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CN3 (Network Enabling University Adv Development).

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 2021	FY 2022	FY 2023
Title: Intelligent, Secure and Self-Sensing/Self-Healing Networks Applied Technology	-	1.179	1.287
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 2022 Plans: Will research artificial intelligence and machine learning (AI/ML) software, predictive analytics software, intelligent data integration software, edge computer processing platforms, edge sensing systems, and other technologies; investigate distributed AI and the communication between computing nodes and edge computing AI/ML solutions for network-driven intelligence; design intelligent multi-modal communication and more reliable, efficient, and effective use of available communication technologies; and investigate biometric and biosensor solutions for intelligent network credentialing and access.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change 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 2022 Plans: Will construct a resilient information network to deliver reliable information pathways with caching, value-based prioritization, and information optimization; improve time and reliability of information/data over secure tactical networks; and investigate decentralized networks with knowledge bases, reasoning, planning, sensing, self-healing and control capabilities for advance teaming and collaborative operations.</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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	0.569	0.600
<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 2022 Plans: Will investigate direct use of signals from satellite constellations in low Earth orbit (LEO) for Assured Positioning, Navigation, and Timing (APNT); design dedicated navigation signal for a "hosted payload" alternative to direct use of signals from the satellites in</p>		-	0.736	0.768

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>LEO; investigate vision-based autonomous relative navigation solutions to address the critical need for reliable operability within GPS denied and contested environments; develop fusing vision, radar, inertial, and other sensors technologies to develop GPS alternatives; and research Global Navigation Satellite System (GNSS) independent navigation solution that is computationally lightweight enough to be implemented on low-cost, physically lightweight platforms.</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 will research a GNSS independent navigation solution that is computationally lightweight enough to be implemented on low-cost, physically lightweight platforms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.094	-
Accomplishments/Planned Programs Subtotals	-	2.578	2.655

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN5: Network Vuln/Effectiveness Assess Methods (N-VEAM)	-	-	4.202	4.418	-	4.418	4.458	4.453	4.455	4.454	0.000	26.440

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.

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 2021	FY 2022	FY 2023
Title: Understanding, Protecting, and Enabling CEMA Effects	-	2.064	2.233
<p>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 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 2022 Plans: Will apply combined Electromagnetic EW and cyber techniques for a converged assessment of CEMA effects on prototype network systems and components, to include technologies operation in the Integrated Tactical Network and Information Assurance and Network Resiliency technologies. Models for performance and behavior of Network technologies and systems will be updated to reduce risks of Integrated Tactical Network failures in congested and contested electromagnetic environments.</p> <p>FY 2023 Plans:</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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. Will 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 2022 to FY 2023 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 2022 Plans: Will continue to verify and validate assessment tools, methodologies and metrics (e.g., probability of detection, path loss, scattering in contested/congested electromagnetic environments) for novel Non-traditional waveforms communications such as millimeter wave, ultraviolet (UV)-based communication technologies and the vulnerabilities of beamforming techniques and network protocols; analyze automated software capabilities, refining methodology to increase speed of vulnerability detection and library of network protocols; update the contested/congested electromagnetic environment to reflect emerging threats; and provide threat environments to technology experimentation and technology exploration activities to inform vulnerability mitigations improving critical technologies to include Assured PNT (A-PNT) capabilities.</p> <p>FY 2023 Plans: Will 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; will design and develop cyber tool stimulus for maturation of tactical network autonomous decision-making engines; will 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 will improve critical technologies.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	1.985	2.185

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding increase reflects planned lifecycle of this effort.			
Title: FY2022 SBIR/STTR Transfer	-	0.153	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	4.202	4.418

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CW2: Exploitation of Atmospheric Impacts across Domains</i>	-	-	-	3.051	-	3.051	1.507	-	-	-	0.000	4.558

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project AV7 (Atmospheric Modeling and Meteorological Technology).

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 research 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 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)

Title: Atmospheric Impacts	FY 2021	FY 2022	FY 2023
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.	-	-	3.051
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will 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 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AV7 (Atmospheric Modeling and Meteorological Technology).</p>				
Accomplishments/Planned Programs Subtotals		-	-	3.051
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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CX3: Intelligent Env Battlefield Awareness Apl Tech</i>	-	-	-	3.141	-	3.141	2.191	0.613	3.161	3.561	0.000	12.667

Note
In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project AR3 (Intelligent Environmental Battlefield Awareness).

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.

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 at the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX7 (Intelligent Env Battlefield Awareness Adv Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Hydrology Mapping	-	-	1.029
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: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AR3 (Intelligent Environmental Battlefield Awareness).			
Title: Predictive Geographic Information System (GIS) Mapping (physical)	-	-	1.302

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<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: Will identify geophysical model component gaps in temporal and static feature capture sections of planned GIS Mapping capability.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AR3 (Intelligent Environmental Battlefield Awareness).</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: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AR3 (Intelligent Environmental Battlefield Awareness).</p>	-	-	0.207
<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: Will identify critical environmental parameters for baseline adaptations, select study and analog sites, and collect pre- and post-disturbance event data.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AR3 (Intelligent Environmental Battlefield Awareness).</p>	-	-	0.603
Accomplishments/Planned Programs Subtotals	-	-	3.141

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CX4: Persistent Geophysical Sensing-Infrasound Apl Tech	-	-	-	2.761	-	2.761	2.565	2.069	3.116	2.595	0.000	13.106

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project AR9 (Persistent Geophysical Sensing-Infrasound Tech).

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. These technologies are critical to providing increased situational awareness leading to faster decision making and informing battlefield and maneuver operations.

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 at the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX8 (Persistent Geophysical Sensing-Infrasound Adv Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Battlefield Intelligence by Geophysical Sensing (BIGS)	-	-	2.761
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: Will 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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding realigned from PE 0602146A (Network C3I Technology) / Project AR9 (Persistent Geophysical Sensing-Infrasound Tech).			
Accomplishments/Planned Programs Subtotals	-	-	2.761

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CX5: Sensing in Contested Environments Technologies</i>	-	-	-	1.007	-	1.007	1.023	-	1.259	2.063	0.000	5.352

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project AR7 (Sensing in Contested Environments Technology).

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 research provides Soldiers the capability to understand biological hazards present in subterranean environments and take necessary steps to mitigate or avoid these threats.

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 at the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CX9 (Sensing in Contested Environments Adv Technologies).

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

	FY 2021	FY 2022	FY 2023
Title: Non-traditional Threat Detection in Contested Environments Tech	-	-	1.007
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.			
FY 2023 Plans: Will develop additional detection algorithms for macroscopic threats and create additional zoonotic threat assays.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602146A (Network C3I Technology) / Project AR7 (Sensing in Contested Environments Technology).			
Accomplishments/Planned Programs Subtotals	-	-	1.007

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602182A / <i>C3I Applied Research</i>	Project (Number/Name) <i>CX5 / Sensing in Contested Environments Technologies</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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CX6: Subterranean Detection and Monitoring Apl Tech	-	-	-	1.587	-	1.587	1.681	1.524	1.524	1.026	0.000	7.342

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project AT2 (Subterranean Detection and Monitoring Technology).

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.

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 at the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This research complements Program Element (PE) 0603042A (C3I Advanced Technology) / Project CZ5 (Subterranean Detection and Monitoring Adv Tech).

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

	FY 2021	FY 2022	FY 2023
Title: Cavity Assessment in Variable Environments-Subterranean (CAVES)	-	-	1.587
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: Will 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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding realigned from PE 0603463A (Network C3I Advanced Technology) / Project AT3 (Subterranean Detection and Monitoring Adv Tech) representing the planned lifecycle progression to a shift in research focus to hard rock geology.			
Accomplishments/Planned Programs Subtotals	-	-	1.587

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CZ6: Assured PNT Enabling Applied Technology</i>	-	-	-	3.661	-	3.661	3.332	2.306	2.257	2.121	0.000	13.677

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602146A (Network C3I Technology) / Project CK1 (Assured PNT Enabling Technologies).

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.

Research 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.

Research in this Project is performed by the United States Army Space and Missile Defense Command (USASMDC) in Huntsville, AL.

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

Title: Assured PNT Enabling Applied Technology	FY 2021	FY 2022	FY 2023
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.	-	-	3.661
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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding realigned from PE 0602146A (Network C3I Technology) / Project CK1 (Assured PNT Enabling Technologies).			
Accomplishments/Planned Programs Subtotals	-	-	3.661

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CZ7: Convergent CEMA Technical Effects</i>	-	-	-	5.611	-	5.611	5.448	5.542	5.544	5.543	0.000	27.688

Note

In Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602182A (C3I Applied Research) / Project CM9 (Convergent CEMA Deception).

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.

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 2021	FY 2022	FY 2023
<p>Title: RF-Enabled CEMA Sensing and Technical Effects</p> <p>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.</p> <p>FY 2023 Plans: Will develop techniques for heterogeneous and distributed signal transmission; will develop signals and waveforms for RF emissions on wideband reconfigurable transceivers and perform proof-of-concept validation; will design and implement wideband reconfigurable RF transceiver hardware interoperable with compact antennas, RF frontend hardware, and data converters; will develop non-RF integrated breadboard communication demonstrator and assess general capabilities of this system external to the laboratory environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602182A (C3I Applied Research) / Project CM9 (Convergent CEMA Deception).</p>	-	-	3.300
<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</p>	-	-	2.311

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
<p>methods of adaptive networking using unconventional communication channels and active tactical cyber defense methods to anticipate adversarial activities and effective responses.</p> <p><i>FY 2023 Plans:</i> Will develop intelligent networking protocols for controlling novel methods for covert communication; will conduct experiments on the use of unconventional spectrum and techniques for covert communications; will explore the integration of developed covert networking techniques with multi-domain technical effects; will investigate the use of game theory approaches to achieve cyber misrepresentation on tactical networks; will build attack graphs to comprehend the interdependencies among vulnerabilities and to analyze the attacker's potential course of action; will 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><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding realigned from PE 0602182A (C3I Applied Research) / Project CM9 (Convergent CEMA Deception).</p>			
Accomplishments/Planned Programs Subtotals	-	-	5.611

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	6.597	41.588	-	41.588	41.582	37.740	41.034	42.661	0.000	211.202
CL5: Air Platform Enabling University Applied Research	-	-	0.698	0.905	-	0.905	0.524	0.952	1.283	1.283	0.000	5.645
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	-	3.945	4.168	-	4.168	4.230	4.354	4.355	4.354	0.000	25.406
CN1: Disruptive Countermeasure Concepts for Aviation	-	-	1.954	7.387	-	7.387	7.513	7.610	7.184	7.182	0.000	38.830
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	-	4.485	-	4.485	4.175	4.410	5.606	4.514	0.000	23.190
CU8: Structures Tech for Enduring Efficient Resilience	-	-	-	1.648	-	1.648	1.675	1.040	1.041	1.040	0.000	6.444
CU9: Systems Design Technology	-	-	-	3.109	-	3.109	3.121	3.009	5.193	5.296	0.000	19.728
CW3: Advanced Rotors Applied Technology	-	-	-	2.589	-	2.589	2.602	-	-	2.625	0.000	7.816
CW4: Air Vehicle Structures and Dynamics Tech	-	-	-	2.985	-	2.985	3.029	3.055	3.057	3.056	0.000	15.182
CW5: Experimental and Computational Aeromechanics Tech	-	-	-	6.600	-	6.600	6.805	6.865	6.868	6.866	0.000	34.004
CW6: Future UAS Propulsion Technology	-	-	-	3.414	-	3.414	3.544	3.575	3.575	3.574	0.000	17.682
CW7: High Speed and Efficient VTOL Vehicle Tech	-	-	-	1.549	-	1.549	1.573	1.571	1.572	1.572	0.000	7.837
CW8: Next Generation Aviation Transmission Apl Tech	-	-	-	1.482	-	1.482	1.504	-	-	-	0.000	2.986

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 2: Applied Research</i>					R-1 Program Element (Number/Name) PE 0602183A / <i>Air Platform Applied Research</i>							
DC2: <i>High Performance Computing for Rotorcraft Apl Tech</i>	-	-	-	1.267	-	1.267	1.287	1.299	1.300	1.299	0.000	6.452

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)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	6.597	0.000	-	0.000
Current President's Budget	0.000	6.597	41.588	-	41.588
Total Adjustments	0.000	0.000	41.588	-	41.588
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	41.588	-	41.588

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CL5: Air Platform Enabling University Applied Research	-	-	0.698	0.905	-	0.905	0.524	0.952	1.283	1.283	0.000	5.645

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.

Research in this Project supports the Future Vertical Lift Army Modernization Priority and the overall aviation portfolio.

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.

This research is done in coordination with and transitions to Program Element 0602148A (Future Vertical Lift Technology), Program Element 0603465A (Future Vertical Lift Advanced Technology Development) and Program Element 0603043A (Air Platform Advanced Technology) and is also coordinated with its sister project in Program Element 0602144A (Ground Technology).

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

	FY 2021	FY 2022	FY 2023
<p>Title: Advanced Teaming</p> <p>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.</p> <p>FY 2022 Plans:</p>	-	0.321	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will investigate and develop decentralized self-organization AI/ML algorithms among large team of unmanned heterogeneous autonomous assets deployed inside contested environments that are robust to emerging threats, lost links, or change in mission priorities. Will develop decentralized interactions that will provide knowledge bases, reasoning, planning, sensing and control tools that reside inside the entire vehicle team and mobile computational resources.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Realigned funds to the new task "Vertical Lift Applied Research" within this Project.</p>				
<p>Title: Coordinated Air-Ground Vehicle Maneuvering</p> <p>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.</p> <p>FY 2022 Plans: Will investigate level coordinated landing/take off of unmanned aerial system from stationary platform near ground vehicle in simulations. Will develop software algorithms for air-ground coordination software support autonomous reconnaissance. Will perform applied research on developing coordination strategies for autonomous ground and air vehicles to perform tactical reconnaissance mission.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Realigned funds to the new task "Vertical Lift Applied Research" within this Project.</p>		-	0.352	-
<p>Title: Vertical Lift Applied Research</p> <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 2022 to FY 2023 Increase/Decrease Statement: Combined/realigned tasks "Advanced Teaming" and "Coordinated Air-Ground Vehicle Maneuvering" from this Project to this "Vertical Lift Applied Research" effort.</p>		-	-	0.905
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans:</p>		-	0.025	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	0.698	0.905
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 2023 Army										Date: April 2022		
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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	-	3.945	4.168	-	4.168	4.230	4.354	4.355	4.354	0.000	25.406

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 2021	FY 2022	FY 2023
Title: Intelligent Unmanned Aerial System Teaming Technologies	-	3.801	4.168
<p>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.</p> <p>FY 2022 Plans: Will develop methods and technologies to provide heterogeneous unmanned teams increased endurance; enable unmanned air and ground vehicle teams to adapt energy usage in dynamic situations; develop algorithms to help predict energy demand between unmanned teams; expand simulation hardware and software to client and server model to enable concurrent simulations; integrate simulation environments with established Department of Defense (DoD) terrain modeling data; investigate techniques to</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>achieve robust unmanned aerial system homing performance in Global Positioning System (GPS)-denied environment; develop simulated agent-level behaviors that achieve coordinated multi-agent target homing through emergent multi-agent interactions; develop threat resilient autonomous tactical behaviors contextualized in perimeter defense and pursuit-evasion, accounting for team maneuver relative to defending agents and anticipated attrition.</p> <p>FY 2023 Plans: Will develop methods and technologies to enable teams of unmanned air vehicles to autonomously detect, identify, locate, and report radio frequency (RF) signals of opportunity; will develop physics based models for Air-Launched Effects (ALE) simulation and advanced ALE/ Future Attack Reconnaissance Aircraft (FARA) teaming simulation; will simulate ALE multi-agent tactics for RF homing and will assess multi-operator, multi-agent simulation with real human operators replacing simulated operators; will investigate algorithms for detection, localization, and navigation on a s-UAS; will create control algorithms for high speed obstacle avoidance, GPS-denied localization, and cooperative tactical teaming behaviors; will examine efficacy of wireless power transfer hardware and battery management electronics for s-UAS; will determine power requirements for s-UAS and will examine effects of platform design variables, control methodologies, and autonomous functions on performance; will investigate s-UAS endurance with optimized mission planning logistics under fixed energy constraints.</p> <p>FY 2022 to FY 2023 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 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.144	-
Accomplishments/Planned Programs Subtotals	-	3.945	4.168

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN1: <i>Disruptive Countermeasure Concepts for Aviation</i>	-	-	1.954	7.387	-	7.387	7.513	7.610	7.184	7.182	0.000	38.830

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 (PE0 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 2021	FY 2022	FY 2023
Title: Cognitive Countermeasures Technology Development	-	1.882	2.064
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 2022 Plans:			
Will investigate dual-wavelength pumping, enabling beyond quantum defect limit efficiency, towards a diode pumped, in-band Midwave Infrared (MWIR) laser source for infrared countermeasures; conduct experiments exploring Ultra-Short Pulse Laser (USPL) out-of-band optical and electro-optical lethality effects; identify necessary USPL power/intensity/wavelength requirements			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Resear rch	Project (Number/Name) CN1 / Disruptive Countermeasure Concepts for Aviation

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>for effective counter-threat lethality capability; design and develop research sensor for detection of specific targets and validate models against select targets.</p> <p>FY 2023 Plans: Will investigate a range of rare earth-doped laser materials based on low-phonon hosts; will conduct comprehensive spectroscopic research aiming at directly diode-pumped, in-band MWIR laser source; will 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; will investigate temperature dependence of device laser parameters aiming at drastic efficiency improvements; will investigate USPL optical effects against realistic surrogate target system and validate sensor Disrupt/Damage/Defeat using non-optical USPL effects; will develop and validate sensor hardware with algorithms for detection of specific targets and perform breadboard validation and assessments against select targets.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports planned lifecycle for 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: Will 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; will 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; will 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; will investigate technologies and capabilities for emplacement and retrieval of ground sensors in challenging operational environments such as rugged terrain or mega-cities. Will 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 2022 to FY 2023 Increase/Decrease Statement:</p>	-	-	5.323

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding administratively realigned from PE 0602146A (Network C3I Technology) / Project AR1 (Robust, Resilient and Intelligent C3I Technology) to support Deep Autonomous Sensing research.			
Title: SBIR/STTR Transfer	-	0.072	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	1.954	7.387

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 2023 Army **Date:** April 2022

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			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	-	4.485	-	4.485	4.175	4.410	5.606	4.514	0.000	23.190

Note

This is a new start in FY 2023.

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)

Title: Adaptive Tactical Autonomy and Control (ATAC) Tech	FY 2021	FY 2022	FY 2023
<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: Will 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. Will mature and evaluate, in piloted simulation, algorithms for automatic reallocation of redundant controls to compensate for failure or battle damage. Will start enhancing Army-developed autonomy algorithms through the application of Machine Learning and Artificial Intelligence concepts.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	-	4.485

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
In FY23 this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	4.485

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU8: Structures Tech for Enduring Efficient Resilience	-	-	-	1.648	-	1.648	1.675	1.040	1.041	1.040	0.000	6.444

Note

This is a new start in FY 2023.

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 2021	FY 2022	FY 2023
Title: Multifunctional Advanced Structural Concepts (MASC)	-	-	1.648
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.			
FY 2023 Plans: Will develop innovative concepts enhancing structural weight efficiency applicable to FVL across size classes. Will develop structural concepts using multifunctionality for parasitic weight avoidance. Will apply integration methodology in guiding development of technologies to optimize benefits of reduced weight, increased resilience, and reduced maintenance.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23, this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	1.648

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Resea rch	Project (Number/Name) CU8 / Structures Tech for Enduring Efficient Resilience

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 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CU9: Systems Design Technology	-	-	-	3.109	-	3.109	3.121	3.009	5.193	5.296	0.000	19.728

Note

This is a new start in FY 2023.

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 2021	FY 2022	FY 2023
Title: Concept Design and Optimization Methods	-	-	3.109
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).			
FY 2023 Plans: Will develop tools and methods to improve rotorcraft design and optimization with advanced component models. Will apply tools to design and analyze Future Vertical Lift and other manned/unmanned air vehicle concepts.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	3.109

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / Air Platform Applied Resea rch	Project (Number/Name) CU9 / Systems Design Technology

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW3: Advanced Rotors Applied Technology	-	-	-	2.589	-	2.589	2.602	-	-	2.625	0.000	7.816

Note
In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AJ6 (Advanced Rotors Technology).

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)

Title: Advanced Hubs Tech	FY 2021	FY 2022	FY 2023
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.	-	-	2.589
FY 2023 Plans: Will complete advanced rotor hub conceptual design studies. Will commence hub component testing.			
FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is realigned from PE 0602148A (Future Vertical Lift Technology) / Project AJ6 (Advanced Rotors Technology)			
Accomplishments/Planned Programs Subtotals	-	-	2.589

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW4: Air Vehicle Structures and Dynamics Tech	-	-	-	2.985	-	2.985	3.029	3.055	3.057	3.056	0.000	15.182

Note

In FY23, funding realigned from PE 0602148A - Future Vertical Lift Technology, Project AL5 - Air Vehicle Structures and Dynamics Technology.

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 enable high speed flight, longer flight envelopes, and lower noise signatures in Future Vertical Lift (FVL) platforms and are 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)

Title: Air Vehicle Structures and Dynamics Technologies	FY 2021	FY 2022	FY 2023
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.	-	-	2.985
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
experiments. Develop 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.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> In FY23, funding realigned from PE 0602148A (Future Vertical Lift Technology) / Project AL5 (Air Vehicle Structures and Dynamics Technology).			
Accomplishments/Planned Programs Subtotals	-	-	2.985

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW5: <i>Experimental and Computational Aeromechanics Tech</i>	-	-	-	6.600	-	6.600	6.805	6.865	6.868	6.866	0.000	34.004

Note

In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AJ8 (Experimental and Computational Aeromechanics Techn).

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 2021	FY 2022	FY 2023
<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: Will 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; Will investigate state of the art of measurement & diagnostics techniques for rotorcraft; Will test rotor blade structural deformation and boundary layer transition using embedded sensor networks; Will investigate methods for rotorcraft hub drag reduction.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In FY23 this effort is realigned from PE 0602148A (Future Vertical Lift Technology) / Project AJ8 (Experimental and Computational Aeromechanics Techn).</p>	-	-	4.197
<p>Title: Computational Aeromechanics</p> <p>Description: Verify, validate and apply high-fidelity modeling and simulation software tools for rotorcraft aeromechanics.</p>	-	-	2.403

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p><i>FY 2023 Plans:</i> Will test and validate computational models for interactional aerodynamics applications including fast-running reduced-order computational fluid dynamics (CFD) models. Will test and validate computational models for rotorcraft air launched effects (ALE) deployment simulations.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> In FY23 this effort is realigned from PE 0602148A (Future Vertical Lift Technology) / Project AJ8 (Experimental and Computational Aeromechanics Techn).</p>			
Accomplishments/Planned Programs Subtotals	-	-	6.600

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW6: Future UAS Propulsion Technology	-	-	-	3.414	-	3.414	3.544	3.575	3.575	3.574	0.000	17.682

Note

In the Fiscal Year 2023 (FY23), this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Project) / AI9 (Future UAS Engine Technology).

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 2021	FY 2022	FY 2023
Title: Multi-Fuel Capable Hybrid Electric Propulsion	-	-	3.414
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: Will assess robust ignition for low quality fuels utilizing advanced ignition assistants and ignition sensing and control; will complete models for oil-free bearings relevant to aviation turbochargers; will validate bearingless motor design and optimization tool with experimental data; will enhance hybrid-electric optimization tool to include design optimization and uncertainty analysis.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from PE 0602148A (Future Vertical Lift Project) / AI9 (Future UAS Engine Technology).			
Accomplishments/Planned Programs Subtotals	-	-	3.414

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

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 2023 Army **Date:** April 2022

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
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CW7: High Speed and Efficient VTOL Vehicle Tech</i>	-	-	-	1.549	-	1.549	1.573	1.571	1.572	1.572	0.000	7.837

Note

In FY23, funding realigned from PE 0602148A Project AL4 High Speed and Efficient VTOL Vehicle Technology.

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)

Title: High Speed Efficient Vertical Take-Off and Landing (VTOL)Vehicle Technologies	FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2023 Plans: Will validate dynamic models for hybrid composite gears with integrated shafts in the VIPER facility; will determine hybrid gear's capability to deliver continuous power at 525 HorsePower (HP);will develop experimental techniques to access hybrid gear failure modes and will develop a dynamic model of a non-conventional transmission topology; will perform oil-out experiments of hybrid composite gear components; will quantify effectiveness of data-driven condition indicators for gears, bearings, and lubrication; will investigate using simulated dynamic responses to train data-drive condition indicators.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	-	1.549

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
In Fiscal Year 2023 (FY23) funding is realigned from PE 0602148A (Future Vertical Lift Technology) / Project AL4 (High Speed and Efficient VTOL Vehicle Technology).			
Accomplishments/Planned Programs Subtotals	-	-	1.549

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW8: Next Generation Aviation Transmission Apl Tech	-	-	-	1.482	-	1.482	1.504	-	-	-	0.000	2.986

Note
In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AJ2 (Next Generation Rotorcraft Transmission Technology).

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 2021	FY 2022	FY 2023
Title: High Reduction Ratio Transmission (HRT) Components	-	-	1.482
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.			
FY 2023 Plans: Will test new corrosion resistant steel components for physical material properties such as tensile strength, surface hardness, bending strength, and surface fatigue. Will develop improved manufacturing techniques based on the physical material properties data as well as develop and test new seal materials and seal configurations.			
FY 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AJ2 (Next Generation Rotorcraft Transmission Technology).			
Accomplishments/Planned Programs Subtotals	-	-	1.482

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / <i>Air Platform Applied Research</i>	Project (Number/Name) CW8 / <i>Next Generation Aviation Transmission Apl Tech</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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
DC2: High Performance Computing for Rotorcraft Appl Tech	-	-	-	1.267	-	1.267	1.287	1.299	1.300	1.299	0.000	6.452

Note

In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AL2 (High Performance Computing for Rotorcraft App Tech).

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 2021	FY 2022	FY 2023
Title: High Performance Computing for Aviation Applications	-	-	1.267
Description: Develop automated, high-fidelity computational tools for rotorcraft analysis and design.			
FY 2023 Plans: Will develop new high-order accurate computational fluid dynamics models for rotorcraft aerodynamic analysis. Will develop accurate and fast-running surrogate models suitable for use in rotorcraft design.			
FY 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year 2023 (FY23) this Project is realigned from Program Element (PE) 0602148A (Future Vertical Lift Technology) / Project AL2 (High Performance Computing for Rotorcraft App Tech).			
Accomplishments/Planned Programs Subtotals	-	-	1.267

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	11.064	15.716	-	15.716	16.059	18.028	22.482	22.060	0.000	105.409
CK9: <i>Advancing Concepts and Technology Forecasting Tech</i>	-	-	2.289	2.529	-	2.529	2.575	2.558	2.559	2.558	0.000	15.068
CN2: <i>Intelligent Weapons Concepts and Technologies</i>	-	-	2.178	3.335	-	3.335	3.611	3.607	3.609	3.608	0.000	19.948
CN9: <i>Soldier Enabling University Applied Research</i>	-	-	0.939	0.396	-	0.396	0.455	2.159	2.759	2.758	0.000	9.466
CO1: <i>Soldier Power And Energy Concepts and Technologies</i>	-	-	1.241	2.387	-	2.387	2.422	2.419	2.420	2.420	0.000	13.309
CO2: <i>Soldier-Intelligent Technology Research</i>	-	-	4.417	1.543	-	1.543	-	-	-	-	0.000	5.960
CV9: <i>Technical-SAVVY Soldier Applied Research</i>	-	-	-	2.331	-	2.331	3.381	3.637	3.743	3.326	0.000	16.418
CW9: <i>Syn Bio for Reactive-Resp Mtls-Soldiers & Sys</i>	-	-	-	3.195	-	3.195	3.615	3.648	7.392	7.390	0.000	25.240

Note
 Project CV9 (Technical-SAVVY Soldier Applied Research) is a New Start in Fiscal Year 2023 (FY23).

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).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army	Date: April 2022
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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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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)	<u>FY 2021</u>	<u>FY 2022</u>	<u>FY 2023 Base</u>	<u>FY 2023 OCO</u>	<u>FY 2023 Total</u>
Previous President's Budget	0.000	11.064	0.000	-	0.000
Current President's Budget	0.000	11.064	15.716	-	15.716
Total Adjustments	0.000	0.000	15.716	-	15.716
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	15.716	-	15.716

Change Summary Explanation

Fiscal Year (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CK9: <i>Advancing Concepts and Technology Forecasting Tech</i>	-	-	2.289	2.529	-	2.529	2.575	2.558	2.559	2.558	0.000	15.068

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 2021	FY 2022	FY 2023
Title: Advancing Concepts and Technology Forecasting	-	2.206	2.529
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 2022 Plans: Will integrate knowledge of applied scientific research outcomes with warfighting concepts with a focus on mid- and far-term Maneuver, Fires, and Mission Command Army Warfighting Concepts; perform long-range technology forecasts and near/mid-			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>term horizon scanning of the Army Priority Research Areas; provide reports, briefings, and information papers to the Army Modernization Enterprise to influence personnel and funding decisions.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 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 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.083	-
Accomplishments/Planned Programs Subtotals		-	2.289	2.529
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN2: <i>Intelligent Weapons Concepts and Technologies</i>	-	-	2.178	3.335	-	3.335	3.611	3.607	3.609	3.608	0.000	19.948

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 2021	FY 2022	FY 2023
Title: Human-Agent Interactions for Intelligent Squad Weapons	-	2.098	3.335
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 2022 Plans: Will investigate methods to label relevant data from Soldier-systems interactions through opportunistic sensing and drive the adaptation of intelligent small-arms technology; design initial approaches for human-computer vision teamed augmented reality.			
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 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports additional research into enhanced approaches for small arms fire control based on aim augmentation.			
Title: SBIR/STTR Transfer	-	0.080	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	2.178	3.335
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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CN9: <i>Soldier Enabling University Applied Research</i>	-	-	0.939	0.396	-	0.396	0.455	2.159	2.759	2.758	0.000	9.466

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.

Research in this Project supports the Synthetic Training Environment and Soldier Lethality and the overall Soldier portfolio Army Modernization Priorities.

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.

Research in this Project complements and transitions to Soldier Enabling University Advanced Development in Program Element (PE) 0603044A (Soldier Advanced Technology).

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

	FY 2021	FY 2022	FY 2023
Title: Soldier Training and Performance	-	0.622	0.396
Description: Collaboratively investigate technologies for Soldier capabilities related to increased protection, performance, agility, situational awareness, training, and lethality.			
FY 2022 Plans: Investigate automated testing framework to guarantee that synthetic training environments are highly trustworthy, reliable, and usable, to ensure that Soldiers are efficiently trained; Optimize intelligent real time edge processing of streams for wide area persistent surveillance, signature event detection and tracking towards the Army's next generation active protection and situational			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>awareness systems; investigate timely and reliable monitoring and assessment technologies for the health and readiness of Warfighters through digital biomarkers and biosensors.</p> <p>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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects the realignments to PE 0602141A (Lethality Technology) / CJ1 (Lethality Enabling University Applied Research).</p>			
<p>Title: Soldier Electronics for the Integrated Combat Platform</p> <p>Description: Design and determine advanced materials and electronics that are standardized to the Soldier and their equipment through integrated combat platform.</p> <p>FY 2022 Plans: Funds research to design and investigate Soldier electronics and standardize data, and power interfaces and connection points across the Soldier and Squad combat platform. Investigate and develop energy storage and other materials such as self-healing and super materials for increased protection, flexible electronics, and power generation.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects the realignments to Program Element 0602141A (Lethality Technology) / CJ1 (Lethality Enabling University Applied Research).</p>	-	0.283	-
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.034	-
Accomplishments/Planned Programs Subtotals	-	0.939	0.396

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CO1: <i>Soldier Power And Energy Concepts and Technologies</i>	-	-	1.241	2.387	-	2.387	2.422	2.419	2.420	2.420	0.000	13.309

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 the Next Generation Squad Weapons (NGSW), Integrated Visual Augmentation System (IVAS), and other 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 2021	FY 2022	FY 2023
Title: Tactical Energy Sources and Energy Materials	-	1.195	2.387
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 2022 Plans: Will investigate improved anodes and cathode materials and electrode structures for aqueous electrolyte batteries including silicon based anode materials for high energy, safe, non-flammable aqueous batteries; extend aqueous electrolytes to other multivalent cations including zinc rechargeable systems; investigate zinc metal reversibility for high energy rechargeable safe batteries; explore the solvation, interface, and transport of highly concentrated electrolytes and the effects on electrode/electrolyte interfaces; assess energy conversion materials and technologies for Fiscal Year 2023 (FY23) inclusion.			
FY 2023 Plans: Will 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;			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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 dioxide; investigate the use of stretchable power devices with textile-woven conductors for a full body power management system with integrated data communication. <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding increase supports additional research in the area of high energy cathodes and catalysts.			
<i>Title:</i> SBIR/STTR Transfer <i>Description:</i> Funding transferred in accordance with Title 15 USC ?638 <i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638 <i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638	-	0.046	-
Accomplishments/Planned Programs Subtotals	-	1.241	2.387

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CO2: <i>Soldier-Intelligent Technology Research</i>	-	-	4.417	1.543	-	1.543	-	-	-	-	0.000	5.960

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 2021	FY 2022	FY 2023
Title: Soldier Performance in Sociotechnical Environments	-	2.872	1.543
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 2022 Plans: Will explore methods for how autonomous systems can leverage real-time measures of squad-level situational awareness to improve mission outcomes; design initial capability to opportunistically assess group performance in dismounted virtual environments; validate group performance measures in augmented reality systems.			
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 2022 to FY 2023 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding decrease reduces research into human cyber operations assessments and advanced human decision-support capabilities to deploy cyber work systems that optimize human-machine interactions and account for operator and adversary behavior.			
<p>Title: Algorithms for Sensing Soldiers in Mission Context</p> <p>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 understanding for enhanced operational performance and decision making under conditions of time sensitive and dynamically changing information.</p> <p>FY 2022 Plans: Will design techniques for tailoring the representation of uncertain battlespace information in time-sensitive environments for increased Soldier situation awareness and improved mission relevant decision making.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	1.384	-
<p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.161	-
Accomplishments/Planned Programs Subtotals	-	4.417	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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CV9: Technical-SAVVY Soldier Applied Research</i>	-	-	-	2.331	-	2.331	3.381	3.637	3.743	3.326	0.000	16.418

Note

This is a new start in FY 2023.

Project CV9 (Technical-SAVVY Soldier Applied Research) is a New Start in Fiscal Year 2023 (FY23).

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 2021	FY 2022	FY 2023
Title: Soldier Technical Enhancement Applied Research - ARL	-	-	1.554
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.			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p><i>FY 2023 Plans:</i> Will 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.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This task is a new start in FY2023.</p>			
<p><i>Title:</i> Soldier Technical Enhancement Applied Research - ARI</p> <p><i>Description:</i> 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><i>FY 2023 Plans:</i> 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><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> This task is a new start in FY2023.</p>	-	-	0.777
Accomplishments/Planned Programs Subtotals	-	-	2.331

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 2023 Army **Date:** April 2022

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>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CW9: <i>Syn Bio for Reactive-Resp Matls-Soldiers & Sys</i>	-	-	-	3.195	-	3.195	3.615	3.648	7.392	7.390	0.000	25.240

Note

In Fiscal Year 2023 (FY23), funding administratively realigned from Program Element 0602143A (Soldier Lethality Technology) / Project BE6 (Reactive/Resp Surfaces & Matls-Soldiers & Sys).

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 2021	FY 2022	FY 2023
Title: Biological Bio-Composite Materials and Processes	-	-	3.195
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: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
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 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.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding administratively realigned from PE 0602143A (Soldier Lethality Technology) / Project BE6 (Reactive/Resp Surfaces & Matls-Soldiers & Sys).			
Accomplishments/Planned Programs Subtotals	-	-	3.195

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	18.816	12.119	13.605	-	13.605	25.231	36.203	28.263	26.690	0.000	160.927
2CY: Information Trust Technology	-	1.220	0.601	0.858	-	0.858	3.041	-	-	-	0.000	5.720
3CY: Network Access and Effects Technology	-	4.191	6.479	7.798	-	7.798	10.541	12.455	12.146	12.143	0.000	65.753
5CY: Offensive Cyber Operations (OCO) Mirror Technology	-	0.999	0.987	1.022	-	1.022	-	-	-	-	0.000	3.008
CI6: Network Obscuration and Deception Tech*	-	-	-	-	-	-	3.078	3.951	1.774	-	0.000	8.803
CY1: Information Assurance and Network Resiliency Tech	-	3.488	3.397	3.927	-	3.927	4.215	4.254	10.377	12.993	0.000	42.651
CY6: Autonomous Cyber Technology	-	6.133	0.655	-	-	-	4.356	15.543	3.966	1.554	0.000	32.207
CY8: Cyber Security App Research and Exper Partner Tech	-	2.785	-	-	-	-	-	-	-	-	0.000	2.785

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2023

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 2023 Army	Date: April 2022
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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 / C3I Applied Cyber
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B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	18.816	12.123	0.000	-	0.000
Current President's Budget	18.816	12.119	13.605	-	13.605
Total Adjustments	0.000	-0.004	13.605	-	13.605
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	13.605	-	13.605
• FFRDC Transfer	-	-0.004	-	-	-

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
2CY: Information Trust Technology	-	1.220	0.601	0.858	-	0.858	3.041	-	-	-	0.000	5.720

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.

Research in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 8CY (Information Trust 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 2021	FY 2022	FY 2023
<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> <p>FY 2022 Plans: Will mature and validate the trust score architecture that provides real time analytics of the data through distributed processing and minimization of network traffic.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Effort transitions to follow on work in PE 0603457A (C3I Cyber Advanced Development) / Project 8CY (Information Trust Advanced Technology)</p>	1.220	0.601	-
<p>Title: PKI-Modernization & Dynamic Access Control for Tactical (DAC-T) Technology</p> <p>Description: This effort is focused on modernizing the Army's Public Key Infrastructure (PKI). Cryptographic algorithms and addresses the 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>The Dynamic Access Control for Tactical (DAC-T) LOE enhances, speeds up and automates 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>	-	-	0.858

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022	FY 2023
<p><i>FY 2023 Plans:</i> Will investigate modern PKI algorithms as well as OCSP stapling; will investigate different courses of action for changes to the current MIL-STD-2045-47001E; will update cryptographic libraries and software stack to support modern cryptographic algorithms and capabilities as well as OCSP Stapling; will 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><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> New Effort in FY23</p>			
Accomplishments/Planned Programs Subtotals	1.220	0.601	0.858

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
3CY: Network Access and Effects Technology	-	4.191	6.479	7.798	-	7.798	10.541	12.455	12.146	12.143	0.000	65.753

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.

Research in this Project complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project 9CY (Network Access and Effects 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 2021	FY 2022	FY 2023
<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 2022 Plans: Will conduct experiments of OCO/RF Enabled access and effects vectors against emerging AC4I targets of interest. Shall investigate software approaches to support vulnerability discovery against emerging targets of interest and conduct experiments to determine development time reduction. Will conduct experiments with decision aids leveraging machine learning to reduce cognitive burden on OCO/RF operators.</p> <p>FY 2023 Plans: Will complete technology readiness level (TRL) 4 OCO/RF enabled effects for an identified target of interest. Will continue development of machine assisted technique development based on existing and known system vulnerabilities. Will conduct experiments and assess the machine assisted techniques against targets of interest.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects planned lifecycle of the program to conduct experiments to determine development time reduction of vulnerability discovery.</p>	3.945	6.479	7.798
<p>Title: Command, Control and Communications Attack</p>	0.246	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Description: This effort investigates RF Enabled access and effects against adversary Command, Control, Communication, Computers, and Intelligence (AC4I) systems executed from agile OCO/RF Enabled firing platforms.			
Accomplishments/Planned Programs Subtotals	4.191	6.479	7.798

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
5CY: Offensive Cyber Operations (OCO) Mirror Technology	-	0.999	0.987	1.022	-	1.022	-	-	-	-	0.000	3.008

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.

This research complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) / Project CB4 (Offensive Cyber Operations (OCO) Mirror 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 2021	FY 2022	FY 2023
Title: Offensive Cyber Operations Mirror Technology	0.999	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 2022 Plans: Will determine methodologies for assisted OCO maneuver and conduct experiments to enable fidelity driven Development Security Operations (DevSecOps) leveraging foundational modeling and simulation environments			
FY 2023 Plans: Will 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 2022 to FY 2023 Increase/Decrease Statement: Funding reflects planned lifecycle of project.			
Accomplishments/Planned Programs Subtotals	0.999	0.987	1.022

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CY1: Information Assurance and Network Resiliency Tech</i>	-	3.488	3.397	3.927	-	3.927	4.215	4.254	10.377	12.993	0.000	42.651

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).

This research complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) /Project 8CY (Information Trust 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 2021	FY 2022	FY 2023
Title: Information Assurance and Network Resiliency Technology	3.488	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 2022 Plans: Will develop, characterize, and conduct experiments on networking methods for unconventional communications modalities; design and develop adaptive networking protocols for the simultaneous operation of multiple communications modalities; implement and conduct experiments on multilayer network control algorithms for mission-centric network operation in complex environments including jamming; develop example of adversarial machine learning (AML) methods within a laboratory environment against existing cyber security classifiers, enhance network intelligence gathering, machine learning applications, and decoding tool capabilities; increase network forensics capabilities to adapt to more complex networks and protocols, investigating methods which may utilize Machine Learning and autonomous analysis; increase network situational awareness, enable sophisticated analysis and reverse engineering of current and emerging network protocols, and apply and assess foundational network security research algorithms.			
FY 2023 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
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 2022 to FY 2023 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		3.488	3.397	3.927
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CY6: Autonomous Cyber Technology	-	6.133	0.655	-	-	-	4.356	15.543	3.966	1.554	0.000	32.207

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.

This research complements Program Element (PE) 0603457A (C3I Cyber Advanced Development) Project 6CY (Autonomous Cyber 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 2021	FY 2022	FY 2023
Title: Autonomous Cyber Technology	6.133	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.			
FY 2022 Plans: Will mature and demonstrate proof-of-concept generative network algorithms and neural network software to simulate adversarial attacks on artificial intelligence / machine learning (AI/ML) algorithms that can be utilized to ensure trustworthiness of autonomous network configuration decisions and mitigate any vulnerable decisions.			
FY 2022 to FY 2023 Increase/Decrease Statement: Effort transitions to follow on work in PE 0603457A (C3I Cyber Advanced Development) / Project 6CY (Autonomous Cyber Advanced Technology).			
Accomplishments/Planned Programs Subtotals	6.133	0.655	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / <i>C3I Applied Cyber</i>	Project (Number/Name) CY6 / <i>Autonomous Cyber Technology</i>
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D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602213A / C3I Applied Cyber	Project (Number/Name) CY8 / Cyber Security App Research and Exper Partner Tech
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CY8: Cyber Security App Research and Exper Partner Tech	-	2.785	-	-	-	-	-	-	-	-	0.000	2.785

A. Mission Description and Budget Item Justification

This Project investigates cyber electromagnetic activities (CEMA), cyber security devices, software and techniques to harden wireless communications networks against cyber-attacks and new mobile networking protocols that afford resilience within our networks to automatically 'fight through' and/or evade hostile cyber effects.

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 2021	FY 2022	FY 2023
Title: Cyber Security Applied Research & Experimentation Partner (AREP) Technology	2.785	-	-
Description: This effort will take innovative basic research theories from the Cyber Collaborative Research Alliance (CRA) and experimentally validate the hypothesis and create proof-of-concept defensive cyber software implementations.			
Accomplishments/Planned Programs Subtotals	2.785	-	-

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 2023 Army **Date:** April 2022

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>							
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	-	20.643	21.919	-	21.919	16.662	10.895	7.308	7.306	0.000	84.733
CP6: <i>Foundational Biotechnology Design and Dev</i>	-	-	20.643	21.919	-	21.919	16.662	10.895	7.308	7.306	0.000	84.733

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, 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	20.643	0.000	-	0.000
Current President's Budget	0.000	20.643	21.919	-	21.919
Total Adjustments	0.000	0.000	21.919	-	21.919
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	21.919	-	21.919

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army		Date: April 2022
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>	
<u>Change Summary Explanation</u> Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.		

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
CP6: <i>Foundational Biotechnology Design and Dev</i>	-	-	20.643	21.919	-	21.919	16.662	10.895	7.308	7.306	0.000	84.733

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.

This Project is coordinated with Program Element (PE) 0603386A (Biotechnology for Materials - Advanced Research) / CP7 (Biotechnology Demonstration and Evaluation).

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 2021	FY 2022	FY 2023
Title: Biotechnology Safety by Design for Defense	-	19.889	21.919
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 2022 Plans: ? Investigate biotechnology capabilities to determine more rapid, innovative, and diverse applications of biotechnology solutions than is currently realized. Design computational models and computer aided design software to enable virtual tests of biotechnology solutions for defense needs. ? Investigate safety-by-design measures and other biosecurity methods to protect biotechnology capabilities and products from misuse to ensure their safe and effective use in an operational environment. ? Determine a Joint digital architecture to consolidate and secure DoD biotechnology data to promote and streamline information exchange and collaboration toward accelerating the development of innovative applications of biotechnologies for defense needs.			
FY 2023 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
? 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.			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding increase reflects planned lifecycle of this effort.			
<i>Title:</i> SBIR/STTR Transfer	-	0.754	-
<i>FY 2022 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	20.643	21.919

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	20.399	18.701	19.649	-	19.649	19.337	17.625	18.655	18.649	0.000	133.015
790: <i>Personnel Performance & Training Technology</i>	-	20.399	18.701	19.649	-	19.649	19.337	17.625	18.655	18.649	0.000	133.015

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	20.399	18.701	0.000	-	0.000
Current President's Budget	20.399	18.701	19.649	-	19.649
Total Adjustments	0.000	0.000	19.649	-	19.649
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	19.649	-	19.649

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity
2040: *Research, Development, Test & Evaluation, Army / BA 2: Applied Research*

R-1 Program Element (Number/Name)
PE 0602785A / *Manpower/Personnel/Training Technology*

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>790: Personnel Performance & Training Technology</i>	-	20.399	18.701	19.649	-	19.649	19.337	17.625	18.655	18.649	0.000	133.015

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 2021	FY 2022	FY 2023
Title: Talent Assessment and Development	20.399	18.414	19.649
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 2022 Plans: Will design assessment materials for computerized adaptive testing applications in the investigation of new proof of concept measures to improve integrated personnel assessments for both Enlisted/Officer Selection and Assignment; will continue to			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
investigate innovative job analytic techniques by determining psychometrically valid talent constructs for the branch assignment process. FY 2023 Plans: Will determine in-service assessment proof of concept measures to improve enlisted personnel assignment; will continue to develop methods and analytic models of personnel assessment; design and develop innovative methods to generate job analysis content; generate competency assessments for junior officer and senior NCOs; develop assessments for team-based personnel assignment and measures for small unit performance. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY22 SBIR/STTR Transfer FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.287	-
Accomplishments/Planned Programs Subtotals		20.399	18.701	19.649
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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	101.341	120.747	33.976	-	33.976	17.584	19.593	20.442	20.434	0.000	334.117
BS7: <i>Medical Technology (CA)</i>	-	7.000	29.467	-	-	-	-	-	-	-	0.000	36.467
MK4: <i>Warfighter Health Applied Rsch Technology</i>	-	29.726	28.649	31.916	-	31.916	15.663	16.977	17.777	17.771	0.000	158.479
MM4: <i>Cbt Casualty Care Applied Rsch Technology</i>	-	19.301	23.437	1.935	-	1.935	1.797	2.498	2.546	2.545	0.000	54.059
MM6: <i>Medical Technologies to Support Dispersed Ops Tech</i>	-	14.052	10.668	0.125	-	0.125	0.124	0.118	0.119	0.118	0.000	25.324
MM8: <i>Infectious Diseases and Applied Rsch Technology</i>	-	24.542	28.526	-	-	-	-	-	-	-	0.000	53.068
MN1: <i>Applied Sensory Systems Trauma Technology</i>	-	6.720	-	-	-	-	-	-	-	-	0.000	6.720

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 Armed Services Biomedical Research Evaluation and Management (ASBREM) Community of Interest (COI). The ASBREM COI, formed

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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

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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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 Defenses (DoD) biomedical research community, as well as their associated enabling research areas.

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	101.341	91.720	0.000	-	0.000
Current President's Budget	101.341	120.747	33.976	-	33.976
Total Adjustments	0.000	29.027	33.976	-	33.976
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	29.467			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	33.976	-	33.976
• FFRDC Transfer	-	-0.440	-	-	-

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

Project: BS7: *Medical Technology (CA)*

- Congressional Add: *Program Increase - Safety and Performance of Female Warfighters in Extreme Heat*
- Congressional Add: *Program Increase - Military Force Vector Borne Health Protection*
- Congressional Add: *Biological Performance Technology*
- Congressional Add: *Center for Excellence in Military Health and Performance Enhancement*
- Congressional Add: *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: *RNA Therapeutics for Infectious Disease Threats*

Congressional Add Subtotals for Project: BS7

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	2.000	-
	5.000	5.000
	-	5.000
	-	3.567
	-	1.500
	-	1.900
	-	5.000
	-	7.500
Congressional Add Subtotals for Project: BS7	7.000	29.467
Congressional Add Totals for all Projects	7.000	29.467

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
BS7: Medical Technology (CA)	-	7.000	29.467	-	-	-	-	-	-	-	0.000	36.467

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 2021	FY 2022
Congressional Add: Program Increase - Safety and Performance of Female Warfighters in Extreme Heat FY 2021 Accomplishments: Program Increase supported applied research on Safety and Performance of Female Warfighters in Extreme Heat. Work executed under the direction of the Army Futures Command.	2.000	-
Congressional Add: Program Increase - Military Force Vector Borne Health Protection FY 2021 Accomplishments: Program Increase supported applied research on Military Force Vector Borne Health Protection. Work executed under the direction of the Army Futures Command.	5.000	5.000
Congressional Add: Biological Performance Technology FY 2022 Plans: Congressional Interest Item funding provided for Biological Performance Technology	-	5.000
Congressional Add: Center for Excellence in Military Health and Performance Enhancement FY 2022 Plans: Congressional Interest Item funding provided for Center for Excellence in Military Health and Performance Enhancement	-	3.567
Congressional Add: Holistic Health and Fitness	-	1.500

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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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 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Holistic Health and Fitness		
<i>Congressional Add:</i> National Trauma Research Repository Data Population Project	-	1.900
<i>FY 2022 Plans:</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 Plans:</i> Congressional Interest Item funding provided for Physiological Study of Female Warfighters to Improve Training		
<i>Congressional Add:</i> RNA Therapeutics for Infectious Disease Threats	-	7.500
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for RNA Therapeutics for Infectious Disease Threats		
Congressional Adds Subtotals	7.000	29.467

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 2023 Army **Date:** April 2022

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
MK4: <i>Warfighter Health Applied Rsch Technology</i>	-	29.726	28.649	31.916	-	31.916	15.663	16.977	17.777	17.771	0.000	158.479

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 2021	FY 2022	FY 2023
Title: Physiological Health and Performance	14.272	-	-
Description: This effort evaluates methods for managing and controlling the effects of fatigue on Soldier operational performance and the impact of nutritional strategies to optimize operational performance. Efforts will also contribute to new high-priority medical investments in human biomedical performance enhancement and medical aspects of manned-unmanned machine teaming (MUM-T).			
Title: Environmental Health and Protection	7.431	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Description: This effort involves applied research addressing the physiological (human physical and biochemical functions) mechanisms of exposure to extreme heat, cold, altitude, and other environmental stressors. This effort establishes scientific evidence for specific and sensitive diagnostics of exertional heat illness to optimize Soldier performance in austere environments. This effort also supports and matures non-invasive technologies, decision-aid tools, and models to enhance Soldier protection and sustainment across the operational spectrum. This effort provides the scientific basis for developing focused heating and cooling solutions to maintain fine motor dexterity, core temperature, and optimize physical and cognitive performance during cold- weather and hot-humid operations. This effort will develop knowledge and materiel solutions that enable Soldier individualized metabolic assessments and optimization during training and operations.</p>				
<p>Title: Injury Prevention and Reduction</p> <p>Description: This effort addresses the Army's number one priority of readiness by improving musculoskeletal injury prevention efforts as well as contributing to preparing Soldiers for potential threats (e.g., directed energy) in and developing capabilities for the multi domain operations environment. It evaluates and assesses the effects of repetitive motion during military operations and training on the human body; provides mathematical models to predict the likelihood of physical injuries following continuous operations and muscle fatigue; evaluates current standards for return-to-duty; and establishes improved medical test methods with the goal of rapid return to duty of Soldiers following injury. This effort also develops prevention-based strategies and medically-based injury criteria for hearing, vestibular (sensory system supporting movement and sense of balance, located in the inner ear), and ocular/ facial protection devices; develops and evaluates neurosensory operational risk factors; develops medically based guidelines to assess neurosensory performance and models the effects of acoustic and impact trauma as stressors on vision and hearing. Efforts will investigate the medical aspects of MUM-T and medical aspects of and protection against directed energy.</p>		4.379	-	-
<p>Title: Psychological Health and Resilience</p> <p>Description: This effort refines and evaluates tools and early interventions to prevent and reduce the impact of military stressors and combat-related exposures on behavioral health problems, including symptoms of post-traumatic stress disorder (PTSD), depression, anger problems, anxiety, substance abuse, suicide, and other health risk behaviors. This effort assesses and refines tools and interventions to enhance and sustain psychological resilience throughout Soldiers' careers. Efforts also address the health and well-being of families.</p>		3.644	-	-
<p>Title: Operational Risk Planning Tools for Battlefield Environmental Threats</p>		-	2.268	1.381

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will develop risk profiles for exposures in extreme environments including cold water; develop and validate models for high-throughput screening for novel or repurposed drugs to counter performance decrements encountered in SubT operational environments; validate heat injury biomarkers to inform return to duty guidance.</p> <p>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; develop gene expression profile signatures to predict individual susceptibility to acute mountain sickness and acclimatization status prior to high altitude ascent.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>			
<p>Title: Prevention of Soldier Performance Degradation in Extreme Environments</p> <p>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.</p> <p>FY 2022 Plans: Will validate performance of pharmaceuticals to reduce acute mountain sickness, heat injuries and other environmental exposures; assess the feasibility of dietary supplements as a mitigation for increased carbon dioxide blood levels and potential respiratory failure recurrent in SubT environments; evaluate cold habituation as an intervention to augment peripheral blood flow in cold exposure; investigate models for the effect of wet clothing on heat loss; determine advanced decision aids for pacing and</p>	-	4.171	4.101

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
load carriage optimization; design physiological modes to predict human state during complex military scenarios; develop and/or assess various countermeasures for improved performance in extreme environments. 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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Leader Decision Aid to Manage Blast Head Injury in All Settings 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. FY 2022 Plans: Will conduct experiments to build upon performance based weight limit criteria for loads added to the head (head protection systems, night vision goggles) to include acute injury based criteria for mounted and dismounted environments. FY 2023 Plans: Will continue to develop injury risk criteria for head supported technologies in multiple military operational environments (mounted and dismounted). FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		-	0.253	0.874
Title: Physical Fitness Standards to Prevent Musculoskeletal Injuries 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		-	1.614	0.890

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
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>FY 2022 Plans: Will quantify relative contributions of modifiable and non-modifiable risk factors for MSKI; examine relationship between Holistic Health and Fitness (H2F) metrics and Soldier fitness and operational readiness to inform updates to H2F program; determine incidence of degraded performance metrics in combat units with and without embedded specialty providers and develop strategies to enhance performance and reduce injury and re-injury rates.</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 2022 to FY 2023 Increase/Decrease Statement: Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<p>Title: Leader Tools to Reduce Musculoskeletal Injury In All Settings</p> <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 2022 Plans: Will define factors that contribute to risk for stress fracture and other MSKI development during Basic Combat Training (BCT); develop evidence-based, actionable recommendations to Army leadership (TRADOC-CIMT) to reduce MSKI in recruits without reducing training standards; determine trends/rates of negative health outcomes incurred by Soldiers to include risk and protective factors.</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 2022 to FY 2023 Increase/Decrease Statement:</p>		-	3.603	2.440

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.			
<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 2022 Plans: Design and conduct experiments for an ultrasound-based bone injury screening device and investigate its translation to a soft tissue imaging based capability for diagnosing and screening of musculoskeletal injury.</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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	0.389	0.318
<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 2022 Plans: Will complete evaluation of drug-delivered testosterone for maintenance of physiological and psychological performance under conditions of medically relevant hypogonadism (a failure of the gonads, testes in men and ovaries in women, to function properly) induced by high operational tempo military activity; investigate pharmacological strategies for improving Soldier vigilance & endurance; refine electrical stimulation technologies to augment military performance and mitigate high OPTEMPO performance degradation.</p> <p>FY 2023 Plans:</p>	-	6.469	4.840

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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 2022 to FY 2023 Increase/Decrease Statement: Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</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 2022 Plans: Will conduct 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 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 2022 to FY 2023 Increase/Decrease Statement: Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	1.781	1.497
<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> <p>FY 2022 Plans:</p>		-	2.334	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will determine the effectiveness of electrical stimulation of the brain for enhancing learning through the consolidation of emotional memories; investigate the effectiveness of slow-wave sleep augmentation via auditory and electrical stimulation for enhancing tactical performance and reducing sleepiness during a subsequent period of sustained wakefulness.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<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 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.</p> <p>FY 2022 Plans: Will investigate pharmacotherapies in preclinical models for their efficacy in speeding recovery and restoring behavioral and physiological function after traumatic stress, to inform clinical trials in humans; design guidelines for medics to use existing Role 1 pharmacologic solutions to prevent and reduce the development of behavioral health issues in Soldiers; investigate the safety and efficacy of pharmacologic candidate compounds to speed recovery after traumatic stress exposure, to be tested in humans; investigate delivery of far-forward, non-pharmacological behavioral health services intervention package, and report on feasibility and effectiveness; determine a neurocognitive optimization, sustainment and recovery platform that mitigates responses to and expedites recovery from stress/trauma at or near point of psychological injury (Role 1); determine a blood-based biomarker screening panel to characterize objective signatures of Acute Stress Disorder that indicate risk of unresolved symptoms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	2.735	-
<p>Title: Unit-Level Psychological Interventions to Enhance Performance</p> <p>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.</p> <p>FY 2022 Plans:</p>		-	2.863	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfigher Health Applied Rsch Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Determine recommendations for leaders to address behavioral health threats and profiles identified by the rapid feedback mechanism; design and investigate measures of morally-challenging combat events, moral reactions, and moral leadership; design and conduct experiments on a framework that assists in identifying profiles of cognition and behavior to assist in matching individuals to appropriate resilience interventions; design and investigate candidate tools to improve small-team culture, performance and resilience; determine neurocognitive mechanisms of performance, particularly under high stress conditions.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<p>Title: Energy Field Biological Effects and Mechanisms</p> <p>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.</p> <p>FY 2023 Plans: Will 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.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase supports research in the area of emerging directed energy threat mechanisms and biological effects.</p>		-	-	15.575
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: SBIR/STTR tax.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638.</p>		-	0.169	-
Accomplishments/Planned Programs Subtotals		29.726	28.649	31.916
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MK4 / <i>Warfigher Health Applied Rsch Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

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>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
MM4: <i>Cbt Casualty Care Applied Rsch Technology</i>	-	19.301	23.437	1.935	-	1.935	1.797	2.498	2.546	2.545	0.000	54.059

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 2021	FY 2022	FY 2023
Title: Prolonged Care	7.299	-	-
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.			
Title: Blood and Blood Products	4.905	-	-
Description: This effort develops and refines knowledge products (such as clinical practice guidelines, manuals, protocols, studies, and media), materials, and systems for control of internal bleeding and mitigation of shock; minimizing the effects of traumatic blood loss; preserving, storing, and transporting blood and blood products.			
Title: Severe Burns	2.822	-	-
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: Tactical Combat Casualty Care	2.100	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Description: This effort refines diagnostic and therapeutic medical devices, drugs, and new clinical practices for hemorrhage control, resuscitation, stabilization, and preservation of vital organ function that can be immediately applied by combat medical personnel in the pre-hospital combat setting.</p>				
<p>Title: Brain Trauma</p> <p>Description: This effort supports refinement of drug (includes mature drug technologies and those that are FDA approved for other indications) and therapeutic strategies to manage brain injury resulting from battlefield trauma.</p>		2.175	-	-
<p>Title: Modular and Automated Battlefield Sustainment of Critical Organ Function Cap Set 2</p> <p>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.</p> <p>FY 2022 Plans: Will conduct experiments on technologies designed to mitigate detrimental effects that would otherwise occur in critically wounded casualties receiving prolonged care in forward operating areas when medical evacuation is either delayed or not possible, or definitive surgical care is unavailable; design tools that will enable medics to continuously monitor vital organ function in severely injured casualties, who for tactical reasons must be provided prolonged critical care in forward operating areas pending availability of medical evacuation and/or definitive surgical care; investigate the effects of reducing inflammation on vital organ function following severe injury; initiate investigation of drugs and other medical products that will protect blood deprived tissues from further damage after blood flow is restored.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	1.223	-
<p>Title: Battlefield Pain Control without Physiological Impairment</p> <p>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.</p> <p>FY 2022 Plans:</p>		-	2.288	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>Will conduct preclinical evaluation of promising non-opioid, side effect-free pain relieving drugs that act on non-opioid targets in the nervous system to inhibit pain signaling without affecting cognitive ability in treating post-traumatic, moderate-to severe pain in order for the wounded casualty to be able to remain in the fight.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<p>Title: Candidate Capabilities for Rapid Burn Treatment</p> <p>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.</p> <p>FY 2022 Plans: Will conduct experiments to evaluate new technologies and clinical practices for improving treatment of acute burns at the point of injury with aim to accelerate wound healing, reduce complications, and increase rate of return to duty; determine a dual treatment targeting both ischemia (poor blood & oxygen supply) and inflammation to prevent burn progression on the battlefield using a large animal model; investigate the effect of enzymatic debridement (removal of damaged tissue) on wound healing of full thickness burns in a preclinical pig large animal model; evaluate extracellular vesicle (particles that are naturally released from a cell)-releasing plasma-alginate wound dressing to reduce inflammation and improve healing of acute wounds; investigate optimal off-the-shelf therapies to accelerate wound healing in a large, 20% total body surface area, and deep partial thickness burn wound model.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	1.650	-
<p>Title: Autonomous Cardiopulmonary Resuscitation</p> <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>FY 2022 Plans:</p>		-	0.514	-

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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 2021	FY 2022	FY 2023
<p>Will investigate new technologies that may be deployed by medics in the far-forward, prehospital environment to temporarily stop lethal non-compressible bleeding until definitive surgical repair is available; will design and determine efficacy and safety of emerging foams that stop bleeding in animal models of non-compressible truncal hemorrhage.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</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> <p>FY 2022 Plans: Will determine and investigate treatment for unconventionally-acquired brain injury threat technologies; conduct Unconventionally-acquired Brain Injury human-like animal experiments; validate Unconventional-acquired Brain Injury threat source symptomology and determine injury mechanisms; validate understanding of injury mechanisms to enable direct medical diagnosis, treatment and clinical management.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	8.660	-
<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> <p>FY 2022 Plans: Will investigate efficacy of an immunomodulation agent (stimulates or suppresses the immune system) to mitigate both intracerebral bleeding (bleeding within the brain tissue), as well as neurological, motor impairment and cognitive deficits following TBI.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	1.232	-

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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 2021	FY 2022	FY 2023
<p>Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p> <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> <p>FY 2022 Plans: Will determine the efficacy of a novel anti-oxidant and anti-inflammatory peptide, currently undergoing FDA evaluation, against blast-induced TBI, and will perform dosing studies to determine the optimum effective dose.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	1.457	-
<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> <p>FY 2022 Plans: Will determine effectiveness of a thin film containing antimicrobial and anti-inflammatory drugs applied to deep partial thickness- and full thickness-burn wounds early after injury to reduce bacterial burden, inflammation, and injury progression.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	0.707	-
<p>Title: Bioengineered Blood Surrogate</p>		-	0.351	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<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> <p>FY 2022 Plans: Will comparatively investigate ability of promising cold-stored whole blood additives to extend shelf life and maintain normal blood function.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<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> <p>FY 2022 Plans: Will investigate single drugs and multiple drugs in combination to determine their efficacy in prolonging survival and improving outcomes in animal models of hemorrhagic shock.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	0.751	-
<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 2022 Plans: Will determine and validate a post mortem human subject model for use in patient in transport research- all use of post-mortem human subjects will be done in an ethical and respectful manner in accordance with the 05-November-2019 Army Policy for Use of Human Cadavers for Research, Development, Test and Evaluation (RDTE), Education and Training. Will conduct engineering</p>		-	1.794	1.935

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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 2021	FY 2022	FY 2023
<p>evaluation of the Interim Medevac Mission Support System to support future studies aimed at improving patient and medical attendant survivability in potentially survivable mishaps.</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 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<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> <p>FY 2022 Plans: Will investigate pharmaceuticals and biologics that reduce cellular metabolism in injured limbs and protects injured tissues from the effects of prolonged lack of blood and oxygen followed by period of blood and oxygen re-supply.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	0.528	-
<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> <p>FY 2022 Plans: Will determine efficacy of two drugs in preserving skeletal muscle function following extended tourniquet application.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>		-	0.580	-
<p>Title: Candidate Capabilities for Battlefield Sustainment of Critical Organ Function</p>		-	1.076	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<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> <p>FY 2022 Plans: Will investigate field-deployable pharmacological treatments using a previously developed combat-relevant small animal model that reliably produces acute kidney injury; investigate drugs that increase renal oxygen delivery and improve energy utilization; determine the efficacy of targeting key immunomodulatory (affecting the immune system) players on progression of smoke inhalation injury in a small animal lung injury model.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>			
<p>Title: SBIR/STTR</p> <p>FY 2022 Plans: SBIR/STTR tax.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC 7638.</p>	-	0.626	-
Accomplishments/Planned Programs Subtotals	19.301	23.437	1.935

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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
MM6: <i>Medical Technologies to Support Dispersed Ops Tech</i>	-	14.052	10.668	0.125	-	0.125	0.124	0.118	0.119	0.118	0.000	25.324

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 2021	FY 2022	FY 2023
Title: Medical Robotic and Autonomous Systems	9.726	7.083	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 2022 Plans: Will conduct in-flight experimentation of emerging semi-autonomous and autonomous en route care technologies and capabilities that are candidates for providing patient management during unmanned aircraft systems (UAS) Casualty Evacuation (CASEVAC) missions; investigate comparisons of performance of medical devices and support systems on board UAS to performance in a controlled environment; funds research of in-flight testing of at least two technologies for low-band width, cyber- secure, communications networking with potential for overcoming limitations in bandwidth, range, beyond line-of-sight transmissions, cyber security, and security domain restrictions which limit medical use of current tactical networks; initiate investigation of methods to modify communications protocols for transmitting telemetry data from the UAS in order to mitigate UAS flight induced communications effects determine and investigate a method for interfacing with the unmanned vehicle's flight controller to adapt			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>the vehicles route planning and flight performance parameters based on patient conditions and injury type to ensure a safe ride profile is attainable; determine method for visual and audio data capture for hands free documentation, requiring a data collection system that is worn by the end user; investigate low size, weight, and power (SWaP) body worn data collection system to ensure solutions function within Army established performance parameters; investigate baseline, rule based, Medic Computer Decision Support System (CDSS) prototype for an end user study of CDSS effectiveness.</p> <p>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</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decreased due to realignment of US Army Medical Research and Development Command to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<p>Title: Virtual Health</p> <p>Description: Develop 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.</p>		4.326	-	-
<p>Title: Virtual Health Applications for Multi Domain Operational Environments</p> <p>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.</p> <p>FY 2022 Plans: Will conduct research and validation of models for the Virtual Health (VH) support and integration with autonomous (real time) and/or semiautonomous patient care capabilities; investigate methods and determine means to leverage contemporary VH data components to drive future semi-autonomous and autonomous VH system support tools; conduct research and design strategies and mechanisms to provide VH solutions when an established synchronous VH consultation is disrupted due to communication failure/outages to include, but not limited to closed loop systems and machine learning techniques; funds research on vocal patterning data analysis to link vocal capture to stress-related changes in risk mechanisms; investigate the link between vocal behavioral markers sleep loss and stress-related changes in health risk mechanisms for more accurate interpretation of commands and recognize changes in environment to determine risk, for improved recommended/best medical courses of action;</p>		-	3.214	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
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 2021	FY 2022	FY 2023
<p>conduct a systematic retrospective review and case analysis of virtual/telehealth encounters across the Military Health System to quantify and categorize the types of casualty information data required to deliver care and methods of data communication using a mixed method (qualitative and quantitative) approach; determine virtual/telehealth health information data elements and prioritization guide and roadmap for future casualty care information data optimization for virtual/telehealth application in the Role 1&2 environment.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>				
<p>Title: SBIR/STTR</p> <p>FY 2022 Plans: SBIR/STTR tax.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638.</p>		-	0.371	-
Accomplishments/Planned Programs Subtotals		14.052	10.668	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 2023 Army										Date: April 2022		
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
MM8: <i>Infectious Diseases and Applied Rsch Technology</i>	-	24.542	28.526	-	-	-	-	-	-	-	0.000	53.068

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 2021	FY 2022	FY 2023
Title: Applied research on drugs and vaccines against parasitic diseases	13.452	-	-
Description: Develop and validate malaria preclinical animal models. Demonstrate and optimize prophylactic safety and efficacy in validated malaria preclinical animal models. Down-select lead malaria prophylactic candidates for use in human clinical trials.			
Title: Applied Research to Prevent Viral Diseases	6.039	-	-
Description: Develop and validate viral disease preclinical animal models. Demonstrate and optimize prophylactic safety and effectiveness in validated viral disease preclinical animal models. Down-select lead viral disease prophylactic candidates for use in human clinical trials.			
Title: Applied Research to Prevent Bacterial Diseases	5.051	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
<p>Description: Optimize antigens and platforms for use in animal studies. Evaluate bacterial diarrheal vaccine candidates for safety, effectiveness, and immunogenicity in animal models to advance to human clinical trials (Enterotoxigenic Escherichia Coli, Shigella and Campylobacter). Examine host/pathogen/vector interactions for scrub typhus and other Rickettsial diseases.</p>			
<p>Title: Prevention & Treatment of Combat Wound Infections during Prolonged Care</p> <p>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.</p> <p>FY 2022 Plans: Will perform test tube and/or cell-based studies to determine the next lead prophylactic and/or treatment candidate for prevention and treatment of combat wound infections; design, assess and validate performance parameters of animal efficacy models of combat wound infections; evaluate the safety and efficacy of lead candidates in validated combat wound infection animal models; investigate technologies for extended release that provides long-term prophylaxis in order to reduce disease and non-battle injury (DNBI) through prevention of wound infections and reduce unit loss rate for effective wound infection prevention to sustain unit readiness, operational effectiveness, Warfighter performance, and quicker return to duty.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.</p>	-	11.327	-
<p>Title: Prevention and Treatment of Endemic Diseases</p> <p>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.</p> <p>FY 2022 Plans: Will perform test tube and/or cell-based studies to investigate and determine the next lead prophylactic and/or treatment candidate for prevention and treatment of endemic bacterial and viral infections; determine, assess and validate performance parameters of animal efficacy models of endemic bacterial and viral infections; investigate the safety and efficacy of lead candidates in validated bacterial and viral infection animal models; assess technologies for extended release that provide long-term prophylaxis.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>	-	16.637	-

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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 2021	FY 2022	FY 2023
Funding and mission realigned as part of US Army Medical Research and Development Command transfer to the Defense Health Agency in order to meet Congressional intent as outlined in NDAA 2019 (Section 711) and NDAA 2020 (Section 737). Funding transferred to Program Element 0602115DHA, Project Code 372G.			
Title: SBIR/STTR	-	0.562	-
FY 2022 Plans: SBIR/STTR tax.			
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC 7638.			
Accomplishments/Planned Programs Subtotals	24.542	28.526	-

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 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602787A / <i>Medical Technology</i>	Project (Number/Name) MN1 / <i>Applied Sensory Systems Trauma Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
MN1: <i>Applied Sensory Systems Trauma Technology</i>	-	6.720	-	-	-	-	-	-	-	-	0.000	6.720

A. Mission Description and Budget Item Justification

This Project conducts laboratory and animal studies for the purpose of developing novel, non-opioid drugs to treat pain in the austere battlefield environment with minimal side effects. Research to understand the influence of stress on the effectiveness of pain relief drugs (analgesics). All drugs, biological products, and medical devices are refined in accordance with Food and Drug Administration (FDA) regulations, which govern testing in animals to assess safety, toxicity, and effectiveness and subsequent human subject clinical trials.

Promising efforts identified in this Project are further matured under Program Element (PE) 0603002A (Medical Advanced Technology) / Project MN7 (Musculoskeletal Injury Screening Tool Adv Tech).

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 2021	FY 2022	FY 2023
Title: Applied Sensory Systems Trauma Technology	6.720	-	-
Description: This effort performs applied research in laboratory and animal studies to develop novel, non-opioid drugs to treat pain in the austere battlefield environment with minimal side effects.			
Accomplishments/Planned Programs Subtotals	6.720	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A