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**Department of Defense
Fiscal Year (FY) 2022 Budget Estimates**

May 2021



Army

Justification Book Volume 1c of 1

Research, Development, Test & Evaluation, Army

RDT&E – Volume I, Budget Activity 3

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Army • Budget Estimates FY 2022 • 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, \$12,799,645,000.00 to remain available for obligation until September 30, 2023.

The FY 2022 Overseas Contingency Operations accounted for in the base budget are as follows:

Direct War cost accounted for in the Base Budget \$67,710,000: Direct War costs are those combat or direct combat support costs that will not continue to be expended once combat operations end at major contingency locations.

Enduring costs accounted for in the Base budget: \$41,546,000: Enduring Requirements are enduring in theater and in CONUS costs that will likely remain after combat operations cease, and have previously been funded in OCO.

FY 2021 includes Division C, Title IX and Division J, Title IV of the Consolidated Appropriations Act, 2021 (P.L. 116-260).

FY 2020 includes Division A, Title IX and X of the Consolidated Appropriations Act, 2020 (P.L. 116-93), Division F, title IV and V from the Further Consolidated Appropriations Act, 2020 (P.L. 116-94) and the Coronavirus Aid, Relief, and Economic Security Act (P.L. 116-136).

COST STATEMENT

The following Justification Books were prepared at a cost of \$472,560: 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 6, Budget Activity 7, and Budget Activity 8.

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FY 2022 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 2021.

2. **Relationship of the FY 2022 Budget Submitted to Congress to the FY 2021 Budget Submitted to Congress.** This paragraph provides a list of program elements/projects that are major new starts, restructures, developmental transitions, and terminated programs. Explanations for these changes can be found in the narrative sections of the Program Element R-2A Exhibits.

New Start Programs:

<u>Budget Activity</u>	<u>OSDPE / Project</u>	<u>Project Title</u>
01	0601104A / CI9	Strategic University Basic Research Alliance
02	0602141A / CJ1	Lethality Enabling University Applied Research
02	0602147A / AF1	Long Range Maneuverable Fires (LRMF) Technology
02	0602181A / CM7	Collaborative Convergence Applied Research
02	0602182A / CN4	Network Enabling University Applied Research
02	0602183A / CL5	Air Platform Enabling University Applied Research
02	0602184A / CK9	Advancing Concepts and Technology Forecasting Tech
02	0602184A / CN2	Intelligent Weapons Concepts and Technologies
02	0602184A / CN9	Soldier Enabling University Applied Research
02	0602184A / CO1	Soldier Power And Energy Concepts and Technologies
02	0602184A / CO2	Soldier-Intelligent Technology Research
02	0602386A / CP6	Biotechnology Demonstration and Evaluation
03	0603025A / CK8	Advanced Technology Development and Convergence
03	0603041A / CL9	Collab Battlefield Networked Leth Sys Adv Tech
03	0603041A / CM2	Collaborative Convergence Adv Tech Development
03	0603041A / CM8	Convergence Battlefield Integration

03	0603042A / CN3	Network Enabling University Adv Development
03	0603043A / CL4	Air Platform Enabling University Adv Development
03	0603044A / CN8	Soldier Enabled University Advanced Development
03	0603119A / CJ9	Ground Enabling University Adv Development
03	0603386A / CP7	Foundational Biotechnology Design and Development
03	0603462A / BH4	Ground Vehicle Holistic Defense Adv Tech
03	0603463A / AO3	Network C3I Advanced Technology
03	0603463A / AO6	Network C3I Advanced Technology
03	0603463A / AP6	Network C3I Advanced Technology
03	0603463A / AP8	Network C3I Advanced Technology
04	0604019A / BU9	IFPC High Energy Laser
04	0604019A / CO6	IFPC High Power Microwave (HPM)
04	0604115A / CE4	Emerging Technology Initiatives Development
04	0604403A / FM3	Future Interceptor
04	0604531A / CQ5	C-SUAS JOINT NEW CAPABILITIES DEVELOPMENT
04	0604531A / CQ6	C-SUAS JOINT ENABLING CAPABILITIES DEVELOPMENT
05	0303667A / CR1	Citizen Broadband Radio System
05	0304270A / CK3	TLS Echelon Above Brigade (EAB)
05	0604601A / S70	Personnel Recovery Support System (PRSS)
05	0604802A / CE3	Precision Munition (Sniper)
05	0604804A / VR7	Combat Service Support Systems
05	0604818A / EJ6	TACTICAL ENHANCEMENT
05	0605053A / BS9	Robotic Payloads
05	0605143A / BX5	Biometrics Enabling Capability (BEC)
05	0605531A / CQ7	C-SUAS JOINT NEW CAPABILITIES
05	0605531A / CQ8	C-SUAS JOINT ENABLING CAPABILITIES
07	0307665A / BI7	Biometrics Enabled Intelligence
07	0607131A / CP2	Precision Fire Technology Improvements

Program Element/Project Restructures:

<u>Budget Activity</u>	<u>Old OSDPE / Project: Title</u>	<u>New OSDPE / Project</u>
01	0601102A / AA1 AA2 AA6 AA7 AA8 AB1 AB2 AB4 AC6: Multiple	0601601A / CL3
01	0602785A / 790: Manpower/Personnel/Training Technology	0603040A / CL1
02	0602787A / MM8: Infectious Diseases and Applied Rsch Technology	0603002A / CJ3
02	0602787A / MN1: Applied Sensory Systems Trauma Technology	0602787A / MK4, MM4
02	0602141A / AH9: Advanced Warheads Technology	0602141A / CJ6
02	0602141A / AI1: Advanced Terrain Shaping Technology	0602141A / CF8
02	0602143A / BC3: Soldier Decision Making & Comms Performance Tech	0602184A / CO2
02	0602143A / BD6: Soldier Sys Interfaces/Integration- Sensor Tech	0602180A / CL7
02	0602144A / CA9: Predictive Maintenance	0602180A / CN7
02	0602145A / BF6: Crew Augmentation and Optimization Tech	0602144A / CG8
02	0602145A / BF8: Artificial Intelligence & Machine Learning Tech	0602180A / CL7
02	0602145A / BF8: Artificial Intelligence & Machine Learning Tech	0602183A / CL5
02	0602145A / BF9: Sensors for Autonomous Operations and Surv Tech	0602180A / CL2
02	0602145A / BG6: Advanced Concepts for Active Defense Technology	0602144A / CG7
02	0602145A / BH5: Platform Electrification and Mobility Tech	0602144A / CG6
02	0602145A / BH9: Protection for Autonomous Systems Tech	0603041A / CM8
02	0602145A / BI2: Sensor Protection Technology	0602144A / CG5
02	0602146A / AN7: COE - Every Receiver is a Sensor Technology	0602180A / CL2
02	0602146A / AO5: Tag Track and Locate Small Satellites Technology	0602146A / CK1, CG3
02	0602146A / AP4: CEMA Camouflage Technology	0602182A / CM9, CN5
02	0602146A / AQ9: Expeditionary Data to Decisions Technology	0602146A / CI3
02	0602146A / AV6: Airborne Engineering Support Technology	0603463A / CI7
02	0602148A / AI5: Next Gen Tactical UAS TD Technology	0602148A / CH2
02	0602148A / AJ4: Digital Vehicle Management and Control Technology	0602148A / CG9
02	0602148A / AK2: Aviation Survivability Technology	0602183A / CN1
02	0602148A / AK2: Aviation Survivability Technology	0602148A / CH3
02	0602148A / AK4: Multi-Role Small Guided Missile Technology	0602148A / CI5

02	0602148A / AK9: Adv Teaming for Tactical Aviation Operations Tech	0602183A / CL8
02	0602148A / AM4: Opt Energy Stg & Therm Mgmt for FVL Survivability	0602148A / CH4
02	0602150A / AC9: High Energy Laser Tactical Vehicle Demonstrator Te	0603466A / AD1
02	0602150A / AD2: High Energy Laser (HEL) Enabling and Support Techn	0602141A / CF7
02	0602150A / AD3: Maneuver Air Defense Technology	0602141A / CJ7
02	0602213A / CY8: Cyber Security App Research and Exper Partner Tech	0603463A / CI7
02	0602213A / CY8: Cyber Security App Research and Exper Partner Tech	0602146A / CI3
02	0603002A / MO9: Vaccines to Prevent Dengue Fever Advanced Tech	0603002A / CJ3
02	0603007A / 792: Personnel Performance & Training	0603040A / CL6
03	0603116A / AI3: Terminal Weapons Effects Against Structures and Critical Targets Tech	0603116A / CH5
03	0603118A / BC4: Soldier Decision Making&Comms Performance AdvTech	0603465A / AL9
03	0603463A / AM9: Protected SATCOM Advanced Technology	0603463A / CI7
03	0603463A / AM9: Protected SATCOM Advanced Technology	0602146A / AN3
03	0603463A / AO3: Stand-In Advanced RF Effects (STARE) Adv Tech	0603463A / AO7
03	0603463A / AO6: Tag Track and Locate Small Satellites Adv Tech	0603463A / CJ8
03	0603463A / AP6: C4ISR Integrated Demonstrations Advanced Tech	0603463A / AN4, AM9, AP9
03	0603463A / AP8: Comms/Horiz Int for Army Mod Priorities Adv Tech	0603041A / CL9, CL2, CM8
03	0603463A / AQ1: Spectrum Obfuscation Advanced Technology	0603463A / CI7
03	0603463A / AQ5: Sensor CE-Integrated Sensor Architecture Adv Tech	0603463A / CI7
03	0603463A / AQ8: High Tempo Data Driven Decision Tools Adv Tech	0603463A / CI7
03	0603463A / AU6: Automated Analytics for Operational Environment AT	0603463A / CF9
03	0603463A / AV2: LEO Advanced Technology	0603463A / CJ8
03	0603463A / BZ8: Aerial Tier Networking (High Altitude)	0602146A / AN3
03	0603465A / AJ1: Future UAS Engine Advanced Technology	0603465A / AI8
03	0603465A / AJ5: Digital Vehicle Management & Control Advanced Tech	0603465A / CH6
03	0603465A / AK3: Aviation Survivability Advanced Technology	0603465A / CH8, CG1
03	0603465A / AM5: Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech	0603465A / CH7
03	0603466A / AD6: Next Generation Fires Radar Advanced Technology	0602141A / CG4
04	0603327A / FG9: Air and Missile Defense (AMD) Electronic Warfare	0604741A / 126
04	0603619A / 606: Cntrmn/Barrier Adv Dev	0603619A / CE5

04	0603639A / BQ4: 155mm Artillery Propulsion XM654	0604802A / BQ3
04	0603639A / FG1: Cannon-Delivered Area Effects Munitions (C-DAEM)	0604802A / FG1
04	0603766A / 907: Tactical Electronic Surveillance System - Adv Dev	0603766A / BX9, CC5, BY9
04	0603774A / VT7: Soldier Maneuver Sensors - Adv Dev	0603774A / BQ5
04	0603801A / F12: Future Attack Reconnaissance Aircraft	0603801A / CK7
04	0603807A / 811: Mil HIV Vac&Drug Dev	0604807A / 849
04	0604017A / FD2: Soldier Robotics Systems	0605053A / BS9
04	0604117A / FI4: Maneuver - Short Range Air Defense (M-SHORAD)	0604117A / CR9, CS1
04	0604120A / ED5: Assured Positioning, Navigation and Timing (PNT)	1206120A / FJ8
04	0604120A / EH8: DISMOUNTED	1206120A / FJ9
04	0604120A / EH9: PSEUDOLITES	1206120A / FK1
04	0604120A / EJ2: MOUNTED	1206120A / FK2
04	0604120A / EJ3: ANTI-JAM ANTENNA	1206120A / FK3
04	0604121A / FD6: Synthetic Training Environment Refine & Prototype	0604121A / CR2, CR3, CR4, CR5, CR7
04	0604121A / SV1: Soldier/Squad Virtual Trainer	0604121A / CR4, CR6
04	0604182A / HX1: Long-Range Hypersonic Weapon	0605232A / HX2
04	0604319A / DU3: IFPC2	0605052A / EY7
04	0604710A / L67: Soldier Night Vision Devices	0604710A / BQ6
04	0604807A / 812: Mil HIV Vac&Drug Dev	0604807A / 849
04	0604808A / 016: Close Combat Capabilities ENG DEV	0604808A / CS2, CS3
04	0604823A / L86: LIGHTWEIGHT COUNTER MORTAR RADAR (LCMR)	0607148A / BY8
04	0604823A / L88: Enhanced AN/TPQ 36	0607148A / BY8
05	0304270A / EW5: Electronic Warfare Development - MIP	0607313A / CE2
05	0304270A / EW6: ARAT-TSS - MIP	0304270A / CR8
05	0604798A / FG7: Emerging Technology Initiatives	0605054A / FI3
05	0605013A / 738: AcqBiz	0605013A / FL9
05	0605013A / FL9: Army Accessioning IT Development	0605233A / CP8
05	0605036A / EQ5: Combating Weapons of Mass Destruction (CWMD)	0605036A / CS6
05	0605041A / EV5: Defensive CYBER Operations	0608041A / CD1
05	0605053A / FB8: Soldier Borne Sensor (SBS)	0604827A / FK4

05	0605766A / DX9: National Integration To Tactical Systems(MIP)	0605766A / BV3
06	0604256A / 976: Army Threat Sim (ATS)	0604759A / FF1
06	0605898A / XW7: Command HQ - ARI	0605801A / M15
07	0303140A / DV4: Key Management Infrastructure (KMI)	0605144A / BY6
07	0305208A / D07: DCGS-A Common Modules (MIP)	0605148A / BY5
07	0305208A / D07: DCGS-A Common Modules (MIP)	0605224A / CK4
07	0305208A / D07: DCGS-A Common Modules (MIP)	0604037A / BY4
07	0205402A / EF2: Integrated Base Defense	0604785A / DS4
07	0607134A / ES1: Long Range Precision Fires (LRPF)	0605231A / CO3

Program Terminations (including transfers to Procurement and Sustainment):

<i><u>Budget Activity</u></i>	<i><u>OSDPE / Project</u></i>	<i><u>Project Title</u></i>
02	0602143A / BB7	Soldier Lethality Technology / Exoskeleton: Technology for Man-Machine Interface
02	0602145A / BF1	Next Generation Combat Vehicle Technology / Autonomous Ground Resupply Tech
02	0602146A / AM6	Network C3I Technology / Modular RF Communications Technology
02	0602146A / AP7	Network C3I Technology / Comms/Horiz Int for Army Mod Priorities Tech
02	0602146A / AQ7	Network C3I Technology / High Tempo Data Driven Decision Tools Technology
02	0602146A / AT2	Network C3I Technology / Subterranean Detection and Monitoring Technology
02	0602146A / AU3	Network C3I Technology / Geospatially Enabled Operational Design Technology
02	0602146A / AW3	Network C3I Technology / DoD PNT M&S Collaborative Initiative (CI) Technolo
02	0602146A / BZ6	Network C3I Technology / Narrowband SATCOM Technology
02	0602150A / AC9	Air and Missile Defense Technology / High Energy Laser Tactical Vehicle Demonstrator Te
02	0602150A / AE4	Air and Missile Defense Technology / Collaborative ISR Sensors Technology
03	0603118A / BB6	Soldier Lethality Advanced Technology / Physical Augmentation: Adv Tech for Field Demo
03	0603462A / BF2	Next Generation Combat Vehicle Advanced Technology / Autonomous Ground Resupply (AGR) Adv Tech
03	0603462A / BG5	Next Generation Combat Vehicle Advanced Technology / Extended Line of Sight (ELOS) Advanced Technology
03	0603462A / BH1	Next Generation Combat Vehicle Advanced Technology / Survivability Systems Controls Advanced Technology

03	0603462A / BK6	Next Generation Combat Vehicle Advanced Technology / Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech
03	0603463A / AN6	Network C3I Advanced Technology / Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech
03	0603463A / AW4	Network C3I Advanced Technology / DoD PNT M&S Collaborative Initiative (CI) Adv Tech
03	0603464A / AE9	Long Range Precision Fires Advanced Technology / Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech
03	0603466A / AE1	Air and Missile Defense Advanced Technology / Close Combat High Energy Laser Advanced Technology
04	0603639A / 694	Tank and Medium Caliber Ammunition / Medium Caliber Ammunition
04	0603747A / C08	Soldier Support and Survivability / Rapid Equipping Force
04	0603804A / G11	Logistics and Engineer Equipment - Adv Dev / Adv Elec Energy Con Ad
04	0603807A / VS7	Medical Systems - Adv Dev / MEDEVAC Mission Equipment Package (MEP) - Adv Dev
04	0604021A / AW7	Electronic Warfare Technology Maturation (MIP) / Electronic Warfare Technology Maturation (MIP)
04	0604115A / AX4	Technology Maturation Initiatives / Computational Prototyping Environment (CPE)
04	0604115A / AX6	Technology Maturation Initiatives / Active Protection Systems Integration
04	0604115A / AX7	Technology Maturation Initiatives / Multi-Mission High Energy Laser (MMHEL) Sys Demo
04	0604115A / AY1	Technology Maturation Initiatives / MUM-T Platform Enabler
04	0604115A / AY3	Technology Maturation Initiatives / Strategic Long Range Cannon
05	0604622A / VR5	Family of Heavy Tactical Vehicles / TWV Protection Kits
05	0604741A / 149	Air Defense Command, Con trol and Intelligence - Eng Dev / Counter-Rockets, Artillery & Mortar
05	0604768A / 688	Brilliant Anti-Armor Submunition (BAT) / ATACMS BLK II
05	0604780A / 582	Combined Arms Tactical Trainer (CATT) Core / Synthetic Envir Core
05	0604798A / DY5	Brigade Analysis, Integration and Evaluation / Production/Field Coordination for Capability Sets
05	0604802A / 613	Weapons and Munitions - Eng Dev / MORTAR SYSTEMS
05	0604802A / EU5	Weapons and Munitions - Eng Dev / .50 Caliber All-Purpose Tactical cartridge (APTC)
05	0604802A / XT2	Weapons and Munitions - Eng Dev / 40mm Door Breach
05	0604804A / FG4	Logistics and Engineer Equipment - Eng Dev / Ultra-Lightweight Camouflage Net System (ULCANS)
05	0604808A / 415	Landmine Warfare/Barrier - Eng Dev / Mine Neutral/Detection
05	0604854A / HB6	Artillery Systems - EMD / Mobile 155MM Howitzer
05	0605033A / EQ3	Ground-Based Operational Surveillance System - Expeditionary (GBOSS-E) / Grnd-Based Opnl

		Surv Sys -Exped (GBOSS-E)
05	0605053A / FB4	Ground Robotics / Common Robotic Systems
07	0203744A / EB6	Aircraft Modifications/Product Improvement Programs / MQ-1C Gray Eagle MODS
07	0305204A / 123	Tactical Unmanned Aerial Vehicles / Joint Technology Center System Integration

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

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Department of Defense
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

05 May 2021

<u>Appropriation</u>	<u>FY 2020 Actual*</u>	<u>FY 2021 Enacted**</u>	<u>FY 2022 Request</u>
Research, Development, Test & Eval, Army	12,842,958	14,144,856	12,799,645
Total Research, Development, Test & Evaluation	12,842,958	14,144,856	12,799,645
<u>Other RDT&E Budget Activities Not Included in the Research, Development, Test and Evaluation Title</u>			
Chem Agents & Munitions Destruction	890,830	942,493	1,001,231
Total Not in Research, Development, Test & Evaluation Title	890,830	942,493	1,001,231

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Department of Defense
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

05 May 2021

Summary Recap of Budget Activities -----	FY 2020 Actual*	FY 2021 Enacted**	FY 2022 Request
Basic Research	557,265	552,521	473,475
Applied Research	1,227,661	1,518,770	914,288
Advanced Technology Development	1,520,145	1,940,015	1,297,437
Advanced Component Development & Prototypes	2,895,592	3,577,387	3,806,330
System Development & Demonstration	3,072,662	2,948,445	3,392,358
Management Support	1,759,840	1,834,218	1,416,698
Operational Systems Development	1,809,793	1,716,794	1,380,248
Software and Digital Technology Pilot Programs		56,706	118,811
Total Research, Development, Test & Evaluation	12,842,958	14,144,856	12,799,645
 Summary Recap of FYDP Programs -----			
General Purpose Forces	733,243	589,525	542,571
Intelligence and Communications	287,081	362,184	280,473
Research and Development	11,434,683	13,058,379	11,911,888
Central Supply and Maintenance	105,885	130,785	61,720
Administration and Associated Activities	61		
Space	274,732		
Classified Programs	7,273	3,983	2,993
Total Research, Development, Test & Evaluation	12,842,958	14,144,856	12,799,645

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Department of Defense
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

05 May 2021

	FY 2020 Actual*	FY 2021 Enacted**	FY 2022 Request
<u>Summary Recap of Non-RDT&E Title FYDP Programs</u>			
Central Supply and Maintenance	890,830	942,493	1,001,231
Total Research, Development, Test & Evaluation	890,830	942,493	1,001,231

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Department of the Army
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

05 May 2021

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R-122BAS: FY 2022 President's Budget (Total Base Published Version), as of May 5, 2021 at 15:01:27

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Department of the Army
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

05 May 2021

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

Line No	Element Number	Program Item	Act	FY 2020 Actual*	FY 2021 Enacted**	FY 2022 Request	Se
1	0601102A	Defense Research Sciences	01	343,481	344,031	297,241	U
2	0601103A	University Research Initiatives	01	85,148	84,697	66,981	U
3	0601104A	University and Industry Research Centers	01	123,654	118,716	94,003	U
4	0601121A	Cyber Collaborative Research Alliance	01	4,982	5,077	5,067	U
5	0601601A	Artificial Intelligence and Machine Learning Basic Research	01			10,183	U
		Basic Research		557,265	552,521	473,475	
6	0602115A	Biomedical Technology	02		11,403	11,925	U
7	0602134A	Counter Improvised-Threat Advanced Studies	02		1,927	1,976	U
8	0602141A	Lethality Technology	02	68,852	117,484	64,126	U
9	0602142A	Army Applied Research	02	30,733	30,757	28,654	U
10	0602143A	Soldier Lethality Technology	02	141,154	201,750	105,168	U
11	0602144A	Ground Technology	02	143,172	158,158	56,400	U
12	0602145A	Next Generation Combat Vehicle Technology	02	255,041	258,351	172,166	U
13	0602146A	Network C3I Technology	02	133,804	202,257	84,606	U
14	0602147A	Long Range Precision Fires Technology	02	117,395	119,007	64,285	U
15	0602148A	Future Verticle Lift Technology	02	94,888	169,536	91,411	U
16	0602150A	Air and Missile Defense Technology	02	93,937	107,584	19,316	U
17	0602180A	Artificial Intelligence and Machine Learning Technologies	02			15,034	U
18	0602181A	All Domain Convergence Applied Research	02			25,967	U
19	0602182A	C3I Applied Research	02			12,406	U
20	0602183A	Air Platform Applied Research	02			6,597	U

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21	0602184A	Soldier Applied Research	02			11,064	U
22	0602213A	C3I Applied Cyber	02	17,351	18,816	12,123	U
23	0602386A	Biotechnology for Materials - Applied Research	02			20,643	U
24	0602785A	Manpower/Personnel/Training Technology	02	20,406	20,399	18,701	U
25	0602787A	Medical Technology	02	110,928	101,341	91,720	U
		Applied Research		1,227,661	1,518,770	914,288	
26	0603002A	Medical Advanced Technology	03	82,256	94,669	43,804	U
27	0603007A	Manpower, Personnel and Training Advanced Technology	03	10,225	11,344	14,273	U
28	0603025A	Army Agile Innovation and Demonstration	03			22,231	U
29	0603040A	Artificial Intelligence and Machine Learning Advanced Technologies	03			909	U
30	0603041A	All Domain Convergence Advanced Technology	03			17,743	U
31	0603042A	C3I Advanced Technology	03			3,151	U
32	0603043A	Air Platform Advanced Technology	03			754	U
33	0603044A	Soldier Advanced Technology	03			890	U
34	0603115A	Medical Development	03		26,711	26,521	U
35	0603116A	Lethality Advanced Technology	03			8,066	U
36	0603117A	Army Advanced Technology Development	03	66,424	62,663	76,815	U
37	0603118A	Soldier Lethality Advanced Technology	03	131,119	151,370	107,966	U
38	0603119A	Ground Advanced Technology	03	136,544	196,055	23,403	U
39	0603134A	Counter Improvised-Threat Simulation	03		24,087	24,747	U
40	0603386A	Biotechnology for Materials - Advanced Research	03			53,736	U

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41	0603457A	C3I Cyber Advanced Development	03	25,492	43,357	31,426	U
42	0603461A	High Performance Computing Modernization Program	03	217,389	221,161	189,123	U
43	0603462A	Next Generation Combat Vehicle Advanced Technology	03	255,386	302,209	164,951	U
44	0603463A	Network C3I Advanced Technology	03	138,937	216,520	155,867	U
45	0603464A	Long Range Precision Fires Advanced Technology	03	196,393	177,142	93,909	U
46	0603465A	Future Vertical Lift Advanced Technology	03	180,163	220,334	179,677	U
47	0603466A	Air and Missile Defense Advanced Technology	03	79,817	175,703	48,826	U
48	0603920A	Humanitarian Demining	03		16,690	8,649	U
		Advanced Technology Development		1,520,145	1,940,015	1,297,437	
49	0603305A	Army Missile Defense Systems Integration	04	59,318	140,195	11,702	U
50	0603308A	Army Space Systems Integration	04		25,584	18,755	U
51	0603327A	Air and Missile Defense Systems Engineering	04	52,672	47,098		U
52	0603619A	Landmine Warfare and Barrier - Adv Dev	04	79,504	56,067	50,314	U
53	0603639A	Tank and Medium Caliber Ammunition	04	72,456	100,367	79,873	U
54	0603645A	Armored System Modernization - Adv Dev	04	138,300	138,685	170,590	U
55	0603747A	Soldier Support and Survivability	04	9,246	5,712	2,897	U
56	0603766A	Tactical Electronic Surveillance System - Adv Dev	04	37,490	182,400	113,365	U
57	0603774A	Night Vision Systems Advanced Development	04	192,530	15,429	18,000	U
58	0603779A	Environmental Quality Technology - Dem/Val	04	19,089	20,906	11,921	U
59	0603790A	NATO Research and Development	04	5,184	4,589	3,777	U
60	0603801A	Aviation - Adv Dev	04	488,397	694,296	1,125,641	U

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61	0603804A	Logistics and Engineer Equipment - Adv Dev	04	7,081	8,587	7,055	U
62	0603807A	Medical Systems - Adv Dev	04	36,307	33,085	22,071	U
63	0603827A	Soldier Systems - Advanced Development	04	25,204	23,184	17,459	U
64	0604017A	Robotics Development	04	80,909	95,367	87,198	U
65	0604019A	Expanded Mission Area Missile (EMAM)	04			50,674	U
66	0604021A	Electronic Warfare Technology Maturation (MIP)	04	23,043	15,034		U
67	0604035A	Low Earth Orbit (LEO) Satellite Capability	04		21,850	19,638	U
68	0604036A	Multi-Domain Sensing System (MDSS) Adv Dev	04			50,548	U
69	0604037A	Tactical Intel Targeting Access Node (TITAN) Adv Dev	04			28,347	U
70	0604100A	Analysis Of Alternatives	04	9,811	9,714	10,091	U
71	0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04		1,328	926	U
72	0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	40,745	57,083	69,697	U
73	0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	364,154	308,805	327,690	U
74	0604115A	Technology Maturation Initiatives	04	171,058	141,109	270,124	U
75	0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	41,690	4,813	39,376	U
76	0604119A	Army Advanced Component Development & Prototyping	04	117,335	172,990	189,483	U
77	0604120A	Assured Positioning, Navigation and Timing (PNT)	04		115,688	96,679	U
78	0604121A	Synthetic Training Environment Refinement & Prototyping	04	99,357	112,093	194,195	U
79	0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04		13,326	13,379	U
80	0604182A	Hypersonics	04	394,619	832,166	300,928	U
81	0604403A	Future Interceptor	04	1,918		7,895	U

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82	0604531A	Counter - Small Unmanned Aircraft Systems Advanced Development	04			19,148	U
83	0604541A	Unified Network Transport	04	28,478	39,192	35,409	U
84	0604644A	Mobile Medium Range Missile	04	4,794	88,100	286,457	U
85	0604785A	Integrated Base Defense (Budget Activity 4)	04	2,000	2,020	2,040	U
86	0305251A	Cyberspace Operations Forces and Force Support	04	58,611	50,525	52,988	U
87	1206120A	Assured Positioning, Navigation and Timing (PNT)	04	133,307			U
88	1206308A	Army Space Systems Integration	04	100,985			U
		Advanced Component Development & Prototypes		2,895,592	3,577,387	3,806,330	
89	0604201A	Aircraft Avionics	05	8,069	7,011	6,654	U
90	0604270A	Electronic Warfare Development	05	57,090	56,624	30,840	U
91	0604601A	Infantry Support Weapons	05	86,154	88,552	67,873	U
92	0604604A	Medium Tactical Vehicles	05		8,213	11,374	U
93	0604611A	JAVELIN	05	14,377	5,983	7,094	U
94	0604622A	Family of Heavy Tactical Vehicles	05	12,085	22,254	31,602	U
95	0604633A	Air Traffic Control	05	5,543	3,383	4,405	U
96	0604642A	Light Tactical Wheeled Vehicles	05	2,843	4,193	2,055	U
97	0604645A	Armored Systems Modernization (ASM) - Eng Dev	05	273,433	123,992	137,256	U
98	0604710A	Night Vision Systems - Eng Dev	05	135,283	54,234	62,690	U
99	0604713A	Combat Feeding, Clothing, and Equipment	05	7,295	2,734	1,658	U
100	0604715A	Non-System Training Devices - Eng Dev	05	29,785	27,013	26,540	U
101	0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	70,279	62,058	59,518	U

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102	0604742A	Constructive Simulation Systems Development	05	11,158	9,779	22,331	U
103	0604746A	Automatic Test Equipment Development	05	10,466	5,375	8,807	U
104	0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	7,480	7,605	7,453	U
105	0604768A	Brilliant Anti-Armor Submunition (BAT)	05	19,177	24,064		U
106	0604780A	Combined Arms Tactical Trainer (CATT) Core	05	8,861	3,438		U
107	0604798A	Brigade Analysis, Integration and Evaluation	05	29,852	18,737	21,534	U
108	0604802A	Weapons and Munitions - Eng Dev	05	182,119	268,858	309,778	U
109	0604804A	Logistics and Engineer Equipment - Eng Dev	05	105,668	53,676	59,261	U
110	0604805A	Command, Control, Communications Systems - Eng Dev	05	12,077	10,674	20,121	U
111	0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	70,489	51,285	44,424	U
112	0604808A	Landmine Warfare/Barrier - Eng Dev	05	33,881	9,239	14,137	U
113	0604818A	Army Tactical Command & Control Hardware & Software	05	124,749	128,676	162,704	U
114	0604820A	Radar Development	05	91,782	105,271	127,919	U
115	0604822A	General Fund Enterprise Business System (GFEBs)	05	41,119	15,428	17,623	U
116	0604823A	Firefinder	05	16,583	18,278		U
117	0604827A	Soldier Systems - Warrior Dem/Val	05	4,606	6,296	6,454	U
118	0604852A	Suite of Survivability Enhancement Systems - EMD	05	81,899	62,012	106,354	U
119	0604854A	Artillery Systems - EMD	05	20,290	36,187		U
120	0605013A	Information Technology Development	05	89,541	126,498	122,168	U
121	0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	97,873	111,078	76,936	U
122	0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	80,381	76,140	35,560	U

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123	0605029A	Integrated Ground Security Surveillance Response Capability (IGSSR-C)	05	6,423			U
124	0605030A	Joint Tactical Network Center (JTNC)	05	15,228	15,671	16,364	U
125	0605031A	Joint Tactical Network (JTN)	05	39,130	30,540	28,954	U
126	0605033A	Ground-Based Operational Surveillance System - Expeditionary (GBOSS-E)	05	3,689	5,758		U
127	0605034A	Tactical Security System (TSS)	05	7,343			U
128	0605035A	Common Infrared Countermeasures (CIRCM)	05	22,226	29,770	16,630	U
129	0605036A	Combating Weapons of Mass Destruction (CWMD)	05	9,589			U
130	0605038A	Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV) Sensor Suite	05	5,805	4,669	7,618	U
131	0605041A	Defensive CYBER Tool Development	05	50,662	28,544	18,892	U
132	0605042A	Tactical Network Radio Systems (Low-Tier)	05	27,236	20,511	28,849	U
133	0605047A	Contract Writing System	05	16,379	22,025	22,960	U
134	0605049A	Missile Warning System Modernization (MWSM)	05	1,475			U
135	0605051A	Aircraft Survivability Development	05	130,211	99,208	65,603	U
136	0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	186,369	153,362	233,512	U
137	0605053A	Ground Robotics	05	24,747	12,010	18,241	U
138	0605054A	Emerging Technology Initiatives	05	36,146	294,366	254,945	U
139	0605143A	Biometrics Enabling Capability (BEC)	05			4,326	U
140	0605144A	Next Generation Load Device - Medium	05			15,616	U
141	0605145A	Medical Products and Support Systems Development	05		919	962	U
142	0605148A	Tactical Intel Targeting Access Node (TITAN) EMD	05			54,972	U

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143	0605203A	Army System Development & Demonstration	05	184,410	150,201	122,175	U
144	0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05		5,780	2,275	U
145	0605224A	Multi-Domain Intelligence	05			9,313	U
146	0605225A	SIO Capability Development	05			22,713	U
147	0605231A	Precision Strike Missile (PrSM)	05			188,452	U
148	0605232A	Hypersonics EMD	05			111,473	U
149	0605233A	Accessions Information Environment (AIE)	05			18,790	U
150	0605450A	Joint Air-to-Ground Missile (JAGM)	05	6,314	7,566	2,134	U
151	0605457A	Army Integrated Air and Missile Defense (AIAMD)	05	211,634	206,850	157,873	U
152	0605531A	Counter - Small Unmanned Aircraft Systems Sys Dev & Demonstration	05			33,386	U
153	0605625A	Manned Ground Vehicle	05	197,304	171,890	225,106	U
154	0605766A	National Capabilities Integration (MIP)	05	7,835	7,670	14,454	U
155	0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	05	7,119	1,678	2,564	U
156	0605830A	Aviation Ground Support Equipment	05	1,596	1,413	1,201	U
157	0303032A	TROJAN - RH12	05	3,936	3,451	3,362	U
158	0303267A	Auctioned Spectrum Relocation Fund	05	7,650			U
159	0303467A	SENSR Spectrum Pipeline SRF	05	251			U
160	0303567A	Non-SENSR Spectrum Pipeline SRF	05	1,236			U
161	0304270A	Electronic Warfare Development	05	18,432	59,755	75,520	U
		System Development & Demonstration		3,072,662	2,948,445	3,392,358	
162	0604256A	Threat Simulator Development	06	41,566	41,486	18,439	U

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163	0604258A	Target Systems Development	06	27,984	35,279	17,404	U
164	0604759A	Major T&E Investment	06	140,946	119,231	68,139	U
165	0605103A	Rand Arroyo Center	06	12,573	12,989	33,126	U
166	0605301A	Army Kwajalein Atoll	06	230,051	221,965	240,877	U
167	0605326A	Concepts Experimentation Program	06	35,403	50,394	79,710	U
168	0605502A	Small Business Innovative Research	06	392,999	369,715		U
169	0605601A	Army Test Ranges and Facilities	06	356,231	390,351	354,227	U
170	0605602A	Army Technical Test Instrumentation and Targets	06	60,170	81,829	49,253	U
171	0605604A	Survivability/Lethality Analysis	06	33,632	36,001	36,389	U
172	0605606A	Aircraft Certification	06	3,319	2,736	2,489	U
173	0605702A	Meteorological Support to RDT&E Activities	06	6,094	6,360	6,689	U
174	0605706A	Materiel Systems Analysis	06	21,233	21,830	21,558	U
175	0605709A	Exploitation of Foreign Items	06	11,168	8,936	13,631	U
176	0605712A	Support of Operational Testing	06	52,280	54,116	55,122	U
177	0605716A	Army Evaluation Center	06	60,474	56,827	65,854	U
178	0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	2,423	2,478	2,633	U
179	0605801A	Programwide Activities	06	56,800	84,510	96,589	U
180	0605803A	Technical Information Activities	06	30,434	25,487	26,808	U
181	0605805A	Munitions Standardization, Effectiveness and Safety	06	52,401	55,648	43,042	U
182	0605857A	Environmental Quality Technology Mgmt Support	06	4,489	1,715	1,789	U
183	0605898A	Army Direct Report Headquarters - R&D - MHA	06	53,320	54,564	52,108	U

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184	0606001A	Military Ground-Based CREW Technology	06	2,053			U
185	0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	64,311	68,911	80,952	U
186	0606003A	CounterIntel and Human Intel Modernization	06	2,925	5,200	5,363	U
187	0606105A	Medical Program-Wide Activities	06		19,164	39,041	U
188	0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	4,500	6,496	5,466	U
189	0909999A	Financing for Cancelled Account Adjustments	06	61			U
		Management Support		1,759,840	1,834,218	1,416,698	
190	0603778A	MLRS Product Improvement Program	07	14,014	9,786	12,314	U
191	0605024A	Anti-Tamper Technology Support	07	8,141	8,436	8,868	U
192	0607131A	Weapons and Munitions Product Improvement Programs	07	14,222	19,666	22,828	U
193	0607134A	Long Range Precision Fires (LRPF)	07	149,455	100,146		U
194	0607136A	Blackhawk Product Improvement Program	07	22,502	8,300	4,773	U
195	0607137A	Chinook Product Improvement Program	07	164,820	49,409	52,372	U
196	0607139A	Improved Turbine Engine Program	07	197,941	232,159	275,024	U
197	0607142A	Aviation Rocket System Product Improvement and Development	07	1,847	13,421	12,417	U
198	0607143A	Unmanned Aircraft System Universal Products	07	17,386	19,460	4,594	U
199	0607145A	Apache Future Development	07	5,224	52,502	10,067	U
200	0607148A	AN/TPQ-53 Counterfire Target Acquisition Radar System	07			56,681	U
201	0607150A	Intel Cyber Development	07		14,652	3,611	U
202	0607312A	Army Operational Systems Development	07	45,026	35,851	28,029	U
203	0607313A	Electronic Warfare Development	07			5,673	U

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204	0607665A	Family of Biometrics	07	1,576	1,276	1,178	U
205	0607865A	Patriot Product Improvement	07	83,833	178,984	125,932	U
206	0203728A	Joint Automated Deep Operation Coordination System (JADOCs)	07	45,447	43,060	25,547	U
207	0203735A	Combat Vehicle Improvement Programs	07	266,197	213,728	211,523	U
208	0203743A	155mm Self-Propelled Howitzer Improvements	07	191,076	217,959	213,281	U
209	0203744A	Aircraft Modifications/Product Improvement Programs	07	8,896	11,261		U
210	0203752A	Aircraft Engine Component Improvement Program	07	138	80	132	U
211	0203758A	Digitization	07	4,043	4,351	3,936	U
212	0203801A	Missile/Air Defense Product Improvement Program	07	1,235	1,241	127	U
213	0203802A	Other Missile Product Improvement Programs	07		15,268	10,265	U
214	0205412A	Environmental Quality Technology - Operational System Dev	07	10,000	250	262	U
215	0205456A	Lower Tier Air and Missile Defense (AMD) System	07	93,743		182	U
216	0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	112,468	72,817	63,937	U
217	0208053A	Joint Tactical Ground System	07		9,510	13,379	U
219	0303028A	Security and Intelligence Activities	07	26,674	23,367	24,531	U
220	0303140A	Information Systems Security Program	07	25,710	28,270	15,720	U
221	0303141A	Global Combat Support System	07	57,604	70,652	52,739	U
222	0303142A	SATCOM Ground Environment (SPACE)	07		18,002	15,247	U
223	0303150A	WWMCCS/Global Command and Control System	07	1,988			U
226	0305179A	Integrated Broadcast Service (IBS)	07	459	382	5,430	U
227	0305204A	Tactical Unmanned Aerial Vehicles	07	22,147	38,151	8,410	U

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228	0305206A	Airborne Reconnaissance Systems	07	13,177	28,858	24,460	U
229	0305208A	Distributed Common Ground/Surface Systems	07	28,821	40,771		U
230	0305219A	MQ-1C Gray Eagle UAS	07	5,000			U
231	0305232A	RQ-11 UAV	07	3,218			U
232	0305233A	RQ-7 UAV	07	7,817			U
233	0307665A	Biometrics Enabled Intelligence	07	4,350		2,066	U
234	0708045A	End Item Industrial Preparedness Activities	07	105,885	130,785	61,720	U
235	1203142A	SATCOM Ground Environment (SPACE)	07	32,764			U
236	1208053A	Joint Tactical Ground System	07	7,676			U
9999	9999999999	Classified Programs		7,273	3,983	2,993	U
		Operational Systems Development		1,809,793	1,716,794	1,380,248	
237	0608041A	Defensive CYBER - Software Prototype Development	08		56,706	118,811	U
		Software and Digital Technology Pilot Programs			56,706	118,811	
Total Research, Development, Test & Eval, Army				12,842,958	14,144,856	12,799,645	

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Department of the Army
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Non RDT&E Title
 (Dollars in Thousands)

05 May 2021

<u>Summary Recap of Budget Activities</u>	<u>FY 2020 Actual*</u>	<u>FY 2021 Enacted**</u>	<u>FY 2022 Request</u>
Research, Development, Test, And Evaluation	890,830	942,493	1,001,231
Total Research, Development, Test & Evaluation	890,830	942,493	1,001,231
<u>Summary Recap of Non-RDT&E Title FYDP Programs</u>			
Central Supply and Maintenance	890,830	942,493	1,001,231
Total Research, Development, Test & Evaluation	890,830	942,493	1,001,231

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Department of the Army
 FY 2022 President's Budget
 Exhibit R-1 FY 2022 President's Budget
 Non RDT&E Title
 (Dollars in Thousands)

05 May 2021

Appropriation: 0390D Chem Agents & Munitions Destruction

Line No	Program Element Number	Item	Act	FY 2020 Actual*	FY 2021 Enacted**	FY 2022 Request	S e c
1	0708081D	Chemical Materials Agency	02	6,500	6,494	6,220	U
2	0708083D	Assembled Chemical Weapons Alternatives	02	884,330	935,999	995,011	U
		Research, Development, Test, And Evaluation		890,830	942,493	1,001,231	
Total Chem Agents & Munitions Destruction				890,830	942,493	1,001,231	

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Army • Budget Estimates FY 2022 • RDT&E Program

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

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

Line #	Budget Activity	Program Element Number	Program Element Title	Page
26	03	0603002A	Medical Advanced Technology.....	Volume 1c - 1
27	03	0603007A	Manpower, Personnel and Training Advanced Technology.....	Volume 1c - 51
28	03	0603025A	Army Agile Innovation and Demonstration.....	Volume 1c - 55
29	03	0603040A	Artificial Intelligence and Machine Learning Advanced Technologies.....	Volume 1c - 60
30	03	0603041A	All Domain Convergence Advanced Technology.....	Volume 1c - 66
31	03	0603042A	C3I Advanced Technology.....	Volume 1c - 75
32	03	0603043A	Air Platform Advanced Technology.....	Volume 1c - 80
33	03	0603044A	Soldier Advanced Technology.....	Volume 1c - 85
34	03	0603115A	Medical Development.....	Volume 1c - 89
35	03	0603116A	Lethality Advanced Technology.....	Volume 1c - 97
36	03	0603117A	Army Advanced Technology Development.....	Volume 1c - 103
37	03	0603118A	Soldier Lethality Advanced Technology.....	Volume 1c - 104
38	03	0603119A	Ground Advanced Technology.....	Volume 1c - 148
39	03	0603134A	Counter Improvised-Threat Simulation.....	Volume 1c - 178
40	03	0603386A	Biotechnology for Materials - Advanced Research.....	Volume 1c - 182
41	03	0603457A	C3I Cyber Advanced Development.....	Volume 1c - 186

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Army • Budget Estimates FY 2022 • RDT&E Program

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

Line #	Budget Activity	Program Element Number	Program Element Title	Page
42	03	0603461A	High Performance Computing Modernization Program.....	Volume 1c - 200
43	03	0603462A	Next Generation Combat Vehicle Advanced Technology.....	Volume 1c - 209
44	03	0603463A	Network C3I Advanced Technology.....	Volume 1c - 278
45	03	0603464A	Long Range Precision Fires Advanced Technology.....	Volume 1c - 362
46	03	0603465A	Future Vertical Lift Advanced Technology.....	Volume 1c - 384
47	03	0603466A	Air and Missile Defense Advanced Technology.....	Volume 1c - 445
48	03	0603920A	Humanitarian Demining.....	Volume 1c - 462

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Army • Budget Estimates FY 2022 • RDT&E Program

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

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Air Platform Advanced Technology	0603043A	32	03.....	Volume 1c - 80
Air and Missile Defense Advanced Technology	0603466A	47	03.....	Volume 1c - 445
All Domain Convergence Advanced Technology	0603041A	30	03.....	Volume 1c - 66
Army Advanced Technology Development	0603117A	36	03.....	Volume 1c - 103
Army Agile Innovation and Demonstration	0603025A	28	03.....	Volume 1c - 55
Artificial Intelligence and Machine Learning Advanced Technologies	0603040A	29	03.....	Volume 1c - 60
Biotechnology for Materials - Advanced Research	0603386A	40	03.....	Volume 1c - 182
C3I Advanced Technology	0603042A	31	03.....	Volume 1c - 75
C3I Cyber Advanced Development	0603457A	41	03.....	Volume 1c - 186
Counter Improvised-Threat Simulation	0603134A	39	03.....	Volume 1c - 178
Future Vertical Lift Advanced Technology	0603465A	46	03.....	Volume 1c - 384
Ground Advanced Technology	0603119A	38	03.....	Volume 1c - 148
High Performance Computing Modernization Program	0603461A	42	03.....	Volume 1c - 200
Humanitarian Demining	0603920A	48	03.....	Volume 1c - 462
Lethality Advanced Technology	0603116A	35	03.....	Volume 1c - 97
Long Range Precision Fires Advanced Technology	0603464A	45	03.....	Volume 1c - 362
Manpower, Personnel and Training Advanced Technology	0603007A	27	03.....	Volume 1c - 51

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Army • Budget Estimates FY 2022 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Medical Advanced Technology	0603002A	26	03.....	Volume 1c - 1
Medical Development	0603115A	34	03.....	Volume 1c - 89
Network C3I Advanced Technology	0603463A	44	03.....	Volume 1c - 278
Next Generation Combat Vehicle Advanced Technology	0603462A	43	03.....	Volume 1c - 209
Soldier Advanced Technology	0603044A	33	03.....	Volume 1c - 85
Soldier Lethality Advanced Technology	0603118A	37	03.....	Volume 1c - 104

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	82.256	94.669	43.804	-	43.804	-	-	-	-	-	-
814: NEUROFIBROMATOSIS (CA)	-	15.000	20.000	-	-	-	-	-	-	-	-	-
945: BREAST CANCER STAMP PROCEEDS	-	0.454	-	-	-	-	-	-	-	-	-	-
97T: NEUROTOXIN EXPOSURE TREATMENT (CA)	-	16.000	16.000	-	-	-	-	-	-	-	-	-
CJ3: Prophylactic for Endemic Diarrheal Diseases	-	-	-	4.009	-	4.009	-	-	-	-	-	-
MG4: Tech Base/Enabling Res in Mil Occup Med Adv Tech	-	7.984	-	-	-	-	-	-	-	-	-	-
MM2: MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)	-	10.000	21.000	-	-	-	-	-	-	-	-	-
MM5: Tech Base/Enabling Res Combat Cas Care Adv Tech	-	2.328	-	-	-	-	-	-	-	-	-	-
MM7: Enabling Med Cap to Support Dispersed OPS Adv Tech	-	1.744	2.913	3.232	-	3.232	-	-	-	-	-	-
MM9: Tech Base/Enabling Rsrch for Infect Dis Adv Tech	-	2.961	-	-	-	-	-	-	-	-	-	-
MN3: Immediate Cardiopulmonary Stabilization Adv Tech	-	1.864	2.071	1.727	-	1.727	-	-	-	-	-	-
MN4: Advanced Life Support Advanced Technology	-	3.710	3.615	3.927	-	3.927	-	-	-	-	-	-
MN5: Next Generation Blood Products Advanced Technology	-	5.725	6.610	9.394	-	9.394	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity	R-1 Program Element (Number/Name)												
<i>2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	<i>PE 0603002A / Medical Advanced Technology</i>												
<i>MN6: Blast & Head Impact Exposure Monitor Advanced Tech</i>	-	1.354	1.878	1.546	-	1.546	-	-	-	-	-	-	-
<i>MN7: Musculoskeletal Injury Screening Tool Adv Tech</i>	-	0.287	3.274	1.664	-	1.664	-	-	-	-	-	-	-
<i>MN8: Drugs to Prevent and Treat Malaria Advanced Tech</i>	-	2.057	-	-	-	-	-	-	-	-	-	-	-
<i>MN9: Far Forward Behavioral Health Care Advanced Tech</i>	-	0.255	1.080	0.283	-	0.283	-	-	-	-	-	-	-
<i>MO2: Traumatic Brain Injury (TBI) Treatment Adv Tech</i>	-	4.108	4.649	10.667	-	10.667	-	-	-	-	-	-	-
<i>MO3: Military Occupational Fitness Standards Adv Tech</i>	-	0.240	-	-	-	-	-	-	-	-	-	-	-
<i>MO4: Burn Recovery Optimization Advanced Technology</i>	-	2.044	3.326	2.059	-	2.059	-	-	-	-	-	-	-
<i>MO7: Improved Bone Repair Advanced Technology</i>	-	1.475	1.564	1.069	-	1.069	-	-	-	-	-	-	-
<i>MO8: Expeditionary Performance Nutrition Advanced Techn</i>	-	0.192	2.062	1.936	-	1.936	-	-	-	-	-	-	-
<i>MO9: Vaccines to Prevent Dengue Fever Advanced Tech</i>	-	2.474	2.037	-	-	-	-	-	-	-	-	-	-
<i>MP3: Phys Chem Toxicity Assessment Sys Adv Tech</i>	-	-	2.590	2.291	-	2.291	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) matures and demonstrates advanced medical technologies including drugs, vaccines, medical diagnostic devices, measures for identification and vector control, and developing medical practices and procedures to effectively protect and improve the survivability of United States Forces across the entire spectrum of military operations. Tri-Service coordination and cooperative efforts are focused in four principal medical areas: Combat Casualty Care, Military Operational Medicine, Militarily Relevant Infectious Diseases, and Clinical and Rehabilitative Medicine. Starting in Fiscal Year 2020 (FY20), the principal area of Clinical and Rehabilitative Medicine is replaced with the area of Medical Assist Support Technologies.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	
<p>Promising medical technologies are refined and validated through extensive testing, which is conducted in compliance with Food and Drug Administration (FDA) regulations for human medical products, and environmental protection agency (EPA) regulations for insect-control products that impact humans or the environment (e.g., repellents and insecticides). The FDA requires medical products to undergo extensive preclinical testing in animals and/or other models to obtain preliminary effectiveness and safety information before they can be tested in human clinical trials. Clinical trials are conducted stepwise: first to prove the product is safe in humans, second to demonstrate the desired effectiveness and optimal dosage (amount to be administered) in a small group human study, and third to demonstrate effectiveness in large, diverse human populations. Each successive phase includes larger numbers of human subjects and requires FDA cognizance prior to proceeding. Work conducted in this PE primarily focuses on late stages of technology maturation activities required to conduct safety and effectiveness clinical trials. Some high-risk technologies may require additional maturation with FDA guidance prior to initiating these clinical trials. Such things as proof of product stability and purity are necessary to meet FDA standards before entering later stages of testing and prior to transitioning into a formal acquisition program where large pivotal trials in diverse populations will be conducted for licensure. Activities in this PE may include completion of preclinical animal studies and small safety and effectiveness studies involving humans according to FDA and EPA requirements. Promising medical technologies that are not regulated by the FDA or EPA are modeled, prototyped, and tested in relevant environments.</p> <p>Blast research and research into maturing field rations in this PE are fully coordinated with the United States Army Combat Capabilities Development Command Soldier Center. This coordination enables improved body armor design and rations for Soldiers. Additionally, the activities funded in this PE are 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 under the authority of the Assistant Secretary of Defense for Research and Engineering, serves to facilitate coordination and prevent unnecessary duplication of effort within the Department of Defense's biomedical research and development community, as well as its associated enabling research areas.</p> <p>The cited work is consistent with the Under Secretary of Defense (Research and Engineering) Science and Technology (S&T) focus areas and the Army Modernization Strategy.</p> <p>Work in this PE is performed by: the U.S. Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.</p>		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	83.030	38.896	41.136	-	41.136
Current President's Budget	82.256	94.669	43.804	-	43.804
Total Adjustments	-0.774	55.773	2.668	-	2.668
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	41.000	57.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-40.546	-			
• SBIR/STTR Transfer	-1.228	-1.227			
• Adjustments to Budget Years	-	-	2.668	-	2.668

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

Project: 814: NEUROFIBROMATOSIS (CA)

Congressional Add: *Peer-reviewed Neurofibromatosis Research*

Congressional Add Subtotals for Project: 814

	FY 2020	FY 2021
	15.000	20.000
	15.000	20.000

Project: 945: BREAST CANCER STAMP PROCEEDS

Congressional Add: *Breast Cancer Stamp Proceeds*

Congressional Add Subtotals for Project: 945

	0.454	-
	0.454	-

Project: 97T: NEUROTOXIN EXPOSURE TREATMENT (CA)

Congressional Add: *Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research*

Congressional Add Subtotals for Project: 97T

	16.000	16.000
	16.000	16.000

Project: MM2: MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)

Congressional Add: *Peer-reviewed Military Burn Research Program*

Congressional Add: *Program increase: Burn care training curriculum*

Congressional Add: *Program increase - peer-reviewed military burn research*

Congressional Add: *Program increase: Advanced hemostat products*

	10.000	-
	-	5.000
	-	10.000
	-	6.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Congressional Add Subtotals for Project: MM2	10.000	21.000
Congressional Add Totals for all Projects	41.454	57.000

Change Summary Explanation

Funding was decrease by \$61.000 million to provide core support to U.S. Army Medical Research Institute of Infectious Disease (USAMRIID) and U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) to maintain the core capability in those two Labs.

\$4.000 million of FY22 will be realigned into APE 611102AB1, Basic Research in Infect Dis, Oper Med and Combat Care;

\$7.000 million of FY22 will be realigned into APE 622787MM4, Cbt Casualty Care Applied Rsch Technology

\$18.200 million of FY22-26 will be realigned into APE 622787MM8, Infectious Diseases and Applied Rsch Technology

\$31.800 million of FY22-26 will be realigned into APE 633002MO2, Traumatic Brain Injury (TBI) Treatment Adv Tech

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) 814 / NEUROFIBROMATOSIS (CA)
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
814: NEUROFIBROMATOSIS (CA)	-	15.000	20.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

Congressional increase for Neurofibromatosis Research Program.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Neurofibromatosis research.

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 2020	FY 2021
Congressional Add: Peer-reviewed Neurofibromatosis Research	15.000	20.000
FY 2020 Accomplishments: Program Increase supported advanced research on Neurofibromatosis. Work executed by Army Futures Command.		
FY 2021 Plans: Program Increase supported advanced research on Neurofibromatosis. Work executed by Army Futures Command.		
Congressional Adds Subtotals	15.000	20.000

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) 945 / BREAST CANCER STAMP PROCEEDS			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
945: BREAST CANCER STAMP PROCEEDS	-	0.454	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This Project receives funds as proceeds from the sale of Breast Cancer Stamps.

A. Mission Description and Budget Item Justification

This Project receives funds as proceeds from the sale of Breast Cancer Stamps.

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

	FY 2020	FY 2021
Congressional Add: Breast Cancer Stamp Proceeds	0.454	-
FY 2020 Accomplishments: Breast Cancer Stamp Proceeds.		
Congressional Adds Subtotals	0.454	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) 97T / NEUROTOXIN EXPOSURE TREATMENT (CA)
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
97T: NEUROTOXIN EXPOSURE TREATMENT (CA)	-	16.000	16.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

Congressional increase for Peer-Reviewed Neurotoxin Exposure Treatment Parkinson's Research Program.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Neurotoxin Exposure Treatment.

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 2020	FY 2021
Congressional Add: Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research	16.000	16.000
FY 2020 Accomplishments: Program Increase supported advanced research on Neurotoxin Exposure Treatment Parkinson's Research. Work executed by Army Futures Command.		
FY 2021 Plans: Program Increase supported advanced research on Neurotoxin Exposure Treatment Parkinson's Research. Work executed by Army Futures Command.		
Congressional Adds Subtotals	16.000	16.000

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) CJ3 / Prophylactic for Endemic Diarrheal Diseases			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CJ3: Prophylactic for Endemic Diarrheal Diseases	-	-	-	4.009	-	4.009	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 this Project was realigned from:
 PE 0602787A (Medical Technology)
 * Project MM8 (Infectious Diseases and Applied Rsch Technology)
 PE 0603002A (Medical Advanced Technology)
 * Project MO9 (Vaccines to Prevent Dengue Fever Advanced Tech)

A. Mission Description and Budget Item Justification

Demonstrate bacterial diarrheal prophylactic candidate safety, effectiveness, and pharmacokinetics through clinical trials in humans. Transition the prophylactic candidate to product developer in support of future FDA licensure.

Research is conducted in compliance with FDA regulations for medical products for human use.

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.

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

Work in this Project is performed by the USAMRDC, Fort Detrick, MD.

Efforts in this Project support the Soldier portfolio and the principal area of Military Relevant Infectious Diseases.

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

	FY 2020	FY 2021	FY 2022
Title: Prophylactic for Endemic Diarrheal Diseases	-	-	4.009
Description: Demonstrate bacterial diarrheal prophylactic candidate safety, effectiveness, and pharmacokinetics through clinical trials in humans. Transition the prophylactic candidate to product developer in support of future FDA licensure.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) CJ3 / <i>Prophylactic for Endemic Diarrheal Diseases</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p><i>FY 2022 Plans:</i> Will mature oral prophylactic candidates for the prevention of bacterial diarrheal diseases; validate commercial off the shelf (COTS) products for prevention of bacterial diarrheal diseases; provide data packages for the FDA to test suitable candidates in humans for safety and effectiveness; demonstrate the candidates in human clinical trials for safety and effectiveness against bacterial diarrheal diseases.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funds realigned from other efforts in Project MM8 (Prevention and Treatment of Viral Diseases) and Project MO9 (Demonstrate Safety and Perform Limited Efficacy in Humans of a Vaccine to Prevent Dengue Fever).</p>			
Accomplishments/Planned Programs Subtotals	-	-	4.009

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MG4 / Tech Base/Enabling Res in Mil Occup Med Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MG4: Tech Base/Enabling Res in Mil Occup Med Adv Tech	-	7.984	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Medical efforts support laboratory studies and field demonstrations of biomedical products designed to counteract diverse environmental, physiological and psychological stressors, as well as reduce the impacts of hazards encountered in training and operational environments. Initiatives will demonstrate and transition medical technologies to support Soldier/squad survivability under demanding operational tempo in order to protect, optimize and enhance Soldier performance and sustain lethality across the diverse range of military operations.

The four main thrust areas are:

- (1) Physiological Health,
- (2) Environmental Protection,
- (3) Injury Prevention and Reduction,
- (4) Psychological (mental) Health and Resilience.

The cited work is fully coordinated with Combat Capabilities Development command Soldier Center and with other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY 2020 adjustments align program resources to Army Modernization Priorities in support of the National Defense Strategy.

Work in this Project is performed by: the U.S. Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2020	FY 2021	FY 2022
Title: Injury Prevention & Reduction	0.754	-	-
Description: This effort supports and validates injury prediction tools and return-to-duty assessments for brain, spine, and chest injury from blast, blunt, and ballistic impact. These are all priorities for Program Executive Office (PEO)-Soldier and support various Maneuver Center of Excellence programs including Soldier Protection Systems (e.g., Integrated Head Protection Systems and Vital Torso Protection Systems). This effort also addresses need for validated aeromedical standards and strategies to enable aircrew to effectively fight, navigate, and land under a range of degraded visual environments and provide aeromedical return to duty guidelines after neurosensory injury (deficits in the nervous system control of vision, hearing, taste, smell, and touch). This supports Cross Functional Team (CFT) Future Vertical Lift.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MG4 / <i>Tech Base/Enabling Res in Mil Occup Med Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Title: Physiological Health & Performance</p> <p>Description: This effort supports and matures laboratory prototypes, evaluates nutritional formulations and interventions, and validates decision aids for the prediction of Soldier performance in high operational tempo military environments.</p>	2.675	-	-
<p>Title: Psychological Health & Resilience</p> <p>Description: This effort supports and validates neurocognitive (relating to or involving the central nervous system and cognitive abilities) assessment and brain injury detection methods, and validates tools and preclinical methods to treat post-traumatic stress disorder in a military population. This effort also supports validation of interventions in Warfighters for PTSD, validation of biomarkers of individual PTSD symptoms, validation of methods to follow effectiveness of PTSD treatments, validation of neuroprotective (protection of nerves and nervous system) interventions and validation of strategies to prevent neurocognitive deficits (reduced ability to learn and comprehend) and symptomatology associated with brain injury. This effort matures and validates early interventions to prevent and reduce military stressor and combat-related behavioral health problems, including symptoms of PTSD, depression, anger problems, anxiety, substance abuse, suicide, and other health risk behaviors. This effort matures and validates tools and interventions to enhance and sustain psychological resilience throughout Soldiers' careers.</p>	0.586	-	-
<p>Title: Environmental Health & Protection</p> <p>Description: This effort supports and matures non-invasive technologies, decision-aid tools, and models to enhance Soldier protection and sustainment across the operational spectrum. The aim is to provide the scientific basis for developing focused heating and cooling solutions to maintain fine motor dexterity, core temperature, and optimized physical and cognitive performance during cold-weather and hot-humid operations. This effort tests a computational algorithm for identifying latent hepatic, renal, and cardiac injury after toxic metal and/or toxic industrial chemical exposure during training and operations. This effort tests models to predict likelihood of neurologic and/or physical injury as a result of hazardous exposure(s) in the operational environment.</p>	3.969	-	-
Accomplishments/Planned Programs Subtotals	7.984	-	-

<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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MM2 / MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MM2: MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)	-	10.000	21.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Congressional increase for Peer-reviewed military burn research.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Medical Advanced Technology 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 2020	FY 2021
Congressional Add: Peer-reviewed Military Burn Research Program	10.000	-
FY 2020 Accomplishments: Program Increase supported advanced research on Military Burn Research Program. Work executed by Army Futures Command.		
Congressional Add: Program increase: Burn care training curriculum	-	5.000
FY 2021 Plans: Program Increase supported advanced research on Burn Care Training Curriculum. Work executed by Army Futures Command.		
Congressional Add: Program increase - peer-reviewed military burn research	-	10.000
FY 2021 Plans: Program Increase supported advanced research on Peer-reviewed Military Burn Research. Work executed by Army Futures Command.		
Congressional Add: Program increase: Advanced hemostat products	-	6.000
FY 2021 Plans: Program Increase supported advanced research on Advanced Hemostat Products.		

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM2 / <i>MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Adds Subtotals	10.000	21.000

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) MM5 / <i>Tech Base/Enabling Res Combat Cas Care Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MM5: <i>Tech Base/Enabling Res Combat Cas Care Adv Tech</i>	-	2.328	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Preclinical and early clinical development, demonstration, and transition of new combat casualty care technologies that save lives and minimize permanent injury following combat-related traumatic injuries. Focus is identifying more effective critical care technologies and clinical practice guidelines to treat severe bleeding, traumatic brain injury, burns and other combat related traumatic injuries.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

Promising efforts identified through applied research conducted under PE 0602787A (Medical Technology) Project 874 (Cbt Casualty Care Tech) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development) Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Combat Trauma Therapies	1.040	-	-
Description: This effort focuses on work required to validate safety and effectiveness of drugs, biologics, and medical procedures intended to minimize immediate and long-term effects from battlefield injuries.			
Title: Pre-Hospital Tactical Combat Casualty Care	0.457	-	-
Description: This effort supports demonstration and validation of materiel and knowledge products to advance the level of care that can be provided given the tactical, environmental, and patient factors inherent in the prehospital combat setting. Successful translation of research to the field will augment combat medic capabilities, thereby reducing death and serious injury in the battlefield space where the majority of preventable casualty deaths occur.			
Title: Traumatic Brain Injury	0.831	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM5 / <i>Tech Base/Enabling Res Combat Cas Care Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Description: This effort supports work required to validate safety and effectiveness of drugs, biologics, and medical procedures intended to minimize immediate and long-term effects from TBI.				
Accomplishments/Planned Programs Subtotals		2.328	-	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MM7 / Enabling Med Cap to Support Dispersed OPS Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MM7: Enabling Med Cap to Support Dispersed OPS Adv Tech	-	1.744	2.913	3.232	-	3.232	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project supports advanced technology research to develop tools and prototype medical intelligent systems for Soldiers operating in resource-constrained, hazardous or denied entry environments and for denied, interrupted, or low communications (DIL) characteristic of Multi-Domain Operations: 1) actionable decision support tools that use machine learning and predictive analytic techniques to produce treatment recommendations for "non-expert" providers (such as combat lifesavers and combat medics), infer the patient's condition based on diverse sources of information (e.g. sensor data, medic observations, etc.) , and provide recommendations based on established care guidelines. 2) secure remote patient tele-monitoring, provider telementoring, and medical device teleoperation, and 3) modular, self-contained, platform agnostic, "roll-on, roll-off" robotic and autonomous unmanned system payloads to support medical resupply, casualty evacuation and treatment via man-machine teaming.

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

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

	FY 2020	FY 2021	FY 2022
Title: Combat Evacuation Mission Module	1.744	-	-
Description: Research, design and develop a tele-monitored and remote-controlled Combat Evacuation Mission Module to support medical resupply and casualty evacuation using future multi-purpose vertical takeoff and landing (VTOL) UAS. Provides a self-contained medical module capability adaptable to various future multi-purpose VTOL UAS.			
Title: Medical Robotic and Autonomous Systems	-	2.913	-
Description: This Task now incorporates the previous Combat Evacuation Mission Module Task. Research, design and develop a tele-monitored and remote-controlled Combat Evacuation Mission Module to support medical resupply and casualty evacuation using future multi-purpose VTOL UAS. Provides a self-contained medical module capability adaptable to various future multi-purpose VTOL UAS. Research, design, and prototype an intelligent decision-support capability that can be operated on an Army or Navy provided End User Device (EUD), such as the NETT Warrior system, to assist medics with patient assessment, triage, treatment, and disposition in a Prolonged Field Care (PFC) environment by assessing patient conditions to provide adaptive care guidelines.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM7 / <i>Enabling Med Cap to Support Dispersed OPS Adv Tech</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021
<p>FY 2021 Plans: Validate conceptual designs and physical prototypes for a Multi-Mission Vehicle Interface (MMVI) system for both manned and unmanned air and ground platforms. This MMVI consists of a common vehicle floor and rail system for rapid configuration of the cabin space and installation of both autonomous and attended en route care systems and innovative patient handling systems. Optimizes design of the MMVI, targeting integration with an Army Future Vertical Lift (FVL) prototype or technology demonstrator vehicle and conduct final integration and demonstration of MMVI prototype. Demonstrate vehicle options that may include 1) a FVL prototype or technology demonstrator vehicle, 2) the ?optionally-manned? variant of the UH-72 Lakota, or 3) the Squad Multipurpose Equipment Transport (SMET) Unmanned Ground Vehicle (UGV). Based on the previous applied research, and in collaboration with US Army Aeromedical Research Laboratory (USAARL) and Combat Capabilities Development Command Aviation and Missile Center, prototype and demonstrate a mission-based flight control interface system integrating with a relevant (optionally-manned FVL variant or similar) UAS flight control system. Demonstrate a proof-of-concept prototype implementation of a rule-based Decision Support System (DSS) knowledge base using published Tactical Combat Casualty Care (TCCC) guidelines for one or more typical use cases. Demonstrate clinical knowledge authoring and knowledge base development techniques. Based on previous applied research, demonstrate sensor fusion, signal processing, and analysis on acquired patient data to understand the context of the data and provide inputs to the Decision Support System. Integrate the DSS with prototype closed loop technologies such as the Navy?s Autonomous Critical Care System (ACCS).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned to other efforts within Project MM7 (Develop Prototype Medical Robotic and Autonomous System).</p>			
<p>Title: Develop Prototype Medical Robotic and Autonomous System (Med-RAS)</p> <p>Description: Matures and demonstrates a tele-monitored and remote-controlled Combat Evacuation Mission Module to support medical resupply and casualty evacuation using future multi-purpose Vertical Take-Off and Landing (VTOL) UAS. Provides a self-contained medical module capability adaptable to various future multi- purpose VTOL UAS. Matures and demonstrates an intelligent decision-support capability that can be operated on an Army or Navy provided End User Device (EUD), such as the NETT Warrior system, to assist medics with patient assessment, triage, treatment, and disposition in a Prolonged Field Care (PFC) environment by assessing patient conditions to provide adaptive care guidelines.</p> <p>FY 2022 Plans: Will mature a self-contained Semi-Autonomous Casualty Management Module (SACM2) for integration of medical capability components to move from human to semi-autonomous, and fully automate interfaces for both tele-operated and closed-loop controlled remote patient monitoring and management systems and in-flight interventions; provide communication infrastructure and cyber security solutions for remote patient monitoring, remote supervision and control of semi-autonomous patient management systems, and Virtual Health support for attending medics; demonstrate a Safe Transport and Evacuation Protocol</p>		-	-
			3.232

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM7 / <i>Enabling Med Cap to Support Dispersed OPS Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
System (STEPS) to implement the flight control constraints necessary to ensure patient safety and protect sensitive medical materiel during flight onboard unmanned or ?optionally-piloted? vehicles; optimize a Multi-Mission Vehicle Interface which includes an innovative patient handling system and a common vehicle interface (physical, electrical, and data links), providing a means to rapidly reconfigure future vehicle platforms for MEDEVAC or CASEVAC missions; mature a hardware system to enable video and audio data collection for integrating Computer Vision and Natural Language Processing technologies to automate documentation of patient encounter and medic interventions.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding realigned from other efforts within Project MM7 (Medical Robotic and Autonomous System).			
Accomplishments/Planned Programs Subtotals	1.744	2.913	3.232

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technol ogy</i>				Project (Number/Name) MM9 / <i>Tech Base/Enabling Rsrch for Infect Dis Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MM9: <i>Tech Base/Enabling Rsrch for Infect Dis Adv Tech</i>	-	2.961	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Advanced technology development, demonstration, and integration of model systems required for Food and Drug Administration (FDA) approval or licensure of medical countermeasures, such as drugs, vaccines, and devices, against military health threats for which human effectiveness studies are not feasible or ethical.

Research is conducted in compliance with FDA regulations and guidance.

Work is managed by the United States Army Medical Research and Development Command (USAMRDC).

Technologies developed in this Project are integrated with specific countermeasures under PE 0603807A (Medical Systems Advanced Development) to conduct pivotal demonstrations of effectiveness required for FDA approval.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense Strategy.

Work in this Project is performed by the USAMRDC, Fort Detrick, MD including USAMRIID (Fort Detrick, MD) and USAMRICD (Aberdeen Proving Ground, MD).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Technology Research on drugs and vaccines against parasitic diseases	1.980	-	-
Description: Test lead drug candidates in healthy volunteers to determine drug pharmacology, safety, and effectiveness against malaria. Transition the lead anti-malarial drug with improved safety, effectiveness and less frequent dosing to advanced development. Perform small studies in healthy volunteers to test vaccine safety, effectiveness and immunogenicity against malaria with down-selection and transition of the vaccines to advanced development.			
Title: Viral Disease Threats	0.981	-	-
Description: Perform small studies in healthy volunteers to test vaccine safety, effectiveness, and immunogenicity against Dengue and Hantaviruses infections so as to down-select and transition lead vaccine candidates to advanced development.			
Accomplishments/Planned Programs Subtotals	2.961	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technol ogy	Project (Number/Name) MM9 / Tech Base/Enabling Rsrch for Infect Dis Adv Tech

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MN3 / Immediate Cardiopulmonary Stabilization Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN3: Immediate Cardiopulmonary Stabilization Adv Tech	-	1.864	2.071	1.727	-	1.727	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project covers development, pre-clinical and early-clinical demonstration, and transition of technologies for immediate pre-hospital hemorrhage detection and control and airway management. These technologies facilitate autonomous intubation and airway management in combat casualties with obstructed airways. This Project also demonstrates advanced technologies for use in forward areas to detect and control non-compressible internal bleeding, and demonstration of pain-relieving drugs that are safe for use during bleeding.

Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology) Project MM4 (Cbt Casualty Care Applied Rsch Technology) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development) Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Immediate Cardiopulmonary Stabilization Advanced Technology	1.864	2.071	-
Description: Development, preclinical and early-clinical demonstration, and transition of technologies that facilitate autonomous intubation and airway management in combat casualties with obstructed airways, as well as advanced hemostatic bandage candidates that augment the patient's blood clotting system and new tourniquet technologies suitable for prolonged use.			
FY 2021 Plans: Perform preclinical demonstration and clinical validation of sensor technology to aid medics performing endotracheal intubation (placement of a flexible plastic tube into the windpipe to maintain an open airway) and airway management; validate currently available pain relieving drugs in an animal model of hemorrhage with orthopedic trauma; demonstrate preclinical and clinical minimally invasive interventional technologies for control of non-compressible truncal hemorrhage; clinically demonstrate new technology to detect hemorrhage in trauma casualties through computer analysis of standard vital signs.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN3 / <i>Immediate Cardiopulmonary Stabilization Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funds realigned to Project MN3 (Tactical Combat Casualty Care Pharmaceuticals and Devices Cap Set 1).				
Title: Tactical Combat Casualty Care Pharmaceuticals and Devices Cap Set 1		-	-	1.727
Description: Development, preclinical and early-clinical demonstration, and transition of technologies that facilitate autonomous intubation and airway management in combat casualties with obstructed airways, as well as advanced hemostatic (arrest of bleeding) bandage candidates that correct the patient's blood clotting system and new tourniquet technologies suitable for prolonged use.				
FY 2022 Plans: Demonstrate most promising bleeding control intervention candidates for limb and junctional bleeding (bleeding from a junction of the torso to the extremities, i.e., the base of the neck, shoulder, axilla, perineum, buttocks, gluteal area and the groin) through mechanical testing, and provide best practices for bleeding control; engineer battlefield-relevant manikin and employ large animal injury models for demonstration of airway management technologies and devices.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned from other efforts within Project MN3 (Immediate Cardiopulmonary Stabilization Advanced Technology).				
Accomplishments/Planned Programs Subtotals		1.864	2.071	1.727
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) MN4 / <i>Advanced Life Support Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN4: <i>Advanced Life Support Advanced Technology</i>	-	3.710	3.615	3.927	-	3.927	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project covers development, demonstration, and transition of technologies that enable advanced life support under prolonged care scenarios, including life-support devices that provide lung and kidney functions in casualties with severe injuries and devices and clinical guidelines for the prevention of irreversible organ damage resulting from prolonged lack of blood circulation.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology) Project MM4 (Cbt Casualty Care Applied Rsch Technology) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development) Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Battlefield Sustainment of Critical Organ Function Capability Set 1	3.710	3.615	3.927
Description: Develop, demonstrate and transition technologies that enable advanced life support under prolonged field care scenarios: life-support devices that provide lung and kidney functions in casualties with severe injuries, and devices and clinical guidelines for the prevention of irreversible organ damage resulting from prolonged lack of blood circulation.			
FY 2021 Plans: Demonstrate lead candidate anti-blood clotting technologies for coating of extracorporeal life support (ECLS) circuitry vs standard of care in advanced animal injury models; validate prototype ECLS technologies with and without mechanical ventilation in simulated forward environments under prolonged field care conditions; begin demonstration of ECLS in combination with non-compressible hemorrhage control technologies, and modular ECLS systems for cardiorespiratory, kidney, and liver support.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN4 / <i>Advanced Life Support Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will perform preclinical validation studies of down selected Nitric oxide-release/Non-adhesive coating in extracorporeal life support (ECLS) circuit vs. immobilized heparin standard of care in advanced injury models; mature and demonstrate a single device and pump driven modular platform for lung and renal support that will carry out ECLS without systemic anticoagulation; demonstrate portable ECLS platform designed to improve blood oxygenation through first in human study to inform the US critical care community about the safety, feasibility and efficacy of this system in reducing mechanical ventilator settings, and avoiding use of mechanical ventilation in the critically ill.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>				
Accomplishments/Planned Programs Subtotals		3.710	3.615	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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) MN5 / <i>Next Generation Blood Products Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN5: <i>Next Generation Blood Products Advanced Technology</i>	-	5.725	6.610	9.394	-	9.394	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project covers technology development, pre-clinical and early-clinical demonstration, and transition of new blood products with increased shelf life and functionality. Cold-stored platelets, fibrinogen replacement technologies, and pharmaceuticals that protect and metabolically stabilize blood-deprived tissues and reverse impaired blood clotting subsequent to severe injury, will improve prompt hemorrhage control, mitigate effects of shock, and minimize sustainment requirements.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology) Project MM4 (Cbt Casualty Care Applied Rsch Technology) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development) Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Next Generation Human-Derived Blood Replacement	5.725	6.610	9.394
Description: Develop, demonstrate in pre-clinical and early-clinical studies, and transition new blood products with increased shelf life and functionality including cold-stored platelets and biopharmaceutical technologies that stop life threatening bleeding, stabilize tissue metabolism, mitigate shock and restore normal blood clotting will improve prompt hemorrhage control and minimize sustainment requirements.			
FY 2021 Plans: Perform preclinical validation of hypotensive (lower than normal blood pressure) resuscitation parameters in militarily-relevant trauma; optimize and validate low volume resuscitation algorithms; validate therapeutic approaches to inform new clinical practices using synthetic and animal models of acute coagulopathy (impaired blood clotting ability) of trauma; demonstrate candidate drugs in animal hemorrhage models to identify potential candidates with optimal hemostatic (refers to an agent that			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN5 / <i>Next Generation Blood Products Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>stops bleeding) and metabolic stabilizing effects; validate candidate hemostatic devices to improve hemorrhage control and survival of bleeding casualties under prolonged field care scenarios and during states of inhibited blood clotting ability; conduct preclinical and clinical demonstration of blood clotting capability when platelets are stored under novel conditions to prolong shelf life.</p> <p>FY 2022 Plans: Will perform preclinical studies and early clinical evaluations aimed at extending availability of whole blood, platelets, and plasma to all areas of the battlefield; comparatively demonstrate ability of promising cold-stored platelet additives to extend shelf life and maintain normal platelet function; validate engineered plasma in a small animal polytrauma model for ability to reverse acute traumatic coagulopathy (a condition in which the blood's ability to form clots is impaired), prolong survival, and improve outcomes; validate currently available portable blood storage and transport containers under a variety of environmental conditions for impact on blood function.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Fund realigned from other efforts within PE 0603002 (Medical Advanced Technology).</p>				
Accomplishments/Planned Programs Subtotals		5.725	6.610	9.394
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MN6 / Blast & Head Impact Exposure Monitor Advanced Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN6: Blast & Head Impact Exposure Monitor Advanced Tech	-	1.354	1.878	1.546	-	1.546	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This project will inform the development of technologies and strategies to detect and provide actionable information to unit leader/Soldier about hazardous exposure to blast and head impact. This capability will help prevent degradation to Soldier cognitive readiness and performance and enhance combat power.

The cited work is fully coordinated with PE 0602143A (Soldier Lethality Technology) and complimentary to PE 0603118A (Soldier Lethality Advanced Technology) and is fully coordinated with other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY21 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
<p>Title: Blast & Head Impact Exposure Monitor</p> <p>Description: This effort will develop a prototype predictive tool that can provide the unit leader an indication of whether a potential mild traumatic brain injury event has occurred. This capability will provide the unit leader an additional objective tool to determine whether a Soldier can be safely exposed to more impacts without increased risk of injury.</p>	1.354	-	-
<p>Title: Injury Criteria for Informing the Development of New Tactical Head borne Systems.</p> <p>Description: This effort validates 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).</p> <p>FY 2021 Plans: Expand the collection of field measurements of blast exposure and head impact data from heavy weapons training, breaching, and airborne communities in order to validate a blast and head impact exposure monitoring algorithm for a next generation head protection system. Refine and validate cervical neck injury criteria for next generation head borne and protection systems.</p> <p>FY 2022 Plans:</p>	-	1.878	1.546

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN6 / <i>Blast & Head Impact Exposure Monitor Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Finalize the validation and deliver Go/No Go Readiness predictive algorithm that will alert and inform unit leader/Soldier of cognitive status after a potential injurious head impact and blast exposure has occurred. Finalize the validation and deliver head supported mass criteria in dismounted Soldier environments.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned to PE 0603002A Project M02 (Traumatic Brain Injury (TBI) Treatment Adv Tech).				
Accomplishments/Planned Programs Subtotals		1.354	1.878	1.546
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MN7 / Musculoskeletal Injury Screening Tool Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN7: Musculoskeletal Injury Screening Tool Adv Tech	-	0.287	3.274	1.664	-	1.664	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 this Project was realigned from:
 PE 0603002A (Medical Advanced Technology)
 *Project MN1 (Applied Sensory Systems Trauma Technology)

A. Mission Description and Budget Item Justification

This project develops strategies and technologies to reduce musculoskeletal injury (MSKI) rates and improve outcomes following Return to Duty (RTD) in the Army training (i.e., TRADOC), operational (e.g., FORSCOM, USASOC) and medical communities (e.g., OTSG) to improve Soldier readiness.

The cited work is fully coordinated with PE 0602143A (Soldier Lethality Technology) and complimentary to PE 0603118A (Soldier Lethality Advanced Technology), and is fully coordinated with the Army Training and Doctrine Command (TRADOC) and other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY21 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Musculoskeletal Injury Screening Tool	0.287	-	-
Description: This capability will deliver a prototype unit leader tool that can provide an objective assessment of musculoskeletal tissue integrity and provide fitness or return-to-duty recommendations.			
Title: Leader and Medical Provider Tools to Prevent and Reduce Musculoskeletal Injury in All Settings	-	3.274	1.067
Description: Project validates in field environment strategies and technologies to reduce musculoskeletal injury (MSKI) rates and improve outcomes following Return to Duty (RTD) in the Army training (i.e., TRADOC), operational (e.g., FORSCOM, USASOC) and medical communities (e.g., OTSG) to improve Soldier readiness.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN7 / <i>Musculoskeletal Injury Screening Tool Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Complete primary data collection and processing of established biomarkers for stress fracture from 1,500 participants; provide initial bone biomarker and microstructure data for transition to the Training and Doctrine Command's U.S. Army Center for Initial Military Training (TRADOC/USACIMT) to inform strategies for reducing injury risk.</p> <p>FY 2022 Plans: Will provide follow-up data, data processing, and dissemination of Nonsteroidal Anti-inflammatory Drugs (NSAIDs) data to the U.S. Army Training and Doctrine Command/Center for Initial Military Training (TRADOC/CIMT); provide the most important modifiable risk factors from validated field musculoskeletal injury data and begin transition of an injury risk capability to TRADOC/CIMT.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned to PE 0603002A Project MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech).</p>			
<p>Title: Forward Neuro-Muscular Skeletal Injury Assessment to Reduce Unnecessary Evacuations</p> <p>Description: This program will validate solutions to accurately assess the severity of acute, non-penetrating soft-tissue injuries in training and operational environments. This capability once transitioned will show proof of concept of a capability that will improve Soldier readiness and return to duty and limit unnecessary evacuations by accurately diagnosing and assessing musculoskeletal injury.</p> <p>FY 2022 Plans: Will validate field expedient bone imaging technologies; validate use of existing handheld ultrasound technologies with limited use providers for use in the field; validate use of real-time handheld ultrasound to assess soft tissue injury in the field by providers with limited training.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned from PE 06022787A (Medical Technology) Project MN1 (Applied Sensory Systems Trauma Technology).</p>	-	-	0.597
Accomplishments/Planned Programs Subtotals	0.287	3.274	1.664

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MN8 / Drugs to Prevent and Treat Malaria Advanced Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN8: <i>Drugs to Prevent and Treat Malaria Advanced Tech</i>	-	2.057	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year 2021 this Project is realigned to:
 PE 0602787A (Medical Technology)
 * Project MM8 (Infectious Diseases and Applied Rsch Technology)

A. Mission Description and Budget Item Justification

This Project covers technology development, demonstration, and transition of a candidate malaria prevention drug with weekly or less frequent dosing. The candidate drug may also be effective for the treatment of *P. falciparum* and *P. vivax* malaria. Infectious disease prevention sustains individual and unit readiness and reduces health services requirements and cost. Research is conducted in compliance with Food and Drug Administration (FDA) regulations for medical products for human use.

Work is managed by the United States (U.S.) 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.

Promising medical countermeasures identified in this Project are further matured under PE 0603807A (Medical Systems Advanced Development), Project 808 (DoD Drug & Vacc Ad).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense Strategy.

Work in this Project is performed by: the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

Efforts in this Project support the Soldier portfolio and the principal area of Military Relevant Infectious Diseases.

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

	FY 2020	FY 2021	FY 2022
Title: Drugs to Prevent and Treat Malaria Advanced Technology	2.057	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN8 / <i>Drugs to Prevent and Treat Malaria Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Description: Test drugs in healthy volunteers to determine drug pharmacology, safety, and effectiveness against malaria. Transition current lead anti-malarial prophylactic drug (triazine) with improved safety, effectiveness, and requiring less frequent dosing to Program Manager for Pharmaceutical (PM Pharm) in support of future FDA licensure.			
Accomplishments/Planned Programs Subtotals	2.057	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MN9 / Far Forward Behavioral Health Care Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MN9: Far Forward Behavioral Health Care Advanced Tech	-	0.255	1.080	0.283	-	0.283	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This effort will deliver a tested delivery system for behavioral health interventions oriented to far forward settings that will ensure the psychological readiness of Soldiers and safeguard their far forward readiness and performance in austere operating environments, under high intensity operational stressors.

The cited work is fully coordinated with PE 0602143A (Soldier Lethality Technology) and complimentary to PE 0603118A (Soldier Lethality Advanced Technology), and is fully coordinated with other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY21 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Optimal Delivery of Far Forward Behavioral Health Care	0.255	-	-
Description: The effort will deliver improved psychological treatment interventions to keep Soldiers in the fight under high intensity operational stressors.			
Title: Far Forward Behavioral Health Care	-	1.080	0.283
Description: This effort will deliver a tested delivery system for behavioral health interventions oriented to far-forward settings that will ensure the psychological readiness of Soldiers and safeguard their far-forward readiness and performance in austere operating environments, under high intensity operational stressors.			
FY 2021 Plans: Validate interventions and technologies that promote rapid recovery from acute stress and other behavioral health problems in far-forward settings immediately following a traumatic battlefield event; field test content and products to deliver behavioral health stabilization services oriented to far-forward settings; provide team-based training (Team CORE) to boost social connection and			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MN9 / <i>Far Forward Behavioral Health Care Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>reduce individual isolation, a major risk factor in behavioral health; mature components for enhancing behavioral health leadership skills and deliver new training.</p> <p><i>FY 2022 Plans:</i> Will complete sleep leadership training data analyses demonstrating efficacy of training for improving sleep leadership and sleep behaviors & transition, a brief sleep leadership training module intended for Behavioral Health Officers (BHOs) or their equivalent to provide to unit leadership teams. The training module will be delivered to the US Army Medical Center of Excellence (MEDCoE) to be incorporated into training courses and to the Office of the Surgeon General (OTSG) Behavioral Health Service Line (BHSL). Will optimize the sleep leadership training by conducting interviews with BHOs and incorporating feedback to increase usability, feasibility, and impact of training.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding realigned to PE 0603002A Project MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech).</p>			
Accomplishments/Planned Programs Subtotals	0.255	1.080	0.283

<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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) MO2 / <i>Traumatic Brain Injury (TBI) Treatment Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO2: <i>Traumatic Brain Injury (TBI) Treatment Adv Tech</i>	-	4.108	4.649	10.667	-	10.667	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In FY 2022 funding for this Project was realigned from:

PE 0602787A (Medical Technology)

- *Project MM4 (Cbt Casualty Care Applied Rsch Technology)
- *Project MM6 (Medical Technologies to Support Dispersed Ops Tech)
- *Project MK4 (Warfigher Health Applied Rsch Technology)

PE 0603002A (Medical Advanced Technology)

- *Project MM7 (Enabling Med Cap to Support Dispersed OPS)
- *Project MN3 (Immediate Cardiopulmonary Stabilization Adv Tech)
- *Project MN4 (Advanced Life Support Advanced Technology)
- *Project MN5 (Next Generation Human-Derived Blood Products Advanced Technology)
- *Project MN6 (Blast & Head Impact Exposure Monitor Advanced Tech)
- *Project MN7 (Musculoskeletal Injury Screening Tool)
- *Project MN9 (Far Forward Behavioral Health Care Advanced Tech)
- *Project MO7 (Improved Bone Repair Advanced Technology)
- *Project MO8 (Expeditionary Performance Nutrition Advanced Tech)

A. Mission Description and Budget Item Justification

This Project covers development, demonstration, transition of technologies for acute battlefield management of brain trauma, and maintains laboratory capability to perform these functions. Efforts include pre-clinical demonstration of drug therapy and resuscitation strategies for treatment of acute brain injury in the pre-hospital setting, biomarkers, diagnostics, and devices, as well as novel drug delivery technologies to facilitate administration of pharmaceuticals at or near the point of injury to protect the injured brain from further damage.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO2 / <i>Traumatic Brain Injury (TBI) Treatment Adv Tech</i>
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Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology) Project MM4 (Cbt Casualty Care Applied Rsch Technology) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development) Project 836 (Field Medical Systems Advanced Development).

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

Work in this Project is performed by the United States Army Medical Research Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2020	FY 2021	FY 2022
<p>Title: Drugs to Prevent and Treat Brain Injury (TBI)</p> <p>Description: Develop, demonstrate, and transition technologies to treat combat-related brain injury. Technologies include drugs administered at or near the point of injury to treat combat-related brain injury while also stabilizing and protecting non-injured brain tissues, and novel drug delivery platforms that specifically target injured brain cells.</p> <p>FY 2021 Plans: Demonstrate pre-clinically neuroprotective and anti-inflammatory effects of drugs and biologics delivered directly to brain cells via targeting nanoparticles; validate pre-clinical and clinical pre-hospital administered drugs to stabilize the blood clotting system in injured brain tissue; demonstrate pre-clinically drugs for stabilizing metabolic function in injured brain tissue and preserving function of brain cells after injury.</p> <p>FY 2022 Plans: Will evaluate a novel drug-releasing gel material designed for application at point of injury that will safely seal open penetrating brain injuries, protecting exposed brain tissue from further injury while simultaneously releasing potent anti-inflammatory, antibiotic drugs directly to the injured brain; validate prehospital intranasal administration of drugs to preserve brain cell function following traumatic brain injury. Will continue studies to demonstrate effectiveness of new drugs developed to preserve brain cell function following traumatic brain injury; optimize approaches to treating traumatic brain injured casualties, who have also been exposed to nerve agent.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned from PE 0602787A Project MM4 (Cbt Casualty Care Applied Rsch Technology), Project MK4 (Warfighter Health Applied Rsch Technology), and Project MM6 (Medical Technologies to Support Dispersed Ops Tech).</p>	4.108	4.649	10.667
Accomplishments/Planned Programs Subtotals	4.108	4.649	10.667

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technol ogy	Project (Number/Name) MO2 / Traumatic Brain Injury (TBI) Treatment Adv 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MO3 / Military Occupational Fitness Standards Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO3: Military Occupational Fitness Standards Adv Tech	-	0.240	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year 2021 this Project is realigned to:
 PE 0303002A (Medical Advanced Technology)
 * Project MN7 (Musculoskeletal Injury Screening Tool Adv Tech)

A. Mission Description and Budget Item Justification

This project will develop an integrated set of trainings, portable interventions, tools, and technologies to assist individuals, small-teams, medics, and leaders in recognizing and mitigating reactions to stress, and maintaining readiness, performance and lethality of small groups, with limited medical asset availability. The cited work is fully coordinated with Combat Capabilities Development Command Soldier Center and with other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Military Occupational Fitness Standards	0.240	-	-
Description: This capability will provide the unit leader a validated toolkit of operationally relevant physical fitness assessments that can supplement clinical criteria to determine whether a Soldier can return to duty after musculoskeletal injury without the risk of re-injury.			
Accomplishments/Planned Programs Subtotals	0.240	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) MO4 / <i>Burn Recovery Optimization Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO4: <i>Burn Recovery Optimization Advanced Technology</i>	-	2.044	3.326	2.059	-	2.059	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project covers technology development, demonstration, and transition of burn recovery optimization technologies, including diagnostic technology to predict skin graft success or failure, technologies to measure and predict burn wound healing rate and assess burn treatment effectiveness, and novel dressings that protect severe burn wounds from further injury and prevent inflammation and infection until definitive surgical burn care is available.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology) Project MM4 (Cbt Casualty Care Applied Rsch Technology) are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development), Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense Strategy.

Work in this Project is performed by the United States Army Medical Research Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2020	FY 2021	FY 2022
Title: Rapid Burn Injury Treatment and Return to Duty Capability Set 1	2.044	3.326	2.059
Description: Mature, demonstrate, and transition burn recovery optimization technologies. These include diagnostic technology to predict skin graft success or failure, and advanced dressings that contain anti-infective and anti-inflammatory agents for prehospital use to protect severe burn wounds from further injury, infection and inflammation for prolonged periods until definitive surgical wound care is provided.			
FY 2021 Plans: Provide initial development of burn wound healing indices and predictive models by initiating a preclinical severe burn animal model study; demonstrate anti-infective, protective bandage for severe burn wounds in an animal model of delayed surgical burn care as would be experienced under prolonged field care conditions; validate nitric oxide-releasing wound dressing in an animal			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO4 / <i>Burn Recovery Optimization Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>model of infected deep partial thickness burn. As part of continuing work on burn wound biomarkers, provide a large animal burn model in which to test burn treatments and grafting.</p> <p><i>FY 2022 Plans:</i> Validate best approach for giving fluids to burn patients (by mouth or intravenously) through a small clinical study; demonstrate new therapies to be deployed by medics at the point of injury to safely remove dead skin and underlying tissues from burn wounds in order to prevent infection; validate two new anti-bacterial agents to provide data for which is most effective in reducing infections in burn wounds; perform validation studies of a hand-held device designed to assess severity of burn wounds through non-contact measurement of the wound's size and depth.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding realigned to PE 0603002A Project MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech).</p>			
Accomplishments/Planned Programs Subtotals	2.044	3.326	2.059

<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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MO7 / Improved Bone Repair Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO7: Improved Bone Repair Advanced Technology	-	1.475	1.564	1.069	-	1.069	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, demonstrates, and validates promising medical technologies and new clinical practices to improve outcomes following severe limb injuries involving complex bone fractures and injured surrounding soft tissues.

All research is conducted in compliance with Food and Drug Administration (FDA) requirements for licensure of medical products for human use.

Promising efforts identified through Applied Research conducted under PE 0602787A (Medical Technology), Project 874 (Cbt Casualty Care Tech), are further matured under this Project. Promising results identified under this Project are further matured under PE 0603807A (Medical Systems Advanced Development), Project 836 (Field Medical Systems Advanced Development).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
<p>Title: Limb Function Repair and Return to Combat Duty & Field Stabilization on Bone in Preparation for Evac</p> <p>Description: Development, demonstration, and transition of technologies that improve outcomes, mobility and return to duty following severe limb injuries involving complex bone fractures and injured soft tissues.</p> <p>FY 2021 Plans: Provide retrospective epidemiological analysis of extremity compartment syndrome (condition characterized by increased pressure within a confined space, such as a muscle compartment, resulting in reduced blood flow, pain, and, if untreated, tissue death and functional impairment) to identify means to improve monitoring, assessment, and diagnosis of casualties at risk for developing extremity compartment syndrome; validate candidate anti-infective agents in animal infected open fracture model under prolonged field care conditions; demonstrate preclinical efficacy of candidate drugs for restoring normal immune response to injury in order to promote normal healing in severe extremity fractures.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>	1.475	1.564	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) M07 / <i>Improved Bone Repair Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funds realigned to other efforts within Project M07 (Limb Function Repair and Return to Combat Duty, Field Stabilization of Bone in Preparation for Evac).				
<p>Title: Field Stabilization of Bone in Preparation for Evac</p> <p>Description: Maturation, demonstration, and transition of technologies that improve outcomes, mobility, and return to duty following severe limb injuries involving complex bone fractures and injured soft tissues in casualties treated under multi-domain operations conditions.</p> <p>FY 2022 Plans: Develop and demonstrate prototype noninvasive external fixation device for stabilization of lower extremity fractures with weight bearing support to enhance casualty mobility.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned from other efforts within Project M07 (Limb Function Repair and Return to Combat Duty & Field Stabilization on Bone in Preparation for Evac).</p>		-	-	0.564
<p>Title: Limb Function Repair and Return to Combat Duty</p> <p>Description: Maturation, demonstration, and transition of technologies that improve outcomes, and return to duty following severe limb injuries involving complex bone fractures and injured soft tissues.</p> <p>FY 2022 Plans: Will validate local and regional antibiotic delivery strategies to achieve therapeutic soft tissue antibiotic levels during and after tourniquet induced ischemia (an inadequate blood supply to an extremity) in a large animal model and will validate if intervention reduces level of infection within an open wound distal to the tourniquet; demonstrate alternative portable technologies to aid medics in diagnosing acute extremity compartment syndrome (increased pressure within a confined body space, especially of the leg or forearm. May require surgery and loss tissue or extremity).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned from other efforts within Project M07 (Limb Function Repair and Return to Combat Duty & Field Stabilization on Bone in Preparation for Evac).</p>		-	-	0.505
Accomplishments/Planned Programs Subtotals		1.475	1.564	1.069
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MO7 / Improved Bone Repair Advanced Technology

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MO8 / Expeditionary Performance Nutrition Advanced Techn
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO8: Expeditionary Performance Nutrition Advanced Techn	-	0.192	2.062	1.936	-	1.936	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project covers the development of real-time, specific, and individualized interventions to optimize mental acuity and fatigue and manage metabolic and nutritional needs to sustain Soldier physical, mental, and immunological performance.

The cited work is fully coordinated with PE 0602143A (Soldier Lethality Technology) and complimentary to PE 0603118A (Soldier Lethality Advanced Technology), and is fully coordinated with other Services in order to avoid duplication of effort.

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
<p>Title: Performance Nutrition for an Expeditionary Force</p> <p>Description: Development of nutritionally-optimized food products prototypes that will allow Soldiers to eat-on-the-go with minimal logistical footprint while ensuring maximal physiological and cognitive performance.</p>	0.192	-	-
<p>Title: Medical Strategies to Sustain Soldier Alertness and Performance in All Settings</p> <p>Description: Develop real-time, specific, and individualized interventions to optimize mental acuity and fatigue and manage metabolic and nutritional needs to sustain Soldier physical, mental, and immunological performance.</p> <p>FY 2021 Plans: Validate interventions to mitigate sleep loss and fatigue and improve individual and team performance in operational settings, including multi-domain battle scenarios; demonstrate the utility and effectiveness of electrical stimulation technologies that provide direct current to the brain as neurocognitive interventions for the enhancement of recuperative sleep and the development of operationally relevant sleep strategies.</p> <p>FY 2022 Plans:</p>	-	2.062	1.936

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO8 / <i>Expeditionary Performance Nutrition Advanced Techn</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will continue validation of interventions to mitigate sleep loss and fatigue and improve individual and team performance in training and operational settings, including multi-domain battle scenarios. Will continue to demonstrate the utility and effectiveness of electrical stimulation technologies that provide direct current to the brain, in addition to acoustic stimulation of brain patterns during sleep, as neurocognitive interventions for the enhancement of recuperative sleep and the development of operationally relevant sleep strategies. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding realigned to PE 0603002A Project MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech).			
Accomplishments/Planned Programs Subtotals	0.192	2.062	1.936

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MO9 / Vaccines to Prevent Dengue Fever Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MO9: Vaccines to Prevent Dengue Fever Advanced Tech	-	2.474	2.037	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 this Project was realigned to:
 PE 0603002A (Medical Advanced Technology)
 * Project MM9 (Tech Base/Enabling Rsrch for Infect Dis Adv Tech)
 * Project CJ3 (Prophylactic for Endemic Diarrheal Diseases)

A. Mission Description and Budget Item Justification

This Project covers technology development, demonstration and transition of a candidate vaccine for the prevention of Dengue fever caused by any of the four Dengue virus serotypes. The vaccine is intended to be effective in people with and without a prior history of Dengue infection. Research is conducted in compliance with FDA regulations for medical products for human use.

Promising medical countermeasures identified in this Project are further matured under Program Element 0603807A (Medical Systems Advanced Development), Project 808 (DoD Drug & Vacc Ad).

The cited work is consistent with the Under Secretary of Defense (Research and Engineering) science and technology focus areas and the Army Modernization Strategy. All FY20 adjustments align program resources to Army Modernization Priorities in support of the National Defense 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 2020	FY 2021	FY 2022
Title: Vaccines to Prevent Dengue Fever Advanced Technology	2.474	2.037	-
Description: Perform Good Manufacturing Practice (GMP) manufacture of Dengue vaccine candidate. Demonstrate Dengue vaccine candidate safety, effectiveness, and pharmacokinetics in humans. Transition the Dengue vaccine candidate to product developer.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO9 / <i>Vaccines to Prevent Dengue Fever Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Continue clinical trial to determine safety and immune response in humans of the optimized vaccine regimen; continue Dengue fever controlled human infection model clinical trial to determine additional safety, appropriate immune response, and effectiveness against all Dengue strains. FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned to other efforts in Project CJ3 (Prophylactic for Endemic Diarrheal Diseases). Funding realigned to PE 0603002A Project MM9 (USAMRIID/USAMRICD Disease Defeat).				
Accomplishments/Planned Programs Subtotals		2.474	2.037	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology				Project (Number/Name) MP3 / Phys Chem Toxicity Assessment Sys Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
MP3: Phys Chem Toxicity Assessment Sys Adv Tech	-	-	2.590	2.291	-	2.291	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY2021.
This Project is a New Start for Fiscal Year 2021 (FY21).

A. Mission Description and Budget Item Justification

This Project covers the development of products and solutions that will protect and prevent degradation of Soldier health, readiness and performance from environmental stressors (heat, cold, altitude, and chemical toxicants) while conducting prolonged operations in the MDO. Develop algorithms and physiological models to inform unit leaders and Soldiers and provide actionable information and interventions to manage metabolic needs, maintain performance, and avoid non-battle injuries while operating in extreme environments.

This Project contains no duplication with any effort within the Military Departments and includes direct participation by other Services. The cited work is fully coordinated with PE 0602143A (Soldier Lethality Technology) and complimentary to PE 0603118A (Soldier Lethality Advanced Technology).

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

Work in this Project is performed by the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2020	FY 2021	FY 2022
Title: Solutions to Sustain Warfighter Performance in Extreme Environments	-	2.590	2.291
Description: Protect and prevent degradation of Soldier health, readiness and performance from environmental stressors (heat, cold, altitude, chemical toxicants) while conducting prolonged operations in the MDO. Develop algorithms and physiological models to inform unit leaders and Soldiers and provide actionable information and interventions to manage metabolic needs, maintain performance, and avoid non-battle injuries while operating in extreme environments.			
FY 2021 Plans: Provide validated tools that sustain lethality and optimize performance to prevent injuries related to multi-environmental stressors; provide scientific-based evidence of the impact of these stressors on medical readiness by leveraging commercial and emerging technologies for knowledge and materiel solutions that optimize physiological and cognitive performance across the spectrum of multi-domain operations; provide predictive models to prevent injury and illness, validated physiological sensor systems, and			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MP3 / <i>Phys Chem Toxicity Assessment Sys Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>assessment tools to optimize performance and improve lethality; demonstrate a capability for improved performance and thermal comfort in hot environments using cooling technology with skin temperature feedback control; demonstrate a capability to increase finger and toe temperatures for improved manual dexterity and performance in cold weather operations.</p> <p>FY 2022 Plans: Will provide validated tools to sustain lethality and optimize performance and to prevent injuries related to multi-environmental stressors; optimize capability to improve performance and thermal comfort in hot environments using innovative cooling technology; deliver to advanced development mature and validated algorithms for exertional heat injury, acute mountain sickness, and cold-weather clothing selection; complete animal model to demonstrate capability to use real-time physiological data to determine the extent to which an individual has been exposed to a toxic chemical; begin validation of method for cold habituation to improve cold tolerance and comfort when operating in arctic conditions.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned to PE 0603002A Project MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech).</p>			
Accomplishments/Planned Programs Subtotals	-	2.590	2.291

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603007A / <i>Manpower, Personnel and Training Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	10.225	11.344	14.273	-	14.273	-	-	-	-	-	-
792: <i>Personnel Performance & Training</i>	-	10.225	11.344	14.273	-	14.273	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) matures and validates applied behavioral and social science technologies that enhance the Soldier Lifecycle (e.g., selection, assignment, training, leader development) and human relations (e.g. unit cohesion). These technologies provide advanced personnel measures 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 evaluates new selection measures, assignment methods, and performance metrics for individuals and units, assesses innovative training methods, and conducts scientific assessments to inform Human Capital policy and programs. Work 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.

Work in this PE complements and is fully coordinated with PE 0602785A (Manpower/Personnel/Training Technology).

The cited work 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

Work in this PE is performed by the United States Army Research Institute (ARI) for the Behavioral and Social Sciences in Ft. Belvoir, VA.

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	11.038	11.659	14.919	-	14.919
Current President's Budget	10.225	11.344	14.273	-	14.273
Total Adjustments	-0.813	-0.315	-0.646	-	-0.646
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.477	-			
• SBIR/STTR Transfer	-0.336	-0.315			
• Adjustments to Budget Years	-	-	-0.646	-	-0.646

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army Date: May 2021

Appropriation/Budget Activity
2040: *Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)*

R-1 Program Element (Number/Name)
PE 0603007A / *Manpower, Personnel and Training Advanced Technology*

Change Summary Explanation

Funding was decrease by \$4.173 million due to the Army Artificial Intelligence Task Force (AITF) planned on doing talent management research in 6.2 and 6.3. As part of the EE PEG 2.5 Trade space Assessment, the Army Research Institute (ARI) was used as a bill payer for this talent management work. The funding from the trade space assessment was left in the original APEs with the intention of creating a new task specific to AI in talent management. G-1 does not want any funding for the AITF to be mixed with their APEs. The subject of AITF involvement in talent management beyond basic research will be addressed in POM23.

\$4.173 million of FY22-26 will be realigned into APE 633040CL6, ATR Using Multiple Cooperative Sensors Adv Tech.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603007A / <i>Manpower, Personnel and Training Advanced Technology</i>				Project (Number/Name) 792 / <i>Personnel Performance & Training</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>792: Personnel Performance & Training</i>	-	10.225	11.344	14.273	-	14.273	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrate applied behavioral and social science technologies that enhance the Soldier Lifecycle (e.g., selection, assignment, training, leader development) and human relations (e.g., unit cohesion). These technologies provide advanced personnel measures 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 demonstrates new selection measures, assignment methods, and performance metrics for individuals and units; assesses innovative leader development and learning 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.

Work in this Project complements PE 0602785A (Personnel Performance & Training Technology)

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering Science and Technology priority focus areas, the Army Vision, the Army People Strategy, the Army's Talent Management Strategy, and the Army Modernization Strategy.

Work 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 2020	FY 2021	FY 2022
Title: Talent Assessment and Development	10.225	11.344	14.273
Description: This effort optimizes and demonstrates innovative talent management approaches to provide the Army the flexibility to adapt to changes in force structure and recruiting environments. This effort matures Soldier selection measures, techniques, and tools to more fully assess Soldier potential and better predict behavior, attrition, Soldier performance, and team effectiveness. This effort also matures and demonstrates methods that develop and model Soldier talents/competencies longitudinally across a career.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603007A / <i>Manpower, Personnel and Training Advanced Technology</i>	Project (Number/Name) 792 / <i>Personnel Performance & Training</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Conducting research to validate personnel assessment measures to improve selection and assignment; conducting research to mature and validate methods to develop critical leader competencies for Non-Commissioned Officer (NCOs); conducting research to demonstrate psychometric validity of small unit performance measurement tools.</p> <p><i>FY 2022 Plans:</i> Will mature research to validate personnel assessment measures to improve selection and assignment by applying additional psychometric analyses to improve a Functional Area longitudinal assessment and assessments designed to predict Officer performance and continuance; mature and validate methods to develop critical leader competencies, such as mindfulness and strategic thinking competencies; mature research and collect data to demonstrate psychometric validity of small unit performance measurement tools.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding was partially realigned to Program Element 0603040 (Artificial Intelligence and Machine Learning Advanced Technologies), Project CL6 (ATR Using Multiple Cooperative Sensors Adv Tech) for work in Artificial Intelligence informed personnel assessment efforts.</p>			
Accomplishments/Planned Programs Subtotals	10.225	11.344	14.273

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603025A / <i>Army Agile Innovation and Demonstration</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	22.231	-	22.231	-	-	-	-	-	-
CK8: <i>Advanced Technology Development and Convergence</i>	-	-	-	22.231	-	22.231	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, this is a new program element.
 Funding was realigned from:
 Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program

A. Mission Description and Budget Item Justification

This Program Element funds the Army's goal of accelerating 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 demonstrate emerging technologies and systems with high payoff potential to address current technology shortfalls or future capability gaps and systems. This Program Element will allow for exploration and adaptation of various technologies in the early stages of development enabling cost saving decisions in the procurement life-cycle by using the try, buy, decide model of identifying and investing in proof of technology demonstrations that the army can adapt and integrate. 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.

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 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603025A / <i>Army Agile Innovation and Demonstration</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	22.231	-	22.231
Total Adjustments	0.000	0.000	22.231	-	22.231
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	22.231	-	22.231

Change Summary Explanation

In Fiscal Year (FY) 2022, this is a new program element, with funding realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603025A / Army Agile Innovation and Demonstration	Project (Number/Name) CK8 / Advanced Technology Development and Convergence
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CK8: <i>Advanced Technology Development and Convergence</i>	-	-	-	22.231	-	22.231	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this is a new start.

A. Mission Description and Budget Item Justification

This project aims to accelerate the Army's goal of finding innovative and nontraditional solutions to the most difficult technological problems. Efforts to pair with nontraditional entities, such as industry or the newly established Army Futures Command Software Factory, bring new ways of doing business to demonstrate emerging technologies and systems with high payoff potential to address current technology shortfalls or future capability gaps and systems. Additionally, this project seeks to provide funding for advanced research/technology that has been discovered in "Innovation Days" that are funded across RDT&E.

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)

	FY 2020	FY 2021	FY 2022
Title: Advanced Technology Development of Existing Commercial Technology	-	-	6.000
<p>Description: Advanced commercial development exists when direct investment leads to rapid technology applications and demonstration. The Army identifies existing technology to further develop and modify for Army use. Partnerships with industry both traditional and non-traditional, allow the Army to advance non-military commercial research and development investments through focused engagements resulting in commercial adaption and integration to address Army technology and modernization efforts. Initial nominal Army investment in proof of technology and technology demonstrations will expedite novel technologies shaping their development to meet Army requirements and expedite both component and complete system adaptation and integration.</p>			
<p>FY 2022 Plans:</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603025A / Army Agile Innovation and Demonstration	Project (Number/Name) CK8 / Advanced Technology Development and Convergence		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>The Army enterprise will identify commercial solutions to technology problem areas focused on next generation combat vehicles, dismounted soldier lethality, power generation and storage, network and satellite support, and novel sensors and technologies.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a FY22 new start. Funding was realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program.</p>				
<p>Title: Sub-System Component and Prototype Convergence</p> <p>Description: The Army investigates, develops, and integrates non-traditional cutting-edge technology. Sub-system component and prototype convergence seeks to develop or integrate one or more technologies to prove out concepts or to merge smaller subsystems towards a more complex solution. This task informs requirements developers where the state of technologies is at, where it is going and on what timeline confirming viability for incorporation into larger technology programs.</p> <p>FY 2022 Plans: Will focus on subsystem component development and maturation of autonomous technologies focused on the integration of disjointed systems, remote predictive maintenance, component hardening (against cyber) of IT and communications systems on manned and unmanned vehicles, network and satellite technologies, and Soldier exoskeletons.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a FY22 new start. Funding was realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program</p>		-	-	4.000
<p>Title: Experimentation and Development of Commercial Dual Use Technologies</p> <p>Description: The Army seeks to connect with industry early in a technology's commercialization process. Experimentation and development will connect with these non-traditional technologies to determine the feasibility and ability to be leveraged against military applications. Technology development will be conducted concurrently to commercial activities with experimentation used to understand proof-of-concept applicability for further Government initiative. As part of this process strategic partnerships will be cultivated with technology aggregators such as In-Q-Tel to ensure a comprehensive approach to connect and transition technologies to the Army.</p> <p>FY 2022 Plans: Will focus experimentation and development on intelligent connectivity between systems and novel sensors and sensor techniques.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a FY22 new start. Funding was realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program.</p>		-	-	5.000
<p>Title: Software Factory Advanced Software Development</p>		-	-	4.900

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603025A / Army Agile Innovation and Demonstration	Project (Number/Name) CK8 / Advanced Technology Development and Convergence

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: As part of the novel Software Factory stood up by Army Futures Command (AFC), Soldiers will be leveraged to address some of the most challenging software research problems that the Army faces. Soldiers will adopt an Agile Development Process to rapidly mature experimental software for mobile technology, secure authentication procedures, and other software needs for Army-specific hardware platforms.</p> <p>FY 2022 Plans: Will design, characterize, and mature software supporting Army wide hardware platforms; will develop and demonstrate the ability to quickly route Soldier created software to mobile devices in an iterative fashion; and will integrate Soldier created software into a secure DevOps environment.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a FY22 new start. Funding was realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program</p>			
<p>Title: Demonstration and Development of Army Discovered Innovative Technologies</p> <p>Description: The Army seeks to develop and demonstrate technology that display unique and innovative potential in a cross-domain fashion. This effort seeks to direct advanced research funding towards technologies that are discovered from Army Innovation events such as Innovation Days funded by PE 0605054A (Emerging Technology Initiatives) Project FI3 (Rapid Capability Development and Maturation) or the Expeditionary Technology Search effort in PE 0605803A (Technical Information Activities) Project CC2 (Expeditionary Technologies). This task complements and coordinates with PE 0604115 (Technology Maturation Initiatives) Project AX3 (Technology Maturation Initiatives) task "Innovation Funding".</p> <p>FY 2022 Plans: Will develop and demonstrate unique solutions to Army wide problems leveraging technology discovered through Army technology search events.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a FY22 new start. Funding was realigned from Abrams Recapitalization, RU01GA0750000, Abrams Upgrade Program</p>	-	-	2.331
Accomplishments/Planned Programs Subtotals	-	-	22.231

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	0.909	-	0.909	-	-	-	-	-	-
CL1: <i>AI Enhanced Intel Operations Advanced Technologies</i>	-	-	-	0.371	-	0.371	-	-	-	-	-	-
CL6: <i>ATR Using Multiple Cooperative Sensors Adv Tech</i>	-	-	-	0.538	-	0.538	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, this Program Element (PE) is created to focus on advanced research efforts in the Army portfolio pertaining to Artificial Intelligence (AI) and Machine Learning (ML) coordinated by the Army's Artificial Intelligence Task Force (AITF); with funding realigned from:

Program Element (PE) 0602785A (Manpower/Personnel/Training Technology)
790 (Manpower/Personnel/Training Technology).

Program Element 0603007A (Manpower, Personnel and Training Advanced Technology)
Project 792 (Personnel Performance & Training).

A. Mission Description and Budget Item Justification

This PE will further develop and mature advanced technologies in the use of artificial intelligence (AI) and machine learning (ML) to improve target recognition/detection using Multiple Cooperative Autonomous Sensors, leader decision making, replication of tactical behaviors to enable autonomous capabilities for maneuver, predictive maintenance, talent management, Intel support for Operations, network and cybersecurity and medical support. The Army's Artificial Intelligence Task Force (AITF) will provide strategic guidance and coordination of these advanced 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 and Machine Learning Basic Research and PE 0602180A Artificial Intelligence and Machine Learning Technologies

The cited work 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).

Work 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 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	0.909	-	0.909
Total Adjustments	0.000	0.000	0.909	-	0.909
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.909	-	0.909

Change Summary Explanation

In FY2022, this is a new PE with two new FY22 Project funded by realignments from Program Elements (PE) 0602785A (Manpower/Personnel/Training Technology) and 0603007A (Manpower, Personnel and Training Advanced Technology) as a part of the Program Evaluation Group (PEG) efficiency drill.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>				Project (Number/Name) CL1 / <i>AI Enhanced Intel Operations Advanced Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL1: <i>AI Enhanced Intel Operations Advanced Technologies</i>	-	-	-	0.371	-	0.371	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this new project was realigned from the following:

Program Element (PE) 0602785A (Manpower/Personnel/Training Technology), Project 790 (Manpower/Personnel/Training Technology).

A. Mission Description and Budget Item Justification

This project will mature and demonstrate various technologies to augment human analysts through Artificial Intelligence (AI)-enabled decision support and recommendation tools supporting Long Range Precision Fires, Mission Command, and Maneuver Commanders. Ultimately, this project will help bridge the research and technology gap within intelligence support to operations and the sensor to shooter thread. This effort complements and fully coordinates with the applied research in Program Element (PE) 0602180A (Artificial Intelligence and Machine Learning Technologies), Project CL2 (AI Enhanced Intel Operations Technologies).

The cited work is consistent with the Army Modernization Strategy and is supported and coordinated with the Army Intel Community, Army Futures Command, and the Army ISR Task Force.

Work in this Project supports the Army Science and Technology Lethality 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 2020	FY 2021	FY 2022
Title: AI Enhancements for Prometheus	-	-	0.371
Description: Prometheus is an umbrella of capabilities to support sensor to shooter automation for the strategic, operational, and tactical levels. This effort will utilize computer vision and deep learning capabilities to automatically triage data collection and hard-to-spot indications and warnings (I&W) to support targeting, allowing human analysts to do the higher-value work of determining if a given lead represents a valid threat.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>	Project (Number/Name) CL1 / <i>AI Enhanced Intel Operations Advanced Technologies</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Maturation of Artificial Intelligence (AI) algorithms for automated detection of adversarial objects of interest and automated intelligence collection management; will improve AI collection management and tasking capability, automate AI workflows, and document repeatable processes for deploying AI capabilities to meet Army needs.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> This is a Fiscal Year (FY) 22 new start. Funding was realigned from Program Element (PE) 0602785A (Manpower/Personnel/ Training Technology), Project 790 (Manpower/Personnel/Training Technology).			
Accomplishments/Planned Programs Subtotals	-	-	0.371

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>				Project (Number/Name) CL6 / <i>ATR Using Multiple Cooperative Sensors Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL6: <i>ATR Using Multiple Cooperative Sensors Adv Tech</i>	-	-	-	0.538	-	0.538	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this new project was realigned from the following:

Program Element 0603007A (Manpower, Personnel and Training Advanced Technology), Project 792 (Personnel Performance & Training).

A. Mission Description and Budget Item Justification

This work will demonstrate and mature a team of air and ground sensors that use Artificial Intelligence (AI) and Machine Learning (ML) 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. This effort complements and fully coordinates with the applied research in Program Element (PE) 0602180A (Artificial Intelligence and Machine Learning Technologies), Project CL7 (ATR Using Multiple Cooperative Sensors App Tech).

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 Lethality 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 2020	FY 2021	FY 2022
Title: Collaborative Target Detection and Tracking	-	-	0.538
Description: Demonstrate and mature an Artificial Intelligence (AI)-enabled scalable team of autonomous air and ground vehicles that will cooperatively conduct a zone recon to identify, geolocate, and track threats using on-board electronic intelligence (ELINT) and electro optical-infrared (EO-IR) sensors.			
FY 2022 Plans: Will refine and mature the AI-enabled target recognition architecture to classify threats at the tactical edge; will integrate novel technologies that uses ELINT sensing to enhance sensing and tracking during zone reconnaissance.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603040A / <i>Artificial Intelligence and Machine Learning Advanced Technologies</i>	Project (Number/Name) CL6 / <i>ATR Using Multiple Cooperative Sensors Adv Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
This is a Fiscal Year (FY) 22 new start. Funding was realigned from Program Element 0603007A (Manpower, Personnel and Training Advanced Technology), Project 792 (Personnel Performance & Training).			
Accomplishments/Planned Programs Subtotals	-	-	0.538

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603041A / <i>All Domain Convergence Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	17.743	-	17.743	-	-	-	-	-	-
CL9: <i>Collab Battlefield Networked Leth Sys Adv Tech</i>	-	-	-	8.871	-	8.871	-	-	-	-	-	-
CM2: <i>Collaborative Convergence Adv Tech Development</i>	-	-	-	0.444	-	0.444	-	-	-	-	-	-
CM8: <i>Convergence Battlefield Integration</i>	-	-	-	8.428	-	8.428	-	-	-	-	-	-

Note

This is a new start in FY 2022.

This is a new start in FY2022.

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. 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 0603465A (Future Vertical Lift Advanced Technology) and 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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603041A / <i>All Domain Convergence Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	17.743	-	17.743
Total Adjustments	0.000	0.000	17.743	-	17.743
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	17.743	-	17.743

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603041A / All Domain Convergence A Advanced Technology				Project (Number/Name) CL9 / Collab Battlefield Networked Leth Sys Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL9: Collab Battlefield Networked Leth Sys Adv Tech	-	-	-	8.871	-	8.871	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

This is a new start Project in Fiscal Year 2022 (FY22).

A. Mission Description and Budget Item Justification

The Collaborative Battlefield Networked Lethality System advanced technology project matures and demonstrates dynamic Weapon-Target Pairing (WTP), fires planning and execution for maneuver forces, integration of fires & intelligence technologies, Artificial Intelligence (AI)-based decision aid implementation, and integration & demonstration of a role-based networked lethality architecture.

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, Tactical Network, Future Vertical Lift, and Long Range Precision Fires Army Modernization Priorities.

This work is done in coordination with PE 0602181A (All Domain Convergence Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: CBNLS Distributed Lethality Architecture	-	-	3.290
Description: This effort provides a decision aid architecture that will integrate with current and future sensors and weapon systems to network fires for a mounted/dismounted and tactical operation center capability for Combined Arms Maneuvers. Matures and demonstrates distributed architecture and data transmission for sensor to shooter to optimize effects-based WTP.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603041A / All Domain Convergence A Advanced Technology	Project (Number/Name) CL9 / Collab Battlefield Networked Leth Sys Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will develop a fires and air space coordination systems to support AI-based decision aids in a networked lethality architecture. Will provide AI-enhanced digital collaborative targeting capability, air space and fires de-confliction, as well as fires planning, coordination and delivery to reduce sensor to shooter timelines.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this is a new start.</p>				
<p>Title: CBNLS Integrated Sensor to Shooter System</p> <p>Description: Demonstrates software that ingests intelligence, sensor cueing, tasking and target hand off data from/to higher and lower echelons for sensor to shooter integration. Integrates software on combat platforms to enable on-board sensor and weapon systems to execute fires missions based on decision aids? recommendations with minimal operator input.</p> <p>FY 2022 Plans: Will integrate CBNLS with intelligence systems for theatre-net centric geolocation data while tying current and emerging weapons to execute fires at the tactical edge. Support demonstrations with Army?s system of systems joint fires architecture to enable multi-domain fires.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this is a new start.</p>		-	-	3.500
<p>Title: CBNLS Fires Synchronization</p> <p>Description: Provides real-time, joint airspace integration between airspace users and fires at various echelons to de-conflict airspace for emerging long range munitions. Matures and demonstrates algorithms for modeling adversary behavior for autonomous engagement using prior knowledge and real-time sensor data.</p> <p>FY 2022 Plans: Will forecast future threat positions using advanced AI algorithms to identify the optimal required airspace to be coordinated based on available long range fires for a large number of nodes and distributed entities. These AI algorithms will provide potential courses of action using reinforcement learning, intuitive role based human?machine interfaces as well as game theory based algorithms for larger data sets.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this is a new start.</p>		-	-	2.081
Accomplishments/Planned Programs Subtotals		-	-	8.871

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603041A / <i>All Domain Convergence A dvanced Technology</i>	Project (Number/Name) CL9 / <i>Collab Battlefield Networked Leth Sys Adv Tech</i>

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603041A / All Domain Convergence A dvanced Technology				Project (Number/Name) CM2 / Collaborative Convergence Adv Tech Development			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CM2: Collaborative Convergence Adv Tech Development	-	-	-	0.444	-	0.444	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year 2022 (FY22). This is a new start Project.

A. Mission Description and Budget Item Justification

This Project develops and integrates critical Project Convergence technologies and the architecture through which the Project Convergence technologies will operate. This is accomplished using adaptive data fusion and task allocation algorithm to support the development of Artificial Intelligence (AI) decision support agents. This project includes development of advanced methods for processing and information extraction for mission oriented tasks in support of tactical decision makers. Additionally, this project will develop the scalable architecture solutions necessary to facilitate tactical data collection, movement, processing, storage and modeling and simulation necessary to enable mission command in multi-domain operations. Also, the project will shape early programs to accelerate technologies and 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, Long Range Precision Fires, Air and Missile Defense, Tactical Network, and Future Vertical Lift Army Modernization Priorities.

This work is done in coordination with PE 0602181A (All Domain Convergence Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: Air and Missile Defense Joint Kill Chain Decision Support Modeling and Simulation	-	-	0.444
Description: Demonstrate interoperability of missile interceptor, sensor, and fire control enabling technology contribution to Joint Kill Chain Air and Missile Defense scenarios in support of Multi-Domain Operations (MDO).			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603041A / <i>All Domain Convergence A dvanced Technology</i>	Project (Number/Name) CM2 / <i>Collaborative Convergence Adv Tech Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will demonstrate enabling missile technology in user defined Joint Kill Chain Air and Missile Defense scenarios by employing high fidelity models within the integrated air and missile defense simulation architecture.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> In FY 2022, this is a new start.			
Accomplishments/Planned Programs Subtotals	-	-	0.444

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603041A / All Domain Convergence A dvanced Technology				Project (Number/Name) CM8 / Convergence Battlefield Integration			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CM8: <i>Convergence Battlefield Integration</i>	-	-	-	8.428	-	8.428	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year 2022 (FY22). This is a new start Project.

A. Mission Description and Budget Item Justification

This Project integrates and demonstrates aided target detection and recognition, autonomous tactical behaviors, Artificial Intelligence (AI)-enabled decision support agent, and data management technologies in Multi-Domain Operations (MDO) field experiments. This Project integrates these technologies on tactical ground, air, air and missile defense, fires, network platforms and other missions to demonstrate reduced sensor to shooter timelines and evaluate operational performance in representative MDO scenarios during annual field experiments.

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, Tactical Network, and Future Vertical Lift Army Modernization Priorities.

This work is done in coordination with PE 0602181A (All Domain Convergence Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: Convergence Ground Platform System Integration	-	-	6.293
Description: Integration of ground efforts in direct support of maturing and demonstrating Project Convergence capabilities. This effort matures and demonstrates ground vehicle technologies as an integrated system and system of systems to reduce sensor to shooter targeting time, increase real-time battlefield understanding and ensure communications across all echelons.			
FY 2022 Plans: Will develop Convergence integration and assessment capability with networked aided target detection and recognition, autonomous tactical behaviors, AI-enabled decision support agent, and data management technologies on multiple ground platforms. Will also mature and demonstrate ground vehicle integration, multi-platform network communication and perform			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603041A / <i>All Domain Convergence A dvanced Technology</i>	Project (Number/Name) CM8 / <i>Convergence Battlefield Integration</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
analytics to inform requirements for both present and future tactical and combat military vehicles against a complex enemy in an MDO environment. FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this is a new start.				
Title: Convergence Aviation Platform Integration Description: Integration of Aviation/Future Vertical Lift efforts in direct support of maturing and demonstrating Project Convergence capabilities. Focus is on integration of capabilities such as geo-location and identification of targets from Army aviation assets, air to ground situational awareness and target data exchange, exchange of unmanned asset control, advanced tactical and teaming behaviors, synchronized data management, and efficient usage of air lethality assets. FY 2022 Plans: Will integrate individual capabilities developed under Full Spectrum Targeting effort (detection, recognition and identification of hidden and decoy targets, sensor fusion), MSET (multiple simultaneous engagement technologies to engage targets autonomously), Advanced Teaming (supervised autonomous mission commands, various payloads), XM915 20 mm cannon, and Integrated Mission Equipment (platform-agnostic architecture for various S&T efforts integrated with each other) in support of Project Convergence (PC) capability demonstrations. Will select for integration from listed efforts based on technology maturity and applicability to overall PC kill chain scenarios in the demonstration. FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this is a new start.		-	-	2.135
Accomplishments/Planned Programs Subtotals		-	-	8.428
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks N/A				
D. Acquisition Strategy N/A				

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603042A / <i>C3I Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	3.151	-	3.151	-	-	-	-	-	-
CN3: <i>Network Enabling University Adv Development</i>	-	-	-	3.151	-	3.151	-	-	-	-	-	-

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this Program Element is a New Start.

In FY 2022, funding is realigned from:

- Program Element 0602145A (Next Generation Combat Vehicle Technology)
- Program Element 0602787A (Medical Technology)
- Program Element 0603466A (Air and Missile Defense Advanced Technology)

A. Mission Description and Budget Item Justification

This PE matures, demonstrates, optimizes, and validates Network Command, Control, Communications, and Intelligence (C3I) technologies through the integration of future equipment and systems that improve overmatch and meet mission needs in the future operating environments.

This PE provides mid-to-long term tactical 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.

Efforts focus on advanced maturation and demonstration of materials, technologies, methodologies and systems that span the range from electronics, protective technologies, electronic warfare, and mission support capabilities such as situational awareness. These efforts directly inform and transition key capabilities to Army programs of record that support the Army modernization priorities.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Work in this Project is performed by the United States (US) Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603042A / <i>C3I Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	3.151	-	3.151
Total Adjustments	0.000	0.000	3.151	-	3.151
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	3.151	-	3.151

Change Summary Explanation

New Program Element in Fiscal Year (FY) 2022 established to for enabling science and technology efforts that support advanced network research.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603042A / C3I Advanced Technology				Project (Number/Name) CN3 / Network Enabling University Adv Development			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CN3: Network Enabling University Adv Development	-	-	-	3.151	-	3.151	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this is a New Start.

A. Mission Description and Budget Item Justification

This project matures and demonstrates advanced Network Command, Control, Communications, and Intelligence (C3I) technologies into future equipment and systems.

This effort accelerates advanced technologies originating from extramural research inform academia, will enable intelligent networks, self-sensing/self-healing network, network security, advanced teaming and operations in a Global Positioning System (GPS) degraded or denied environment. This effort accelerates the Army modernization in next generation Network and Assured Positioning, Navigation, and Timing (APNT) systems. Work in this project will lead to emerging technologies in areas of strategic importance to the Army in communications and networking, by engaging competitively selected Universities.

Work in this Project complements and transitions from PE 0602182 C3I Applied Research.

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Intelligent, Secure and Self-Sensing/Self-Healing Networks	-	-	0.400
Description: Mature and integrate advanced intelligent network solutions with autonomous or self-sensing intelligence to deny corruption, and/or attacks and to execute operational missions securely and reliably.			
FY 2022 Plans: Will mature, demonstrate and integrate advanced capabilities in artificial intelligence and machine learning (AI/ML), predictive analytics, cyber, intelligent data integration, edge computer processing platforms, edge sensing systems, space or persistent surveillance applications and other technologies; optimize and demonstrate distributed learning under privacy and resource constraints and their communication between computing nodes and edge computing AI/ML solutions for network-driven			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603042A / <i>C3I Advanced Technology</i>	Project (Number/Name) CN3 / <i>Network Enabling University Adv Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
intelligence; demonstrate intelligent multi-modal communications with improved reliability, efficiency, localization and effectiveness; and integrate sensor technologies (biometric and biosensor solutions) for intelligent network credentialing and access. FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a Fiscal Year (FY) 2022 New Start.				
Title: Advanced Real-Time Tactical Networks Description: Develop tactical network technology platforms consisting of a fleet of ground and air vehicles that will perform an autonomous reconnaissance mission in a relevant environment. FY 2022 Plans: Will develop, demonstrate and integrate Artificial Intelligence/Machine Learning Autonomy-related algorithms with improved holistic network functionalities to support advanced navigation/routing and autonomous reconnaissance mission. Will use shared perception and situational awareness for collaborative Ground and Air autonomous systems, and advanced teaming operations in uncertain environments and challenging situations; and integrate mature technologies with/to experimental Ground and Air platforms for accelerated development and prototyping. FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a Fiscal Year (FY) 2022 New Start.		-	-	1.300
Title: Advanced Sensors and Non-GPS PNT Systems Description: Develop advanced sensors with enhanced signal processing software/algorithms to improve assurance against both electronic and kinetic attacks relative to GPS, and that can provide matured PNT technology in disrupted, degraded or denied GPS environments. FY 2022 Plans: Will design, fabricate, and integrate GPS signal integrity monitoring sensors and reporting systems to enhance Soldier awareness in disrupted, degraded or denied GPS environments; and develop, mature, demonstrate, and integrate technologies involving atomic timing modules, advanced vision, radar, or other Global Navigation Satellite System (GNSS)-independent PNT solutions that are computationally and physically lightweight. FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a Fiscal Year (FY) 2022 New Start.		-	-	1.451
Accomplishments/Planned Programs Subtotals		-	-	3.151

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603042A / <i>C3I Advanced Technology</i>	Project (Number/Name) CN3 / <i>Network Enabling University Adv Development</i>

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603043A / <i>Air Platform Advanced Technology</i>							
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	0.754	-	0.754	-	-	-	-	-	-
CL4: <i>Air Platform Enabling University Adv Development</i>	-	-	-	0.754	-	0.754	-	-	-	-	-	-

Note

In Fiscal Year 2022, this Program Element (PE) is created to focus on longer-term, far-reaching advanced technology efforts in the Air portfolio.

A. Mission Description and Budget Item Justification

This PE undertakes advanced technology 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 research into advanced technologies is conducted pertinent to 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 DoD aviation needs.

Work 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 0602183A (Air Platform Applied Research).

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

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

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	0.754	-	0.754
Total Adjustments	0.000	0.000	0.754	-	0.754
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.754	-	0.754

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity
2040: *Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)*

R-1 Program Element (Number/Name)
PE 0603043A / *Air Platform Advanced Technology*

Change Summary Explanation

In FY2022, this is a new PE with one new Project.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603043A / Air Platform Advanced Technology	Project (Number/Name) CL4 / Air Platform Enabling University Adv Development
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL4: Air Platform Enabling University Adv Development	-	-	-	0.754	-	0.754	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This is a new start in FY 2022.

This project is a new start in FY 2022.

A. Mission Description and Budget Item Justification

This Project focuses on experimentation and demonstration of advanced technologies 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 mature and integrate advanced 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 effort conducts and demonstrates advanced technology efforts arising from academic research in all areas of strategic importance to Army Aviation in AI/ML, autonomous systems, Advanced Teaming, Survivability, air-launched effects/payloads, coordinated air-ground maneuvering, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances. The project will continuously experiment with methods to identify, demonstrate and transition novel technology from entities that might not otherwise collaborate with the DoD, with the end goal of accelerating the adoption of cutting-edge applied research technology for the warfighter in the Army aviation portfolio.

Work in this Project supports the Army Modernization Priority Future Vertical Lift and the overall aviation portfolio.

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 and transitions to PE 0603465A (Future Vertical Lift Advanced Technology Development) and PE 0603119A (Ground Advanced Technology), and is also coordinated with its sister project in PE 0602148A (Future Vertical Lift Technology) and PE 0602183A (Air Platform Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Teaming	-	-	0.333

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603043A / Air Platform Advanced Technology	Project (Number/Name) CL4 / Air Platform Enabling University Adv Development

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: Demonstrate and integrate 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: Will further mature and demonstrate 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 integrate and provide decentralized interactions that will provide knowledge bases, reasoning, planning, sensing and control tools that reside inside the entire vehicle team and mobile computational resources. Will implement scalable approaches for perception to allow for rapid evaluation and recognition of previously detected landmarks</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding for this new effort is realigned from various PE/Projects listed in the Note Section of this Project as part of the Program Evaluation Groups (PEG) efficiency drill.</p>			
<p>Title: Coordinated Air-Ground Vehicle Maneuvering</p> <p>Description: Demonstrate and integrate a technology prototype platform consisting of a fleet of ground and air vehicles that will perform an autonomous reconnaissance mission in a relevant environment.</p> <p>FY 2022 Plans: Will demonstrate level coordinated landing/take-off of unmanned aerial system from stationary platform near ground vehicle in simulations. Will further mature and deploy software for air-ground coordination software support autonomous reconnaissance. Will integrate and demonstrate coordination strategies for autonomous ground and air vehicles to perform tactical reconnaissance mission.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding for this new effort is realigned from various PE/Projects listed in the Note Section of this Project as part of the Program Evaluation Groups (PEG) efficiency drill.</p>	-	-	0.421
Accomplishments/Planned Programs Subtotals	-	-	0.754

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603043A / <i>Air Platform Advanced Technology</i>	Project (Number/Name) CL4 / <i>Air Platform Enabling University Adv Development</i>

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603044A / <i>Soldier Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	0.890	-	0.890	-	-	-	-	-	-
CN8: <i>Soldier Enabled University Advanced Development</i>	-	-	-	0.890	-	0.890	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE matures, optimizes, and validates applied research technologies to demonstrate improved capabilities and systems that advance Soldier and Squad lethality-overmatch and Soldier performance beyond those technologies planned within the Soldier Lethality Cross-Functional Team. Advanced technology research efforts focus on the maturation and integration of broad capabilities and systems that span a range of technical areas to address enduring Soldier needs. These efforts transition outputs to existing and emerging systems in support of continuing enhancement of Soldier capabilities. 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.

In FY20 the Army restructured Science and Technology resources to align to the Secretary of the Army's six modernization priorities and allow transparent accountability of these priorities. Creation of this PE will facilitate the Soldier Lethality priority identification of technologies that enable multiple Soldier systems and are enduring (e.g. power generation, storage and distribution; protective materials; network integration; human systems integration, personnel research). This PE creation completes the FY20 restructuring process and ensures consistency across the six priority areas PE structures, with each priority area having two PEs per Budget Activity: one aligned to Soldier efforts that support priority systems (e.g. Next Generation Squad Weapons, Integrated Virtual Augmentation System) and the other aligned to enduring enabling technologies projects for future capabilities and/or technology upgrades. The enabling projects will be moved from the Soldier Technologies PE 63311 A to this new PE, improving visibility of Army research efforts that enable the future operating 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 is performed by the United States (US) Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603044A / <i>Soldier Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	0.890	-	0.890
Total Adjustments	0.000	0.000	0.890	-	0.890
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	0.890	-	0.890

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603044A / <i>Soldier Advanced Technology</i>	Project (Number/Name) CN8 / <i>Soldier Enabled University Advanced Development</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CN8: <i>Soldier Enabled University Advanced Development</i>	-	-	-	0.890	-	0.890	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This is a new start in FY 2022.

In Fiscal Year 2022 (FY22), This is a new Start.

A. Mission Description and Budget Item Justification

This Project leverages advanced technological innovations from academia to accelerate the optimization and demonstration of improved capabilities and systems that advance Soldier and Squad lethality-overmatch and Soldier performance and meet mission needs in the future operating environments. This Project funds collaborative, enduring advanced extramural university-based maturation and demonstration of technologies and brings together competitively selected universities with Army research teams into Technical Alliances. This effort will focus efforts on mid- to far-term Army modernization priorities while also maintaining delivery of near-term technologies critical to supporting the modernization priorities. The technical scope of this Project includes the optimization, maturation and demonstration of overarching Soldier-centric technologies including human systems integration, simplified synthetic training environments, advanced protective materials, power and energy, Warfighter endurance, robotics, as well as other innovative Soldier enabled advanced research technologies that will accelerate the Army modernization in Synthetic Training Environment, and Soldier Lethality. This effort conducts advanced research and development leading to 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 continuously strive to engage and collaborate with entities that might not otherwise collaborate with the DoD to demonstrate and provide novel Soldier-centric technologies for accelerating the adoption of emerging technologies for the Warfighter in the Army Soldier portfolio.

Work in this Project supports the Army Modernization Priority Synthetic Training Environment, and Soldier Lethality and the overall Soldier portfolio.

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.

Work in this Project complements and supports transitions from Soldier Enabling University Applied Research in PE 0602184A (Soldier Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Soldier Performance and Training	-	-	0.590

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603044A / <i>Soldier Advanced Technology</i>	Project (Number/Name) CN8 / <i>Soldier Enabled University Advanced Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: Mature and demonstrates Soldier capabilities related to increased protection, performance, agility, situational awareness, training, and lethality.</p> <p>FY 2022 Plans: Further mature and integrate reliable monitoring and assessment technologies for the health and readiness of Warfighters through digital/wireless biomarkers and biosensors; comprehensive automated testing framework to guarantee that synthetic training environments are highly trustworthy, reliable, and usable.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a new start. Funding increase reflects realigning of funding to create this New task to support enduring, overarching maturation of Soldier-centric technologies with academic partners for increased situational awareness capabilities.</p>			
<p>Title: Soldier Advanced Materials for the Integrated Combat Platform</p> <p>Description: Optimize and mature advanced materials and electronics that are standardized to the Soldier and their equipment through integrated combat platform.</p> <p>FY 2022 Plans: Mature Soldier electronics technology and optimize server processing to enable real-time data/video analytics and faster target detection capabilities. Mature and demonstrate advanced materials, such as flexible, energy storage, self-healing and super materials, for increased protection, power, and wireless technology to further integrate with the Soldier and Squad combat platform.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a new start. Funding increase reflects realigning of funding to create this New task to support university-based, enduring, overarching maturation of advanced materials for increased Soldier protection capabilities.</p>	-	-	0.300
Accomplishments/Planned Programs Subtotals	-	-	0.890

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	26.711	26.521	-	26.521	-	-	-	-	-	-
EB3: <i>HIV Medical Development</i>	-	-	26.711	26.521	-	26.521	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE funds the Military Human Immunodeficiency Virus (HIV) Research Program and the following medical research efforts: Walter Reed Army Institute of Research (WRAIR) Vaccine Production research, Underbody Blast (UBB) research, and Deployed Warfighter Protection. Funding also supports the Medical Operational Data System (MODS), Pharmacovigilance Defense Application System (PVDAS), Mobile HealthCare Environment (MHCE), and the Civilian Authorized Salaries and Other Operational Requirements programs.

The Military HIV Program supports the research and development to develop candidate HIV vaccines, to assess safety and effectiveness in human subjects and to protect military personnel from risks associated with HIV infection.

The WRAIR Vaccine Production Facility research project supports the development and licensure of vaccines and relevant biologics critical to the global health of our Warfighters serving domestically or abroad in compliance with US Food and Drug Administration (FDA) regulations.

The Underbody Blast (UBB) Testing medical research project provides funds to establish a scientific and statistical basis for evaluating skeletal injuries to vehicle occupants during ground vehicle UBB events. Areas of interest to the Secretary of Defense are medical research that provides an understanding of the human response and tolerance limits and injury mechanisms needed to accurately predict skeletal injuries to ground combat vehicle occupants caused by UBB events. This enhanced understanding will support the establishment of an improved capability to conduct Title 10 Live Fire Test and Evaluation and to make acquisition decisions.

The Deployed Warfighter Protection program Armed Forces Pest Management Board provides for the development of new or improved protection of military personnel from insects and tick vectors of disease pathogens.

The Medical Operational Data System (MODS), Pharmacovigilance Defense Application System (PVDAS), and Mobile HealthCare Environment (MHCE) identify, explore and demonstrate key technologies to overcome medical and military unique technology barriers.

The Civilian Authorized Salaries and other operational requirements provide funding for authorized civilian workforce performing medical research, development, acquisition management and oversight that support the medical research, development, test, and evaluation (RDTE) programs at the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, Maryland.

In FY21 programs these programs were transferred from the Defense Health Agency (DHA) to the United States Army.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	27.723	26.849	-	26.849
Current President's Budget	0.000	26.711	26.521	-	26.521
Total Adjustments	0.000	-1.012	-0.328	-	-0.328
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-1.012			
• Adjustments to Budget Years	-	-	-0.328	-	-0.328

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>				Project (Number/Name) EB3 / <i>HIV Medical Development</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
EB3: <i>HIV Medical Development</i>	-	-	26.711	26.521	-	26.521	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Military Human Immunodeficiency Virus (HIV) Research Program develops vaccine candidates, to assess their safety and effectiveness in human subjects, and to protect military personnel from risks associated with HIV infection. All HIV technology development is conducted in compliance with United States Food and Drug Administration (FDA) regulations. This program is jointly managed through an Interagency Agreement between the United States Army Medical Research and Development Command (USAMRDC) and the National Institute of Allergy and Infectious Diseases. The cited work is also consistent with the Assistant Secretary of Defense, Research and Engineering Science and Technology focus areas.

The Walter Reed Army Institute of Research (WRAIR) Vaccine Pilot Bioproduction Facility (PBF) is the Department of Defense (DOD) only facility capable of producing good manufacturing practices (GMP) quality biologic products for use in early phase clinical trials. The mission of the WRAIR PBF is to support the development and licensure of vaccines and relevant biologics critical to the global health of our Warfighters serving domestically or abroad in compliance with United States FDA regulations. This project supports vaccine development efforts of strategic importance to the DoD, including Service medical research and development programs, those of other DoD organization such as the Defense Threat Reduction Agency and the Defense Advanced Research Projects Agency, and pandemic bio preparedness for emerging infectious disease threats in the Global Health Security Agenda.

The Underbody Blast (UBB) Testing medical research project will provide new data on the biomechanics of human skeletal response that occurs in an attack on a ground combat vehicle, it will provide better protection to mounted warriors from the effects of underbody blast caused by landmines or improvised explosive devices (IEDs). The data will provide a biomedical basis for the development of a Warrior-representative blast test manikin (the Warrior Injury Assessment Manikin or WIAMan project) and the required biomedically-valid injury criteria that can be used in Title 10 Live Fire Test and Evaluation (LFT&E) to characterize dynamic events, the risk of injury to mounted warriors, and to support acquisition decisions. The data produced by this project will be used to satisfy a critical need for a scientifically valid capability for analyzing the risk of injury caused by UBB.

The Deployed Warfighter Protection project, the Armed Forces Pest Management Board (AFPMB), plans to develop new or improved protection for ground forces from disease-carrying insects. The focus of this program is to develop new or improved systems for controlling insects that transmit malaria, dengue, chikungunya and other emerging infectious diseases under austere, remote, and combat conditions; understand the physiology of insecticidal activity to develop new compounds with greater specific activity and/or higher user acceptability; examine existing area repellents for efficacy and develop new spatially effective repellent systems useful in military situations; develop new methods or formulations for treating cloth to prevent vector biting; and expand the number of active ingredients and formulations of public health pest pesticides, products and application technologies available for safe, and effective applications. The AFPMB partners with the President's Malaria Initiative and the World Health Organization Global Malaria Program to lead development of new tools for insect-borne disease prevention.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>	Project (Number/Name) EB3 / <i>HIV Medical Development</i>
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The Medical Operational Data System (MODS) deploys modernized data visualization capabilities to enhance Army Unit and Individual Medical Readiness Reporting. MODS provides Army leadership with a responsive and reliable human resource and readiness information management data system for all categories of military and civilian medical and support personnel. MODS provide Tri-Service support through applications such as Electronic Profile, Behavioral Health, and Medical Education.

The Pharmacovigilance Defense Application System (PVDAS) provides military providers Defense Patient Safety reports from the Food and Drug Administration (FDA) after a drug's release to market. The program identifies, explores, and demonstrates key information technologies to overcome medical and military unique technology barriers.

The Mobile HealthCare Environment (MHCE) is the capability of secure, bidirectional messaging and data exchange between patients, providers and clinics using any electronic device. The program identifies, explores, and demonstrates key information technologies to overcome medical and military unique technology barriers.

The Civilian Authorized Salaries and Other Operational requirements provide funding for authorized civilian workforce performing medical research, development, acquisition management and oversight that support the medical research, development, test, and evaluation (RDTE) programs at the United States Army Medical Research and Development Command (USAMRDC), Fort Detrick, Maryland.

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

	FY 2020	FY 2021	FY 2022
<p>Title: HIV Medical Development</p> <p>Description: The Military HIV Research Program aims to mature candidate HIV vaccines, to validate their safety and effectiveness in human subjects, and to protect the military personnel from risks associated with HIV infection. In addition, program also aims to develop other prevention and treatment strategies to mitigate the HIV epidemic globally. This project determines one or more vaccine candidates that are optimized through pre-clinical down-selection studies in large animal models and conducts human clinical trials in Africa, Asia and the United States to test for safety and immunogenicity (ability to invoke an immune response), and early proof of concept efficacy testing.</p> <p>FY 2021 Plans: The Military HIV research program continues Early Capture HIV Cohort studies in Europe and Asia with the purpose of characterizing recruitment, retention, HIV prevalence, HIV incidence and biological characteristics of acute HIV infection in high risk volunteers. Human population studies in Asia, Europe and West Africa will continue to provide knowledge about the earliest HIV events to inform vaccine development. Human clinical trials in Africa, Asia and the United States designed to test for safety, immunogenicity and early proof of concept efficacy of candidate vaccines will continue.</p> <p>FY 2022 Plans: Military Health Research Program will complete a human trial evaluating multi-dose vaccine regimens with the optimized dose of the Army's lead adjuvant, determining a lead protein boost vaccine candidate for further development; determine whether rapid administration of vaccines can elicit stronger antibody responses; determine which formulations of the leading Army adjuvant</p>	-	7.909	8.134

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>	Project (Number/Name) EB3 / <i>HIV Medical Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
are the best for safety, immune responses and manufacturing; demonstrate Good Manufacturing Practice manufacture of next generation subtype B mosaic vaccine candidates, informed by results from trials in large animal models. FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: WRAIR Vaccine Production Facility Research Description: The WRAIR Vaccine Pilot Bioproduction Facility will focus on advanced technology development and transition through production of early phase (1/2a) clinical materials from varied platforms, such as live virus, conjugates, recombinant proteins, monoclonal antibodies, RNA and DNA approaches that: (a) expand collaborative partnerships for product development that meet DoD requirements; (b) open active intramural-based discovery efforts of new products for development; and (c) initiate and extend strategic partnerships with external collaborators (Government and industry) to develop/co-develop potential new biologic approaches to pandemic disease preparedness. FY 2021 Plans: The WRAIR PBF program continues vaccine and biologic production efforts for use in early phase clinical trials to assess safety and effectiveness of candidate vaccines. FY 2022 Plans: The WRAIR Pilot Bioproduction Facility is a support function for novel S&T programs from across MRDC and the DoD to advance the development of vaccine products into early phase (1/2a) clinical trials. Following full operational capability establishment in FY21 the PBF will focus on fostering partnerships with both internal and external stakeholders to continue vaccine and biologic production efforts to support transfer of 6.1-6.3 activities for DoD and external stakeholders. These efforts will align to the technology maturation and risk reduction of medical countermeasures for through early phase (1/2a) clinical trials to assess safety and effectiveness of candidate vaccines to support the warfighter. FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		-	8.189	8.417
Title: Underbody Blast Testing Description: The Under Body Blast (UBB) Testing will provide an understanding of the biomechanics of skeletal injuries that occur in a combat vehicle UBB event involving a landmine or improvised explosive device (IED), and the biomedical basis for the development of a Warrior-representative blast test manikin and associated biomedically-validated injury criteria that can be used to characterize dynamic events and injury risks for LFT&E crew survivability assessments and vehicle development efforts to better protect Warriors from UBB threats. FY 2021 Plans:		-	1.274	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>	Project (Number/Name) EB3 / <i>HIV Medical Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>The Underbody Blast Testing program prepares final reports and complete contract closeouts to support completion of program efforts.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Project ended in FY21.</p>				
<p>Title: Deployed Warfighter Protection</p> <p>Description: The Deployed Warfighter Protection program will mature new or improved protection for ground forces from disease carrying insects and ticks.</p> <p>FY 2021 Plans: The Deployed Warfighter Protection research project continues to conduct translational research to develop and field tools that protect against emerging infectious disease threats and enable deployed forces to enhance protection from biting insects, primarily mosquitoes and sand flies, which transmit force degrading diseases. The AFPMB Vector Control Capabilities Gap Analysis (completed in FY 2016) continues to be used to inform the development of functional and performance requirements for future acquisition programs. In addition, the AFPMB continues to develop the necessary test and evaluation plans to determine a candidate product's ability to meet its stated requirements.</p> <p>FY 2022 Plans: The Deployed Warfighter Protection program continues early translational research for the development of novel tools that protect deployed forces from biting ticks, mosquitoes and other insects which transmit lethal and force degrading diseases. The Armed Forces Pest Management Board (AFPMB) continues to inform the development of performance requirements and necessary test and evaluation plans to determine a candidate product's capabilities and limitations. Novel vector control capabilities (including RNAi insecticides targeting specific vector species) and personal bite protection tools (including new uniform fabric technologies and area repellents) will be developed for further testing in operationally relevant environments.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	6.347	6.545
<p>Title: Medical Operational Data System</p> <p>Description: The Medical Operational Data System is the Army's authoritative data source for Individual Medical Readiness (IMR) reporting, and supports Army Global Medical Force Readiness (GMFR) to include the Army Surgeon General Title X responsibilities to recruit, retain, pay and train the Army Medical Force.</p> <p>FY 2021 Plans: Medical Operational Data System responds to Milestone Decision Authority decisions to add new capabilities, significantly enhance, and technically upgrade existing capabilities, and use federally funded research and development center resources</p>		-	1.868	1.983

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>	Project (Number/Name) EB3 / <i>HIV Medical Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>for system engineering and acquisition effectiveness services. These technology upgrades support the system's ability to help strengthen the scientific basis for decision-making in patient safety and quality performance within the Military Health System.</p> <p>FY 2022 Plans: Medical Operational Data System (MODS) will complete the Engineering Process needed for required modifications to the MODS Medical Assembly Mobilization Planning Data Platform to support the Army's evolving business/operational requirements in support of Medical Readiness of the Force.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Pharmacovigilance Defense Application System</p> <p>Description: The Pharmacovigilance Defense Application System (PVDAS) provides military providers Defense Patient Safety reports from the Food and Drug Administration (FDA) after a drug's release to market.</p> <p>FY 2021 Plans: Pharmacovigilance Defense Application System implements the testing of the drug surveillance and data visualization capabilities that were developed during previous fiscal years.</p> <p>FY 2022 Plans: Pharmacovigilance Defense Application System will demonstrate modifications to directly access to military healthcare databases, thus eliminating the need for its own data warehouse, to give the application access to the most up-to-date information while also increasing capability and capacity to conduct drug studies and analyses. The results will optimize drug-use safety and improve prescribing practices in the Military Healthcare System (MHS) at reduced total cost of ownership (TCO).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: No change.</p>		-	0.224	0.316
<p>Title: Mobile Health Care Environment</p> <p>Description: The Mobile HealthCare Environment matures and demonstrates technologies to support the capability of secure, bidirectional messaging and data exchange between patients, providers and clinics using any electronic device.</p> <p>FY 2021 Plans: The Mobile HealthCare Environment program finalizes its functionality expansion which will be the data exchange with other systems, specifically a patient's personal health record, and enterprise systems such as their electronic health record. These</p>		-	0.238	0.344

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603115A / <i>Medical Development</i>	Project (Number/Name) EB3 / <i>HIV Medical Development</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>system enhancements supports the Army's ability to help strengthen the scientific basis for decision-making in patient safety and quality performance within the Military Health System.</p> <p>FY 2022 Plans: Will continue device and data integration with backend records databases. Demand in these areas requires extensive requirements analysis, programming, and validation of secure chat, video and file sharing capabilities within the platform expansion completed for data integration.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Civilian Authorized Salaries and Other Operational Requirements</p> <p>Description: Funding is provided to the USAMRDC for Medical Research Development Acquisition (RDA) Management and Oversight to include the payroll of civilians as well as nominal operating expense.</p> <p>FY 2021 Plans: Funds authorized civilian salaries and associated expenses (supplies, equipment, travel, etc.) at USAMRDC and United States Army Medical Research Acquisition Activity. Funding also provides regulatory, clinical monitoring and data support for the Special Immunization Program. This program provides non-licensed vaccines under FDA oversight to personnel at risk of exposure to selected infectious diseases.</p> <p>FY 2022 Plans: Will fund civilian salaries and associated expenses (supplies, equipment, travel, etc.) at USAMRDC. Funding also provided regulatory, clinical monitoring and data support for the Special Immunization Program as necessary. This program will provide non-licensed vaccines under FDA oversight to personnel at risk of exposure to selected infectious diseases.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	0.662	0.782
Accomplishments/Planned Programs Subtotals		-	26.711	26.521
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	8.066	-	8.066	-	-	-	-	-	-
CG2: <i>Lethality Enabling University Adv Development</i>	-	-	-	6.981	-	6.981	-	-	-	-	-	-
CH5: <i>Terminal Effects Against Critical Targets Adv Tech</i>	-	-	-	1.085	-	1.085	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

B. Program Change Summary (\$ in Millions)	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	8.066	-	8.066
Total Adjustments	0.000	0.000	8.066	-	8.066
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	8.066	-	8.066

Change Summary Explanation

New Program Element in Fiscal Year (FY) 2022 established for enabling science and technology efforts that support advanced lethality research.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>				Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>CG2: Lethality Enabling University Adv Development</i>	-	-	-	6.981	-	6.981	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

This project is a FY22 new start. This project was created to demonstrate increased investment in our university partners.

A. Mission Description and Budget Item Justification

The Project leverages advanced developments and technological innovations from academia, of lethal directed energy, laser diagnostics and accelerated design of future hypersonics, deep learning and novel materials of importance to the Army, by maturing developments and performs demonstrations focused on getting technology to the warfighter more quickly. This Project exploits advanced research and development 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 maturation and demonstration of various advanced technologies originating from extramural applied research in academia pertaining to lethal directed energy, laser diagnostics, future hypersonic glide body design, deep learning, novel materials, and expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range applied to lethality. This effort validates advanced research and performs demonstrations leading to potential emerging technologies in areas of strategic importance to the Army in directed energy, future hypersonic glide body design, deep learning 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 PE 0620141A (Lethality Technology), PE 0602147A (Long Range Precision Fires), PE 0603464A (Long Range Precision Fires Advanced Technology), and PE 0603466A (Air and Missile Defense Advanced Technology)

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

	FY 2020	FY 2021	FY 2022
Title: Laser Diagnostics for Hypersonics and Directed Energy	-	-	2.208

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>	Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort matures laser diagnostics to assess turbulence and boundary layer transition, leading to validation of hypersonic flight models and enhanced directed energy system effectiveness and range through improved targeting, prediction and beam control.</p> <p>FY 2022 Plans: Will mature a suite of laser diagnostics for hypersonic ground testing and models to predict effects of atmospheric turbulence on laser propagation. Advanced development to inform the expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range for testing and evaluation of hypersonic and directed energy systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a new start.</p>			
<p>Title: Turbulence and Transition Modeling and Validation for Hypersonic Vehicles</p> <p>Description: This effort matures modeling turbulence and transition for hypersonic vehicles to accelerate design of future hypersonic glide bodies and systems through modeling and sub scale testing.</p> <p>FY 2022 Plans: Will accelerate and mature the design and advancement of hypersonic glide bodies and systems through turbulence and transition modeling. Reduce flight test risk through modeling and sub scale wind tunnel testing of effects of new design features. Advanced development to inform the expansion of the Ballistic, Aero-Optics and Materials (B.A.M.) range for testing and evaluation of aerothermodynamic performance at hypersonic speeds.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a new start.</p>	-	-	2.853
<p>Title: Novel Materials for Extreme Environments</p> <p>Description: This effort matures and validates computational and multiscale models of high strain rate materials to mitigate the effects of hypervelocity impacts (HVIs) and offer thermal protection.</p> <p>FY 2022 Plans: Will mature and validate critical high temperature materials and characterization testing and analysis capability for the design of thermal protection systems to defeat emerging threats from hypersonic weapons. Provide protection overmatch from high kinetic energy impacts through material layering and unique structures.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>	-	-	0.800

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>	Project (Number/Name) CG2 / <i>Lethality Enabling University Adv Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
This effort is a new start.			
Title: Intelligent Hypersonics and Other Missile Defense Systems Description: This effort matures and validates hypersonic vehicle flight systems with deep learning neural networks that can adapt to changing conditions and become more lethal. Integration of air and missile defense (AMD) C2 systems and their instrumentation, simulation, and stimulation. FY 2022 Plans: Will validate ablation characteristics and the semi-autonomous synthetic flight control systems performance utilizing machine learning and deep neural network tools for hypersonic vehicle geometries. Will integrate robust and extensible instrumentation, simulation, and stimulation prototype capability for prototype development, and operational testing of air and missile defense (AMD) C2 systems. FY 2021 to FY 2022 Increase/Decrease Statement: This effort is a new start.	-	-	1.120
Accomplishments/Planned Programs Subtotals	-	-	6.981

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technology</i>				Project (Number/Name) CH5 / <i>Terminal Effects Against Critical Targets Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CH5: <i>Terminal Effects Against Critical Targets Adv Tech</i>	-	-	-	1.085	-	1.085	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, this is a realignment from OSDPE 0603116A, Project AI3.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates engineering tools and high-fidelity modeling and simulation capabilities to predict and optimize weapon performance to ensure lethality against structures and critical assets. This project provides validated 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 0602141A (Lethality Technology) / Project CF8 (Terminal Effects Against Critical Targets Tech).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Terminal Effects Demonstration	-	-	1.085
Description: Demonstrates and provides a predictive capability for terminal effects and lethality and a fast running engineering tool to support long-range precision fires weaponeering on critical structural and geological targets of interest.			
FY 2022 Plans: Will provide engineering codes for blast effects against structures and critical targets and will demonstrate damage detection algorithms for Battle Damage Assessment (BDA) tools.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 reflects planned lifecycle of this effort, beginning in FY22.			
Accomplishments/Planned Programs Subtotals	-	-	1.085

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603116A / <i>Lethality Advanced Technol ogy</i>	Project (Number/Name) CH5 / <i>Terminal Effects Against Critical Targets Adv Tech</i>

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603117A / <i>Army Advanced Technology Development</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	66.424	62.663	76.815	-	76.815	-	-	-	-	-	-
BS2: <i>Army Advanced Technology Development</i>	-	66.424	62.663	76.815	-	76.815	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The Army Advanced Technology Development budget line includes development of subsystems and components and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

Efforts develop proof of technological feasibility and assessment of subsystem and component operability that may lead to full system development and prototyping.

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	66.338	62.663	63.334	-	63.334
Current President's Budget	66.424	62.663	76.815	-	76.815
Total Adjustments	0.086	0.000	13.481	-	13.481
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	0.086	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	13.481	-	13.481

Change Summary Explanation

Increase to support Army priorities.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)					R-1 Program Element (Number/Name) PE 0603118A / Soldier Lethality Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	131.119	151.370	107.966	-	107.966	-	-	-	-	-	-
AY5: Soldier Squad Small Arms Armaments Advanced Tech	-	7.671	9.797	11.447	-	11.447	-	-	-	-	-	-
AY7: Small Arms Fire Control Advanced Technology	-	12.350	13.465	13.094	-	13.094	-	-	-	-	-	-
AY9: Body Armor & Integrated Headborne Advanced Tech	-	14.200	9.648	7.717	-	7.717	-	-	-	-	-	-
AZ6: Soldier Signature Management Advanced Technology	-	1.640	1.685	2.969	-	2.969	-	-	-	-	-	-
AZ8: Soldier Squad Small Arms Armaments Adv Tech	-	2.085	-	-	-	-	-	-	-	-	-	-
BB3: Dismounted Soldier Survivability Equip/Tech Integ	-	1.406	1.277	3.026	-	3.026	-	-	-	-	-	-
BB6: Physical Augmentation: Adv Tech for Field Demo	-	3.836	2.899	-	-	-	-	-	-	-	-	-
BB8: Soldier Centric Advanced Technology	-	7.476	5.880	5.292	-	5.292	-	-	-	-	-	-
BC1: Human Performance AdvTech for Mobility & Lethality	-	4.633	11.380	14.003	-	14.003	-	-	-	-	-	-
BC4: Soldier Decision Making&Comms Performance AdvTech	-	1.918	1.925	-	-	-	-	-	-	-	-	-
BC8: Training Advanced Technology (Other than STE)	-	1.280	4.307	2.993	-	2.993	-	-	-	-	-	-
BC9: Adv Soldier Sensors/ Displays AdvTech for Dismounts	-	13.097	10.792	13.163	-	13.163	-	-	-	-	-	-
BD7: Soldier Sys Interfaces/ Integration-Sensor AdvTech	-	9.273	8.741	8.374	-	8.374	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army										Date: May 2021			
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>								
<i>BD9: Soldier & Sm Unit Tactical Energy AdvTech</i>	-	2.973	3.141	3.184	-	3.184	-	-	-	-	-	-	
<i>BE2: Joint Service Combat Feeding Advanced Technology</i>	-	1.709	2.367	2.424	-	2.424	-	-	-	-	-	-	
<i>BE5: Personnel & Airdrop Safety Advanced Technology</i>	-	6.491	6.076	6.879	-	6.879	-	-	-	-	-	-	
<i>BE9: STE Advanced Technology</i>	-	21.581	12.790	13.401	-	13.401	-	-	-	-	-	-	
<i>BS8: Soldier Lethality Advanced Technology</i>	-	17.500	45.200	-	-	-	-	-	-	-	-	-	

A. Mission Description and Budget Item Justification

This PE matures and demonstrates Soldier Lethality technologies that improve Soldier operational performance by increasing lethality, mobility, protection, and optimizing situational awareness across the spectrum of operating environments and missions. This PE matures Soldier weapons and enabling components / subsystems, demonstrates lethal weapons systems with potential to provide greater lethality, target acquisition, fire control, and range at a significantly reduced weight for optimized Soldier and Small Unit system performance. The major focus areas for Soldier Lethality Science and Technology are Soldier weapons and ammunition technologies, protection technologies, cognitive and physical performance measures, training in synthetic training environments, and mission support capabilities such as situational awareness sensors and displays, dismounted power and energy technologies, and Soldier and Small Unit sustainment capabilities. This technology diverse PE also matures and demonstrates sensor technologies that increase Warfighter situational understanding, survivability, and lethality by providing sensor capabilities to acquire and engage all targets and threats at longer ranges in complex environments and operational conditions (e.g. day/night, obscured, smoke, adverse weather, and other degraded visual environments), and for advancing live training technologies that accurately replicate and realistically represent the effects of current and future weapons systems during force-on-force and force-on-target training. This PE matures and demonstrates effective technology in personal combat clothing, protective equipment such as personal armor, helmets, and eyewear, combat rations, shelters, logistical support items for aerial delivery of personnel and cargo, and energy systems to power current and emerging Soldier-born ISR, sensor, optical, and communication systems with the least weight and sustainment burden on the Soldiers and Small Combat Units. This PE matures and demonstrates technologies supporting the Army's Synthetic Training Environment (STE), a single, interconnected synthetic training system that will enable Army units and leaders to conduct realistic multi-echelon / multi-domain combined arms maneuver and mission command training, increasing proficiency through repetition. A specific research thrust area is applying systems-based practices to mature and demonstrate scientific and tailored knowledge of Soldiers' physical and cognitive architecture to facilitate rapid and efficient designs, assessments and trade-off analyses of technology insertions on the Soldier. Significant S&T investments are directed to improve the effectiveness of the technologies a Soldier utilizes while reducing the size and weight of the form factor of the equipment.

Work in this PE complements PE 0602143A (Soldier Lethality Technology).

All FY21 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>
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Work in this Project is performed by the United States Army Futures Command.

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	135.968	109.608	112.771	-	112.771
Current President's Budget	131.119	151.370	107.966	-	107.966
Total Adjustments	-4.849	41.762	-4.805	-	-4.805
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	17.500	45.200			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-17.500	-			
• SBIR/STTR Transfer	-4.849	-3.438			
• Adjustments to Budget Years	-	-	-4.805	-	-4.805

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

Project: BS8: *Soldier Lethality Advanced Technology*

Congressional Add: *Subterranean Warfighter Advanced Technology*

Congressional Add: *Rapid Safe Advanced Materials*

Congressional Add: *Multi-Spectral Sensor Mitigation*

Congressional Add: *Helmet Pad Suspension Systems*

Congressional Add: *Program increase - advanced AI/AA analytics for modernization and readiness*

Congressional Add: *Program increase - small arms fire control advanced technology*

Congressional Add: *Program increase: Advanced technology for maneuver support and protection*

Congressional Add: *Program increase - military engineering technology for infield waste*

Congressional Add: *Program increase - flexible LED lighting for tents and shelters*

Congressional Add: *Program increase*

Congressional Add Subtotals for Project: BS8

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	1.500	-
	6.000	-
	5.000	-
	5.000	-
	-	10.000
	-	8.000
	-	10.000
	-	2.000
	-	5.200
	-	10.000
Congressional Add Subtotals for Project: BS8	17.500	45.200
Congressional Add Totals for all Projects	17.500	45.200

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	
Change Summary Explanation FY20 increase related to FY20 Congressional Adds.		

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) AY5 / <i>Soldier Squad Small Arms Armaments Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AY5: <i>Soldier Squad Small Arms Armaments Advanced Tech</i>	-	7.671	9.797	11.447	-	11.447	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates individual and crew-served weapon designs and technologies that enhance the fighting capabilities and survivability of the dismounted Warfighter in support of the Army's Soldier Lethality Modernization priority and all of the Services. All work is led by the Joint Service Small Arms Program (JSSAP) and is based upon the Joint Service Small Arms Master Plan (JSSAMP) and the Joint Capabilities Integration Development System's Small Arms Analyses.

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

This effort complements work done in PE 0602143A (Soldier Lethality Technology) / AY6 (Soldier Squad Small Arms Armaments Technology).

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

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

	FY 2020	FY 2021	FY 2022
Title: Small Arms Technology Demonstration	7.671	2.900	4.899
<p>Description: This effort matures and demonstrates the Next Generation Family of Ammunition by optimizing small arms ammunition and weapon system technologies for integration into live fire demonstrations. It refines weapon system integration and supports the Joint Warfighter's small arms capability needs as well as validates small arms weapon system technology readiness levels and confidence of design functionality in advanced operating scenarios.</p> <p>FY 2021 Plans: Demonstrate emerging small arms technologies in current and next generation weapon systems to address sustained suppressive and precise lethal fires for area target capability gaps for improved effectiveness at extended ranges; optimize and integrate technology components for the weapon system to achieve enhanced controllability, reduced recoil, and increased accuracy; mature weapon sensors for enhanced aiming.</p> <p>FY 2022 Plans: Will mature and demonstrate technological advancements of small arms systems in relevant environments; mature and demonstrate automated target recognition and engagement technologies, signature reduction devices, technologies and evaluations for legacy and Next Gen weapons, ammunition design optimizations for novel targets, augmented weapon system</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AY5 / <i>Soldier Squad Small Arms Armaments Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
controllability, and advanced optical systems with machine learning algorithms for technology insertions into emerging systems identified by the Joint Warfighters. FY 2021 to FY 2022 Increase/Decrease Statement: Increase provides for further maturation of prior 6.2 investments into TRL 6 technology demonstrations and transitions to the PMs focused on dismounted Soldier improvements in denied and austere environments in the areas of remote powered armament systems, increased probability of hit, Next Generation Soldier Weapon supporting technologies, signature reduction technologies, and small arms lethality increases.				
Title: Next Generation Family of Ammo Description: This effort matures and demonstrates the next generation of small arms live training ammunition by optimizing it through integration into new weapon systems that will provide an increased level of lethality. FY 2021 Plans: Mature and demonstrate integrated technologies for the combat tracer and reduced range tracer concept projectiles of the NGFoA to validate tracer concept designs for aligning the tracer ammunition effort with conventional ammunition and the Next Generation Soldier Weapon (NGSW). FY 2022 Plans: Will improve performance of initial base technologies of the combat tracer and reduced range tracer concepts to validate and demonstrate capability as fully functional projectiles. Ammunition effort aligned with the Next Generation Squad Weapon (NGSW). FY 2021 to FY 2022 Increase/Decrease Statement: Decrease follows the lifecycle glide path with reduced workload expected with FY22 as final year of execution.		-	6.897	6.548
Accomplishments/Planned Programs Subtotals		7.671	9.797	11.447
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) AY7 / <i>Small Arms Fire Control Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AY7: Small Arms Fire Control Advanced Technology</i>	-	12.350	13.465	13.094	-	13.094	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates fire control and targeting sensor technologies and techniques to improve targeting and lethality in order to maintain overmatch at longer ranges in all operational environments and to meet the capability needs of Army Science and Technology Soldier Lethality, Next Generation Combat Vehicle, and Long Range Precision Fires modernization priorities.

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

This effort complements work done in PE 0602143A (Soldier Lethality Technology) / AY8 (Small Arms Fire Control Technology).

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

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

	FY 2020	FY 2021	FY 2022
Title: Small Arms Fire Control Advanced Technology	12.350	13.465	11.738
<p>Description: This effort will mature and demonstrate fire control and targeting sensor technologies and techniques to improve targeting and lethality, and maintain overmatch at longer ranges in all environments. This effort is coordinated with PE 0602143A (Soldier Lethality Technology), PE 0602145A (Next Generation Combat Vehicle Technology), 0603462A (Next Generation Combat Vehicle Advanced Technology), and PE 0603463A (Network C3I Advanced Technology).</p> <p>FY 2021 Plans: Mature and optimize sensor designs to create a next generation, digital weapon sight fire control system; demonstrate a modular, multispectral, digital weapon sensor demonstrator to enhance Soldier targeting and lethality; mature individual weapon sight fire control system prototype based on user feedback to provide a far target location capability; validate illuminator and designator laser sources, and multifunction sensor system for fire support and dismounted Scout operations; optimize image processing approaches for initial demonstration.</p> <p>FY 2022 Plans: Will complete maturation of digital weapon sight fire control system prototypes; demonstrate final digital weapon sight configuration; execute technology demonstrations in relevant environments to support system optimization of target handoff and target cueing capabilities; optimize capability to enable seamless integration with Enhanced Night Vision Goggle-Binocular</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AY7 / <i>Small Arms Fire Control Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
(ENVG-B), Integrated Visual Augmentation System (IVAS), and Next Generation Squad Weapon (NGSW); complete prototype integration for fire support and dismounted scout operations; demonstrate multifunction precision targeting capabilities in military relevant environments. FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in this task reflects the separation of Advanced Fire Control Technology into a unique task for FY 2022 and beyond. Demonstrations of hardware for task complete in final year.				
Title: Advanced Fire Control Tech Description: This effort will mature and demonstrate fire control and targeting sensor technologies and techniques to improve targeting and lethality, and maintain overmatch at longer ranges in all environments. This effort is coordinated with PE 0602143A (Soldier Lethality Technology), PE 0602145A (Next Generation Combat Vehicle Technology), 0603462A (Next Generation Combat Vehicle Advanced Technology), and PE 0603463A (Network C3I Advanced Technology). FY 2022 Plans: Will mature and demonstrate technologies of integrated circuit boards to improve performance and reliability under pyro-shock and reduced power consumption FY 2021 to FY 2022 Increase/Decrease Statement: This task was part of the Soldier Squad Small Arms Armaments Advanced Technology Project Task in FY 2021, and has been separated in FY 2022 and beyond for greater emphasis. Increase in FY 2022 is due to ramp up of task execution from requirements generation to tech maturation and demonstrations.		-	-	1.356
Accomplishments/Planned Programs Subtotals		12.350	13.465	13.094
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) AY9 / <i>Body Armor & Integrated Headborne Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AY9: Body Armor & Integrated Headborne Advanced Tech</i>	-	14.200	9.648	7.717	-	7.717	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates body armor weight reductions and improves the performance of personal protection and survivability equipment. It also demonstrates combat helmet ballistic, blast, and small arms protection performance enhancements and the integration and optimization of power, energy, and digital sensor and display headborne technologies.

This effort supports Force Protection capability demonstrations for Soldiers and Small Units and demonstrated technologies from this effort transition to various Program Executive Office (PEO) Soldier programs. This effort complements work done in PE 0602143A (Soldier Lethality Technology) / AZ2 (Body Armor & Integrated Headborne 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 2020	FY 2021	FY 2022
Title: Body Armor & Integrated Headborne Advanced Technology	14.200	9.648	7.717
Description: This effort focuses on maturing, integrating and demonstrating personal protective capabilities against ballistic, blast, and directed energy threats as well as the development and demonstration of Soldier worn platform architectures to optimize the integration of personal protective equipment and Soldier lethality enabling technologies. Demonstrates advanced test methods to validate personal protective equipment performance enhancements against current and emerging small arms, fragmentation, and blast threats from anti-personnel munitions. The objective of these technology development efforts is to significantly increase Soldier lethality by enhancing the protective capabilities and reducing sub-system and system-level weight of individual protective equipment to reduce the Soldier burden and increase survivability.			
FY 2021 Plans: Mature body armor systems for protection against emerging small arms threats; optimize system level testing of body armor against small arms threats with the objective of capturing high rate force profiles to better understand injury mechanics of blunt trauma to inform future requirements that link to injury criteria; improve the helmet system design by applying human systems			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AY9 / <i>Body Armor & Integrated Headborne Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>integration practices to the incorporation of multiple protective and situational awareness technologies required for the Integrated Headborne System to improve helmet ergonomics, stability, and headborne load distribution.</p> <p>FY 2022 Plans: Will exploit state of the art high performance ballistic materials for body armor against small arms threats to provide trade space analysis regarding art of the possible to Army stakeholders and inform future requirements for torso protection against small arms threats; Exploit novel and emerging processing techniques and latest developmental materials for combat helmets to assess state of the art helmet performance against small arms threats and inform future protection requirements for Army combat helmets; Design power and data interface architectures for combat helmets to develop common interface design standards for Soldier headborne technology; Develop communication headset subsystems with new wireless down links to the individual radio and integrate preliminary enhanced audio capabilities to provide hearing protection and situational awareness cues.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Decrease in funding reflects planned lifecycle of this effort. FY 2022 funding levels decrease to focus development toward a new capability for emerging small arms threat defeat and anti-personnel munitions protection.</p>			
Accomplishments/Planned Programs Subtotals	14.200	9.648	7.717

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) AZ6 / <i>Soldier Signature Management Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AZ6: Soldier Signature Management Advanced Technology</i>	-	1.640	1.685	2.969	-	2.969	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project optimizes, matures and demonstrates advances in novel materials, technologies, techniques and applications increasing the capabilities of camouflage and concealment against known and emerging sensor threats, providing effective deception capabilities, as well as combinations of physical and electronic signature decoy components and maturing analytical processes for modeling performance of signature management technologies during multi-domain operations. These technologies will produce proof of concept systems that 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 high-valued assets. Demonstrations conducted under this Project will support Science and Technology efforts in Soldier Lethality protection/survivability Projects will provide disruptive Camouflage, Concealment and Deception technologies to the Operational Army, supporting expeditionary maneuver in the Multi-Domain Battle Environment to open and retain windows of advantage.

Work in this Project supports key Army needs and leverages/complements the technical research of several PEs and Projects to include PE 0602143 (Soldier Lethality Technology) / BB4 (Dismounted Soldier Survivability Materials), AZ5 (Soldier Protection Technology - Vulnerability), BE1 (Support Technology to Mission Command), AZ9 (Soldier - Small Unit Detectability Technology); PE 0601102A (Defense Science Research); and PE 0602145A (Next Generation Combat Vehicle Technology) BI2 (Sensor Protection 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 2020	FY 2021	FY 2022
Title: Soldier Camouflage, Concealment and Decoys Demonstration	1.640	1.685	2.969
Description: This effort demonstrates innovative camouflage, concealment, and deception technologies for the dismounted Soldier to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats and to reduce the probability of detection and identification across the electromagnetic spectrum. Matures physics-based models for material and system performance that support probability of detection metrics in the multi-domain operational environment, assisting to close the capability gap between current camouflage, concealment, and deception technologies and defeating enemy sensorial capabilities in future operating environments.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AZ6 / <i>Soldier Signature Management Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p><i>FY 2021 Plans:</i> Demonstrates textile coatings and garment designs for Soldier clothing and individual equipment to reduce the probability of Soldier detection from battlefield thermal sensors while integrating other key garment performance requirements; optimizes the balance between detection, protection, comfort and durability of clothing systems; matures and demonstrates topical applications to conceal exposed skin (i.e. face, hands) from thermal sensors; validate the visual, infrared, and radar signatures of Soldiers wearing current clothing and individual equipment.</p> <p><i>FY 2022 Plans:</i> Will optimize down- selected textile coatings and functional garment designs for Soldier clothing and individual equipment to inconspicuously transfer Soldier thermal emissions away from the Soldier's body to reduce the probability of Soldier detection from battlefield thermal sensors while integrating other key garment performance requirements; continue to mature and demonstrate additional topical applications using engineered optical materials within binder agents to conceal exposed skin (i.e., face, hands) from thermal sensors; collect imagery data of Soldiers and squad formations against ground and aerial sensor threats in multiple bands of the electromagnetic spectrum to assess highest impact improvement opportunities; apply newly developed aided target detection techniques against Soldier camouflage and concealment capabilities to assess Soldier detectability capability gaps against emerging threat sensors and sensor platform.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding realigned from PE 0602143A (Soldier Lethality Technology) / AZ9 (Soldier Protection Advanced Tech ? Detectability) to support planned field demonstrations of several signature management capabilities and the associated test costs to cover data acquisition teams, sensor deployment and test site utilization. Planned technologies include combat uniforms with technology intended to camouflage Soldier thermal signatures as well as face paints to conceal the thermal signature of Soldiers exposed skin to include hands and face requiring test events in multiple geographic locations and environments.</p>			
Accomplishments/Planned Programs Subtotals	1.640	1.685	2.969

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

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AZ8 / <i>Soldier Squad Small Arms Armaments Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AZ8: Soldier Squad Small Arms Armaments Adv Tech</i>	-	2.085	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 this Project is realigned to:
 PE 0603463A (Network C3I Advanced Technology)
 * Project AQ1 (Spectrum Obfuscation Advanced Technology)

A. Mission Description and Budget Item Justification

This Project optimizes, matures and demonstrates novel materials, technologies, techniques and applications that increase camouflage and concealment capabilities for high-value assets against known and emerging sensor threats, provides effective deception capabilities, matures analytical processes for modeling performance of signature management technologies during multi-domain operations as well as develops combinations of physical and electronic signature decoy components. These technologies will produce proof of concept system demonstrators that 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 high-valued assets. Demonstrations conducted under this project will support S&T efforts in Soldier Lethality protection/survivability projects providing disruptive Camouflage, Concealment and Deception technologies to the Operational Army, supporting expeditionary maneuver in the Multi-Domain Battle Environment to open and retain windows of advantage.

Work in this Project supports key Army needs and leverages/complements the technical research of several PEs and Projects to include 0601102A (Defense Science Research), PE 0602143A (Soldier Lethality Technology) / BB4 (Dismounted Soldier Survivability Materials), AZ5 (Soldier Protection Technology - Vulnerability), BE1 (Support Technology to Mission Command), AZ9 (Soldier-Small Unit Detectability Technology), and PE 0602145A (Next Generation Combat Vehicle Technology) / BI2 (Sensor Protection 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 2020	FY 2021	FY 2022
Title: High-Value Asset Camouflage, Concealment and Decoys Demonstration	2.085	-	-
Description: This effort demonstrates innovative camouflage, concealment and deception technologies for high-value assets to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats, including multispectral, hyperspectral and Light Detection and Ranging (LiDAR) sensors, and to reduce the probability of detection			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) AZ8 / <i>Soldier Squad Small Arms Armaments Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
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.			
Accomplishments/Planned Programs Subtotals	2.085	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BB3 / <i>Dismounted Soldier Survivability Equip/Tech Integ</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BB3: <i>Dismounted Soldier Survivability Equip/Tech Integ</i>	-	1.406	1.277	3.026	-	3.026	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates the integration of Soldier survivability materials and technologies to increase the speed and efficiency of dismounted Soldier movement and maneuver. This Project focuses on reducing Soldier worn equipment weight, improving Soldier and system integration and reducing the dismounted Soldier's detectability, susceptibility, and vulnerability to operational threats. Operational threats are characterized as combat threats (e.g. flame and thermal, blast and ballistic, multispectral sensors, and laser threats), environmental threats (e.g. cold, heat, wet, vector, water contamination, concealment, etc.), and Soldier system components and system limitations (e.g. size, weight, and bulk). This Project includes the demonstration and validation of integrated technologies, novel subsystems/systems, and test methods.

This Project complements work done in PE 0602143A (Soldier Lethality Technology) / Project BB4 (Dismounted Soldier Survivability 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 is performed by the United States Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Dismounted Soldier Survivability Equipment and Technology Integration	1.406	1.277	3.026
Description: This effort matures and integrates multifunctional protective materials, sub-components, and systems for field demonstrations to significantly increase the survivability of the Soldier through their multi-functional clothing and individual protective equipment. This effort also demonstrates and validates tradeoff analyses in sub-component and system-level designs of ballistic, blast, signature management and integrated protection clothing and equipment technologies.			
FY 2021 Plans: Matures cold weather clothing technologies to provide weight reduction while improving protection to increase maneuverability of the Soldier in extreme climates; optimizes advanced textile printing processes for system integration of multiple functionalities (e.g. signature management, flame resistance, etc.) that will result in cost savings compared to current methods while creating durable clothing systems for Soldiers; integrates and demonstrates a water filtration capability designed to remove toxic chemical			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BB3 / <i>Dismounted Soldier Survivability Equip/Tech Integ</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>threats from indigenous water sources, reducing the need for water carriage and ensuring hydration levels are maintained when in a contested re-supply operational environment.</p> <p>FY 2022 Plans: Will mature and optimize the systems engineering architecture, framework and physical demonstrator units that demonstrate integrated body-worn Soldier survivability technologies for Soldier user assessments in support of the Combat Protective Ensemble (CAPE) program; validate combat ensemble components that address gaps in extremities protection, thermal management, and moisture control through optimizing operational clothing and individual equipment for (1) temperate to extreme cold climates and (2) temperate to extreme heat and high humidity environments; exploit recent advancements in power and data transfer mechanisms to mature multiple candidate modular load management systems integrating body-worn power and data distribution to optimize the Soldier system integration of body-worn individual equipment with particular focus on system level weight reduction and enhanced ergonomics to greatly improve Soldier ability to shoot, move and communicate; validate and demonstrate maturing candidate camouflage and concealment materials from PE 0602143A (Soldier Lethality Technology) with a focus on visible through infrared bands of the electromagnetic spectrum; validate and demonstrate maturing high performance materials for integrated and modular ballistic and blast protection from PE 0602143A (Soldier Lethality Technology) against anti-personnel munitions and small arms threats.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase reflects the required ramp up from concept generation to physical development and engineering cost requirements to launch component design iterations and physically validate the maturity and feasibility of follow-on integration and interface requirements of multiple technologies for the combat ensemble.</p>			
Accomplishments/Planned Programs Subtotals	1.406	1.277	3.026

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BB6 / <i>Physical Augmentation: Adv Tech for Field Demo</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BB6: <i>Physical Augmentation: Adv Tech for Field Demo</i>	-	3.836	2.899	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates human augmentation technologies for enhanced Soldier mobility & lethality to provide an advantage over adversaries during close combat and infantry tasks. This will be achieved by demonstrating and validating operationally ready physical augmentation systems that meet the mission requirements by optimizing movement & maneuver and logistics sustainment task performance.

Work in this Project leverages research of several PEs and Projects including PE 0602143A (Soldier Lethality Technology) / Project BC2 (Next Gen Mobility & Lethality Tech for Warfighters), Project BB9 (Human Performance Technology for Mobility & Lethality), Project BB5 (Physical Augmentation: Tech for Human Interactions), and PE 0603118A (Soldier Lethality Advanced Technology) / Project BC1 (Human Performance AdvTech for Mobility & Lethality), and Project BB8 (Soldier Centric Advanced Technology). Additionally, work in this Project complements and is coordinated with Medical Research and Development Command and the Veteran Administration's exoskeleton research area. This Project is also coordinated with work performed across the DoD under the Reliance 21 Human Systems Community of Interest: Protection, Sustainment, and Warfighter Performance.

Results of these efforts may transition to the Program Executive Office (PEO) Soldier, Army Training and Doctrine Command (TRADOC), Human Systems Integration (HSI) Directorate (Army G1), and 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 2020	FY 2021	FY 2022
Title: Wearable Assistive Devices Advanced Technology for Feld Demo	3.836	2.899	-
Description: This effort demonstrates wearable physical augmentation devices to validate Soldier metrics such as endurance, survivability, speed, and strength, as well as system metrics such as power consumption and duration, actuator and controller performance, and integration with Soldier clothing and individual equipment (CIE). Results will demonstrate if the Army will benefit from leveraging industry investments and determine if these systems enhance Soldier mobility and lethality in operational environments.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BB6 / <i>Physical Augmentation: Adv Tech for Field Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Demonstrate and validate labor-intensive Field Artillery/ADA-focused augmentation/assist devices to optimize human performance; validate technical, physiological, and field demo data of assist devices and exoskeletons with objective measures of human performance, injury prevention/reduction, and identification of potential negative impacts of applying physical assist devices to Soldiers in military environments.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding decreased to support PE 0602143A (Soldier Lethality Technology) / AY8 (Advanced Fire Control Tech) to address fire control acceleration.</p>				
Accomplishments/Planned Programs Subtotals		3.836	2.899	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BB8 / <i>Soldier Centric Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BB8: <i>Soldier Centric Advanced Technology</i>	-	7.476	5.880	5.292	-	5.292	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates optimized Warfighting function (e.g. shoot, move, perceive, decide, and communicate) with Soldier centric technologies, systems and/or subsystems designed to augment Soldier ability during missions. This Project capitalizes on operational partnerships by providing Science and Engineering subject matter experts (SMEs) the ability to assist Commanders in course of action development for potential near term solutions and condition setting for mid/far term science objectives. Provides Soldier assessments to optimize, improve performance, validate and integrate technologies and methodologies with users. Research focuses on the Warfighter as the capability and will rapidly iterate user driven solutions that maximize their tactical performance. This Project also matures and demonstrates Soldier centric technologies for the Soldier/Squad Virtual Trainer (S/SVT) to support 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 with, 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. The S/SVT system combines and integrates several individual Soldier and Squad training capabilities, STE Squad Capability (SSC), Weapon Skill Development (WSD), Joint Fires Training (JFT), and Use of Force (UoF), into a single capability that can be conducted simultaneously or individually and enable physical movement/exertion related to the execution of Soldier/Marine individual and Squad collective training tasks. The STE will provide the realistic repetitions necessary to fight 25 bloodless battles before the first battle; a Secretary of Defense priority.

This Project is fully coordinated with work done in PE 0602143A (Soldier Lethality Technology) and PE 0603118A (Soldier Lethality Advanced Technology) as well as work conducted by Medical Research & Development Command (MRDC), Army Research Institute (ARI), U.S. Military Academy (USMA), and other academic and industry partners. This work is in partnership with Forces Command (FORSCOM) operational units and the appropriate Training and Doctrine Command (TRADOC) organizations as well as established transition partners, including Army Test and Evaluation Command (ATEC) & Program Executive Offices.

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 2020	FY 2021	FY 2022
Title: Operational Unit Partnership and Soldier Touch Point	7.476	-	-
Description: This effort optimizes innovation through Science and Technology touch points with the Operational force, resulting in rapid iteration, concept maturation, integration, validation of laboratory findings, and transition of technologies and methodologies in response to operational unit demand signal. This effort streamlines demonstration, data collection, and technology maturation			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BB8 / <i>Soldier Centric Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
for near term Doctrine, Organization, Training and Education, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) solutions, enabling faster delivery of materiel and non-materiel products/knowledge refined with direct Soldier input. This body of work allows validated, empirical, assessment of any equipment capability or training intervention as part of the Soldier architecture to inform future acquisition investments, training, and operational trade space decisions.			
<p>Title: STE Soldier/Squad Virtual Trainer</p> <p>Description: This effort matures and demonstrates a common battle drill squad-level mixed reality based system that allows for the rapid conduct and repetition of squad-level training. The training system will make it possible to conduct diverse, repeatable and effective training without extensive training infrastructure. This effort matures and demonstrates novel and realistic training environments that provide increased levels of proficiency and readiness through immersive training scenarios conducted at the point of need.</p> <p>FY 2021 Plans: Improve the performance of individual Soldier position and orientation tracking and mitigation of day and night lighting effects on augmented reality devices; and demonstrate multi-modal, Soldier interfaces (e.g. haptic suits, 3D sound, acoustics, etc.) into virtual environments.</p> <p>FY 2022 Plans: Will mature device agnostic camera and tracking technologies required for dynamic occlusion to successfully perform in all potential training environments; validate technologies that enhance immersion (haptic suits, 3D sound, etc.) for Soldier training in mixed reality environments; improve performance of weapon tracking algorithms by utilizing better processing technologies and deep learning algorithms using markerless tracking.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease supports shift to long-term objectives of merging live and synthetic training.</p>	-	5.880	5.292
Accomplishments/Planned Programs Subtotals	7.476	5.880	5.292

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BC1 / <i>Human Performance AdvTech for Mobility & Lethality</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BC1: <i>Human Performance AdvTech for Mobility & Lethality</i>	-	4.633	11.380	14.003	-	14.003	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures technologies, methodologies, and human performance models to demonstrate increased mobility & lethality of the individual and small unit to achieve overmatch. It validates and integrates human performance assessment methods and algorithms into training/education, test and evaluation methodologies, and materiel solutions to compare performance impacts between different materiel and non-materiel solutions to maximize the individual Warfighter and small unit. These methods and algorithms have potential to enable the development of aspects of doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) improvements and efficiencies. This Project also uses Soldier assessments to iteratively improve the performance, optimize, and integrate technologies to augment Soldier function (e.g. shoot, move, perceive, decide, and communicate) during missions for maximizing performance. This Project supports the Measuring and Advancing Soldier Tactical Readiness and Effectiveness (MASTR-E) Science and Technology program supported by the Office of the Secretary of Defense Close Combat Lethality Task Force.

This Project is fully coordinated and complementary with the other PE/Projects in support of MASTR-E to include the following: PE 0602143A (Soldier Lethality Technology) / Projects BC6 (Human Perf-Tech for Warfighter Enhancement), BC2 (Next Gen Mobility & Lethality Tech for Warfighters), and BB9 (Human Performance Tech for Mobility & Lethality). This work is also supported by and fully coordinated with efforts conducted by Medical Research & Development Command (MRDC), Army Research Institute (ARI), U.S. Military Academy (USMA), and other academic and industry partners. This work is in partnership with Forces Command (FORSCOM) operational units and the appropriate Training and Doctrine Command (TRADOC) organizations as well as established transition partners, including Army Test and Evaluation Command (ATEC) & Program Executive Office- Soldier (PEO-S). 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: Systems Interfaces & Cognitive Processes and Protection, Sustainment, and Warfighter Performance.

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Soldier/Squad Performance Metrics for Lethality	4.633	4.325	4.658
Description: This effort validates and matures technologies, methodologies, and human performance models to demonstrate increased Soldier and Small Unit mobility & lethality to achieve overmatch. The effort validates and integrates human performance			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC1 / <i>Human Performance AdvTech for Mobility & Lethality</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>sensors, models, and design guidance into training/education, test and evaluation, and materiel. The results of this work will allow the Army to develop equipment, systems and training devices that maximize the close combat Soldier and small unit performance in multi-domain operations.</p> <p>FY 2021 Plans: Mature technologies, methodologies, and human performance models for demonstrating increased mobility and lethality of the individual and small unit to achieve overmatch; optimize and integrate human performance assessment methods and algorithms into training techniques, test and evaluation methodologies, and materiel solution options to provide analyses and performance impacts between materiel and non-materiel solutions to maximize performance of the individual Warfighter and small unit; demonstrate methods and algorithms that have the potential to improve system design and efficiencies.</p> <p>FY 2022 Plans: Will demonstrate an instrumented test bed (squad Situational Training Exercise lane and Shoot House) for the evaluation of Soldier and small unit mobility and lethality; utilizing the test bed, demonstrate the linkages between individual technical performance measures, measures of performance, and squad measures of effectiveness under controlled conditions to optimize repeatability and reliability; train and validate predictive performance algorithms in relevant environments; demonstrate down-selected machine learning performance algorithms developed in PE 0602143A (Soldier Lethality Technology) in multidimensional human performance datasets (such as the 72-hr mission field study).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Operational Unit Partnership and Soldier Touch Point</p> <p>Description: This effort optimizes innovation through Science and Technology touch points with the Operational force, resulting in rapid iteration, concept maturation, integration, validation of laboratory findings, and transition of technologies and methodologies in response to operational unit demand signal. This effort streamlines demonstration, data collection, and technology maturation for near term DOTMLPF solutions, enabling faster delivery of materiel and non-materiel products/knowledge refined with direct Soldier input. This body of work allows validated, empirical, assessment of any equipment capability or training intervention as part of the Soldier architecture to inform future acquisition investments, training, and operational trade space decisions.</p> <p>FY 2021 Plans: Down-select relevant Soldier and squad predictors of tactical performance (e.g. shoot, move, decide); continue to conduct and analyze large scale field studies and data sets from units performing mission essential tasks in realistic, constructive tactical environments; employ a cross-assessment of variables such as equipment use and configuration, situational awareness tools,</p>		-	7.055	9.345

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC1 / <i>Human Performance AdvTech for Mobility & Lethality</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>sleep levels, nutritional intake, human augmentation assists, etc. to inform training and materiel solutions designed to maximize tactical performance to overcome Soldier limitations and achieve overmatch.</p> <p>FY 2022 Plans: Will conduct small and large scale field studies to fully mature dataset to train and validate human performance algorithms and analyze findings and data sets from expert and novice units performing mission essential tasks in realistic, constructive tactical environments; provide and advance a front end solution to access and visualize database elements; demonstrate human performance data visualization tools to increase situational awareness and improve decision making.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned from PE 0603118A (Soldier Lethality Advanced Technology) / BB8 (Soldier Centric Advanced Technology). Funding increase in FY22 will enable additional experimentation in relevant environments, validating algorithms generated in the lab in relevant environments.</p>				
Accomplishments/Planned Programs Subtotals		4.633	11.380	14.003
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC4 / <i>Soldier Decision Making&Comms Performance AdvTech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BC4: <i>Soldier Decision Making&Comms Performance AdvTech</i>	-	1.918	1.925	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

Fiscal Year 2022 Administratively moving to the Future Vertical Lift (FVL) portfolio:
 PE 0603465A (Future Vertical Lift Advanced Technology)
 * Project AL9 (Holistic Sit Awareness and Dec Making Adv Tech)

A. Mission Description and Budget Item Justification

This Project integrates research, theory and applied operations to maximize effectiveness of Soldiers and their equipment. Efforts in this Project support early application of Human Systems Integration (HSI) during Advanced Technology Development by translating research findings into performance-based prototype subsystem, component, and software interface design criteria for use in the Army's requirements definition process and materiel acquisition process for Army Modernization. Application of this work will yield reduced workload, fewer errors, reduced task times, enhanced Soldier protection, user acceptance, and allow the Soldier to extract maximum performance from the equipment. Representative major efforts address Soldier cognitive load and cognitive fusion research, advanced aircraft design to include flight in degraded visual environments, and development of human performance measures and methods to address current and future human system integration challenges. Individual efforts exploit adaptive learning methods and strategies, applied methods to accelerate expertise development, integration of displays for ease of use and optimized situational awareness, and development of technical frameworks for crew automation integration in Command and Control Systems (C2). Efforts also support flight crew decision-aiding and autonomy, advanced crew station design for aircraft, full mission operations in degraded visual environments, and advanced manned-unmanned teaming concepts.

Results of these efforts are transitioned to the Program Executive Offices (PEO), Army Training and Doctrine Command (TRADOC), Human Systems Integration (HSI) Directorate (Army G1), and the Army Test and Evaluation Command (ATEC). This Project complements work done in PE 0602143A (Soldier Lethality Technology) / Project BC3 (Soldier Decision Making & Communications Performance 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 2020	FY 2021	FY 2022
Title: Human System Integration Demonstration	1.918	1.925	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC4 / <i>Soldier Decision Making&Comms Performance AdvTech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort provides early front end analysis and assessment for HSI in Army systems acquisition to influence Advanced Technology Development and prototype design specifications. Research findings translate into performance-based design specifications and human performance analyses for use in the Army's requirements definition process, training development, and materiel acquisition process. Results of these efforts provide quantified, data-driven analysis on the value of applying HSI early in Army technology development and systems acquisition and are transitioned to technology developers, evaluators, and other Advanced Technology Development stakeholders to include the Future Vertical Lift and Air Missile Defense Program Offices, TRADOC, and the ATEC.</p> <p>FY 2021 Plans: Demonstrate effects of augmented pilot displays on Soldier performance and system effectiveness by conducting human performance and human-system interface analyses on Pilot Degraded Visual Environment Cueing simulations and data collected during Advanced Technology Development flight trials; provide early (Advanced Technology Demonstration) assessment of HSI considerations for advanced crew station technology design and autonomy/crew task automation, thereby reducing life-cycle costs; optimize HSI designs of highest priority Army technologies and systems including advanced crew station technology design and autonomy/crew task automation for enhanced Soldier performance and system effectiveness.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, this effort is administratively realigned to the Future Vertical Lift (FVL) portfolio into Program Element 0603465A Project AL9; no change in scope of work.</p>			
Accomplishments/Planned Programs Subtotals	1.918	1.925	-

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

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BC8 / <i>Training Advanced Technology (Other than STE)</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BC8: <i>Training Advanced Technology (Other than STE)</i>	-	1.280	4.307	2.993	-	2.993	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced live training technologies in support of the Army's need for live simulations that accurately replicate and realistically represent the effects of current and future weapons systems during force-on-force and force-on-target training. Integration of the Live/Mixed reality into a single synthetic training environment will modernize the current Live Training Environment and allow fair fight engagements across all training environments and training devices.

This effort complements work done in 0602143A (Soldier Lethality Technology) / Project BC7 (Training Technology (Other than Synthetic Training Environment (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).

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

	FY 2020	FY 2021	FY 2022
Title: Live Training Technology Applications	1.280	-	-
Description: This effort investigates technology to enhance the fidelity of live training systems and develops future live training capabilities for conducting force-on-force, combined arms exercises to enhance readiness at Army home stations and Combat Training Centers.			
Title: STE: Live Training Applications	-	4.307	2.993
Description: This effort exploits technology to demonstrate enhanced fidelity of live training systems and develops future live training capabilities for conducting force-on-force, combined arms exercises to enhance readiness at Army home stations and Combat Training Centers.			
FY 2021 Plans: Demonstrate software applications and procedures to measure and calibrate eBullet telemetry data; mature prototype devices to demonstrate the geo-pairing capabilities of the eBullet; and optimize the accuracy of the Weapon Orientation Module device to improve measurements of weapon azimuth, elevation, and cant at low power and cost.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC8 / <i>Training Advanced Technology (Other than STE)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature and demonstrate software algorithms that calculate weapon orientation or position for direct or indirect fire weapons based on a number of different sensor inputs (e.g. inertial, computer vision, LIDAR); improve the size, weight, and power consumption of the Weapon Orientation Module; demonstrate a matured position tracking capability suitable for crew served indirect fire weapons. FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects minor changes to scope of the effort.			
Accomplishments/Planned Programs Subtotals	1.280	4.307	2.993

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BC9 / <i>Adv Soldier Sensors/Displays AdvTech for Dismounts</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BC9: <i>Adv Soldier Sensors/Displays AdvTech for Dismounts</i>	-	13.097	10.792	13.163	-	13.163	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, optimizes, and demonstrates fully digital sensor systems, architectures, and interfacing capabilities to fuse sensors, and network situational understanding information and targeting capabilities to enable maintained mounted and dismounted visual advantage, increased situational awareness, decreased fratricide, and decreased response times to all threats in all environments. Work in this Project supports the Army Science and Technology Soldier Lethality, Next Generation Combat Vehicle, and Future Vertical Lift Army Modernization priorities.

This effort complements work done in PE 0602143A (Soldier Lethality Technology) / BD1 (Advanced Soldier Sensors/Displays Tech 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 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 2020	FY 2021	FY 2022
Title: Advanced Soldier Sensors/Displays Advanced Technology for Dismounts	13.097	10.792	13.163
Description: This effort will mature and demonstrate low cost Soldier-borne situational understanding systems with greater fidelity for improved maneuver and lethality, as well as integrates automated target cueing to increase probability of recognition/identification and tracking of threats in all environments.			
FY 2021 Plans: Optimize augmented reality (AR) capabilities for mounted and dismounted Soldiers; mature AR enabled common operating picture (COP) technologies to provide shared situational understanding between mounted and dismounted Soldiers; exploit existing aided target recognition (AiTR) algorithms to reduce Soldier target acquisition timelines; mature multi-source data fusion and autonomous threat detection capabilities; mature approaches for overlays and displays of 3D point cloud information; finalize requirement allocations for user platforms to achieve AR capability and provide suggested architecture for platforms to support.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BC9 / <i>Adv Soldier Sensors/Displays AdvTech for Dismounts</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will improve performance of augmented reality (AR) systems for mounted/mechanized infantry interactions by providing heading corrections and providing self-location to infantry within a combat vehicle; mature sensor systems and integrate with command and control systems for information sharing capabilities between dismounted and mounted Soldiers on a tactical vehicle platform; mature novel sensor payloads with enhanced processing to improve detection, localization and notification capabilities required for improved situational awareness against all threats; optimize performance of sensors to enable effective range of threats, and framerates required for dismounted hostile fire detection; mature opto-acoustic techniques to enable dismounted multi-modal hostile fire detection.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Increase represents resources to continue maturation of novel sensors needed for dismounted detection of all threats in all environments to include urban areas.</p>				
Accomplishments/Planned Programs Subtotals		13.097	10.792	13.163
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BD7 / <i>Soldier Sys Interfaces/Integration-Sensor AdvTech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BD7: <i>Soldier Sys Interfaces/Integration-Sensor AdvTech</i>	-	9.273	8.741	8.374	-	8.374	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project will integrate technologies for sensing, processing, displaying information, interfacing with users, and cognitive improvement to enhance Soldier & Small Unit situational awareness & understanding. This effort will integrate battlefield and body worn sensors and data fusion algorithms to provide the dismounted Small Unit leader with clear, actionable information for making well informed, rapid, tactical decisions. This effort will mature and integrate advanced dismounted Soldier robotic and autonomous systems technologies to demonstrate autonomous navigation, manned-unmanned teaming, and networked reconnaissance to improve Soldier lethality, situational awareness, and survivability during tactical operations.

Work in this Project complements several PEs and Projects to include PE 0602143A (Soldier Lethality Technology) / BD6 (Soldier Sys Interfaces/Integration - Sensor Technology), BB9 (Human Performance Tech for Mobility & Lethality), and PE 0603118A (Soldier Lethality Advanced Technology) / 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 2020	FY 2021	FY 2022
Title: Soldier System Interfaces & Integration (Sensor Advanced Technology)	9.273	8.741	8.374
Description: This effort will integrate battlefield and body-worn sensors and mature data fusion algorithms to provide the dismounted Small Unit leader with clear, actionable information to make well informed, rapid, tactical decisions. This effort will mature and integrate advanced dismounted Soldier robotic and autonomous systems technologies to demonstrate autonomous navigation, manned-unmanned teaming, and networked reconnaissance to improve Soldier lethality, situational awareness, and survivability during tactical operations.			
FY 2021 Plans: Continues to integrate battlefield and Soldier worn sensors with body area networks and the Nett Warrior architecture; matures and integrates advanced algorithms and user interfaces for Small Unit mission planning, human performance sensing, Soldier worn equipment sensing, and remote sensing; conducts field demonstrations of integrated battlefield and Soldier worn sensor			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BD7 / <i>Soldier Sys Interfaces/Integration-Sensor AdvTech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>systems to validate performance and operation; matures algorithms, user interfaces, and architectures to enable autonomous tactical SUAS and conduct field demonstrations to validate the performance and operation of the system; integrates SUAS with the Integrated Visual Augmentation System (IVAS) and Nett Warrior to enable sharing of networked tactical data between small units for increased Soldier lethality.</p> <p>FY 2022 Plans: Will mature and integrate Small Unit leader planning and decision tools, human performance algorithms and visualization tools, and Soldier equipment sensing algorithms and user interfaces; conduct field demonstrations of integrated Soldier sensor systems with Nett Warrior and the Integrated Visual Augmentation System (IVAS) in relevant field environments to validate performance and operation; demonstrate advanced autonomous tactical Small Unmanned Aerial Systems (SUAS) capabilities (ie. collision avoidance, fast flight, nighttime navigation, target detection) on representative military platforms in relevant field environments to validate the performance and operation of the technologies; mature technologies to enable hasty resupply of consumable items found in an infantry squad basic load for the Multi Domain Operations (MDO) battlespace.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease reflects minor planned change in project scope for this effort.</p>				
Accomplishments/Planned Programs Subtotals		9.273	8.741	8.374
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BD9 / <i>Soldier & Sm Unit Tactical Energy AdvTech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BD9: <i>Soldier & Sm Unit Tactical Energy AdvTech</i>	-	2.973	3.141	3.184	-	3.184	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project will demonstrate advanced Power and Energy (P&E) technologies for the dismounted Soldier to lighten equipment load, reduce resupply need, and enhance mobility. This Proj will conduct Soldier and Small Unit power and energy technology maturation, integration with clothing and individual equipment, technical analysis, and operational assessment.

Work in this Project complements several PEs to include PE 0602143A (Soldier Lethality Technology) / BD6 (Soldier Sys Interfaces/Integration - Sensor Tech), BB9 (Human Performance Tech for Mobility & Lethality), BD8 (Soldier & Sm Unit Tactical Energy Tech), and PE 0603118A (Soldier Lethality Advanced Technology) / 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 2020	FY 2021	FY 2022
Title: Dismounted Soldier Power and Energy	2.973	3.141	3.184
Description: This effort matures, integrates, and demonstrates advanced Soldier Power and Energy (P&E) technologies that are used to power the dismounted Soldier and small unit's command and control, communications, computers, and sensor devices during tactical operations. This work will result in the Army being able to provide the power and energy the future Soldier requires to operate effectively, while doing so at a reduced physical burden.			
FY 2021 Plans: Mature, integrate, and demonstrate technologies for increasing the run-time of rechargeable battery technologies, specifically Si-Anode based rechargeable batteries configured to centrally power Soldier electronic systems, to reduce the weight and physical burden on Soldiers; conduct field demonstrations to validate battery operation; integrate efficient Soldier power generation technologies such as advanced fuel cell systems with Soldier tactical electronic systems and conduct field demonstrations to characterize system performance and validate operational capabilities.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BD9 / <i>Soldier & Sm Unit Tactical Energy AdvTech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature, integrate, and demonstrate technologies for increasing the run-time of rechargeable battery technologies for the Soldier's weapon, body, or helmet electronics; conduct field demonstrations to validate the performance and operation of batteries to support operational Soldier materiel; mature, integrate, and demonstrate novel power management technologies for transferring power efficiently between electronic components resident on the Soldier's head, body, or weapon; mature and demonstrate Soldier power generation technologies for recharging batteries during a Platoon Level dismounted mission. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	2.973	3.141	3.184

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BE2 / <i>Joint Service Combat Feeding Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BE2: <i>Joint Service Combat Feeding Advanced Technology</i>	-	1.709	2.367	2.424	-	2.424	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates combat ration and field feeding technologies to optimize Warfighter performance, decrease the risk of exposure to chemical and biological contaminants in foods, and reduce the logistics burden to enable semi-independent operations. 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.

This Project matures and demonstrates work done in PE 0602143A (Soldier Lethality Technology) / Project BE3 (Joint Service Combat Feeding 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 2020	FY 2021	FY 2022
Title: Joint Service Combat Feeding Advanced Technology Demonstration	1.709	2.367	2.424
Description: This effort matures and demonstrates combat ration and field feeding technologies to optimize Warfighter performance, decrease risk of exposure to chemical and biological contaminants in foods, and reduce the logistics burden to enable semi-independent operations.			
FY 2021 Plans: Demonstrate multispectral imaging of ration components for identifying potential biological contamination; optimize rapid identification of food pathogen viability to provide real-time food safety information to commanders; validate chemical agent permeability in ration packaging in support of Chemical Biological Radiological Nuclear (CBRN) threats; validate nutrient stability in Close Combat Assault Ration components to ensure nutrient retention during processing and prolonged storage; and continue maturing and demonstrating nutrient densification technologies and alternative packaging configurations to reduce weight/logistics burden and enable semi-independent operations.			
FY 2022 Plans: Will validate critical limits for multispectral imaging to identify potential quality degradation of ration components; optimize field-deployable biosensor detection platforms for multiple pathogens in food matrices to reduce risk of food-borne illness on the battlefield; demonstrate baseline Close Combat Assault Ration effect on Warfighter physical performance to enable semi-			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE2 / <i>Joint Service Combat Feeding Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
independent operations; validate decontamination agent performance on ration packaging in support of Chemical Biological Radiological Nuclear (CBRN) threats; validate effects of cycling temperatures and processing methods on nutrient compounds in ration components to ensure nutrient retention during processing and prolonged storage; validate small scale atmospheric water harvester performance to decrease logistical burdens in multi-domain operations; and validate conductive materials performance during heating and sterilization processing methods to enhance ration heating efficiency.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort				
Accomplishments/Planned Programs Subtotals		1.709	2.367	2.424
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BE5 / <i>Personnel & Airdrop Safety Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BE5: <i>Personnel & Airdrop Safety Advanced Technology</i>	-	6.491	6.076	6.879	-	6.879	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates equipment and innovative techniques for precision aerial delivery of cargo and personnel. Technologies support Army Modernization Priority, Soldier Lethality. Aerial delivery is a key capability for rapid force projection and global precision delivery to support the mission readiness profile for Global Response Force (GRF). These efforts are designed to advance state of the art precision delivery technologies such as parachutes; guidance, navigation, and control (GNC) components and subsystems; tracking sensors; software algorithms; and safety rigging that integrates with currently equipped aircraft, unmanned aerial systems (UAS), and advanced rotary wing aircraft. These efforts provide the Warfighter with highly accurate, timely cargo/payload delivery and resupply in all terrain and weather conditions. Precision delivery/resupply reduces vulnerability of ground Soldiers, aircraft, and aircrew. Precision aerial delivery supports remote warfare with activities such as placement of battlefield sensors and reduction of Soldier load.

This Project complements work done in the Science & Technology Precision, Navigation and Timing Modernization priority.

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 2020	FY 2021	FY 2022
Title: Personnel & Airdrop Safety Advanced Technology	6.491	6.076	6.879
Description: This effort matures and demonstrates parachute materials and designs, precision guidance and navigation software and hardware, tracking sensors, and safety devices to increase the accuracy of delivering cargo to remote locations and/or complex terrains in global positioning system (GPS) denied environments. This effort also provides technologies that increase safety during personnel insertions into theaters of operation. This effort supports capability demonstrations for mitigating the Army's challenge of overburdened Soldiers through the use of tactical aerial resupply technologies, as well as supporting Anti-Access/Area Denial (A2/ AD) and manned-unmanned teaming (MUM-T) operational concepts by demonstrating airdrop from non-traditional platforms.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE5 / <i>Personnel & Airdrop Safety Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Demonstrate novel parachute control methods in all phases of flight and for application across a broad range of airdrop systems to introduce advantageous changes in fundamental flight performance and to support precision guidance of parachutes in complex, non-traditional airdrop environments.</p> <p>FY 2022 Plans: Will optimize heavy equipment airdrop system performance to minimize altitude loss and increase system reliability. Will demonstrate capabilities to airdrop up to at least 50,000 lbs through live airdrop testing from a C-17 aircraft. Will demonstrate advancements in high altitude insertion technology that facilitate extended offset insertions in GPS denied conditions. Will mature Next Generation Static Line parachute systems and demonstrate effectiveness in Immediate Response Force (IRF) mission. Will optimize the design of an autonomously guided powered aerial resupply system with a minimum of tenfold increase in horizontal standoff capability compared to conventional guided airdrop systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 supports increased live airdrop testing of at least 50,000 lbs. from a C-17, and demonstrations of a tenfold horizontal standoff capability and extended offset in GPS denied conditions in a MDO environment.</p>				
Accomplishments/Planned Programs Subtotals		6.491	6.076	6.879
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE9 / <i>STE Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BE9: <i>STE Advanced Technology</i>	-	21.581	12.790	13.401	-	13.401	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies supporting the Army's Synthetic Training Environment (STE). The Synthetic Training Environment (STE) is the next generation holistic collective training capability that will train units where they will fight, with whom they will fight with, 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; a Secretary of Defense priority.

This Project complements work done in PE 0602143A (Soldier Lethality Technology) / Project BE8 (Synthetic Training Environment (STE) 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).

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

	FY 2020	FY 2021	FY 2022
<p>Title: STE Soldier/Squad Virtual Trainer</p> <p>Description: This effort matures and demonstrates a common battle drill squad-level mixed reality based system that allows for the rapid conduct and repetition of Squad-level training. The training system will make it possible to conduct diverse, repeatable and effective training without extensive training infrastructure. This effort also matures and demonstrates novel and realistic training environments that provide increased levels of proficiency and readiness through immersive training scenarios conducted at the point of need.</p>	5.887	-	-
<p>Title: STE Training Management Tool</p> <p>Description: This effort matures and demonstrates STE-relevant tools and technologies that automatically adapt training to the learner's skill level, conduct intelligent after action reviews, automate team training assessments, and enable the visualization of and interaction with a Mixed Reality Common Operating Picture of the battlespace.</p>	1.118	3.371	3.300

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE9 / <i>STE Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p><i>FY 2021 Plans:</i> Validate prototypes and methods for conducting automated team assessments during STE-relevant use-cases; demonstrate artificial intelligence (AI) methods to support self-optimizing systems that produce skill retention and transfer into the operational environment; demonstrate human factors elements for information visualization, multimodal interaction, and human performance assessment using a distributed interactive visualization architecture enabling real-time collaborative mission planning, rehearsal, command and control, training, and after action review.</p> <p><i>FY 2022 Plans:</i> Will exploit the association between squad level performance measures for individuals and teams and optimize how to best provide instructors with data to assess their performance and readiness; mature generalized intelligent tutoring framework allowing for both individual and team tutoring capabilities within synthetic training environments; demonstrate a team competency tracking capability that utilizes Dept. of Defense learning architecture standards; validate battlespace visualization tools to support large-scale simulations with synthetic training environments and mission command decision making.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>			
<p><i>Title:</i> STE One World Terrain</p> <p><i>Description:</i> This effort matures and demonstrates tools and methods that improve the speed, fidelity and delivery of synthetic terrain and environmental data needed to support mission rehearsal and training in a representation of the globe, fully accessible through the Army network and usable by all simulation trainers. This effort also matures and develops complex representations (including megacities and subterranean) of the operational environment and the Multi-Domain battlefield in synthetic training environments.</p> <p><i>FY 2021 Plans:</i> Demonstrate tools that rapidly and automatically process terrain source data into a single representation; mature tools to support conducting uninterrupted training in sub-surface, surface, and infrastructure within dense urban environments including: automated underground geometry and feature generation, representation of key civilian infrastructure components via scenario generation tools, representation of complex road networks and controls, and enabling rich attribution of hydrological features and complex structures.</p> <p><i>FY 2022 Plans:</i> Will demonstrate processes, tools and software for surface level feature classification and extraction for material and terrain artifacts to support One World Terrain (OWT) application spaces for the resulting modernized 3D terrain products; improve attribution deficiencies for OWT; demonstrate runtime implementation optimizations to rapidly assemble tailored terrain datasets</p>	5.702	2.816	2.904

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE9 / <i>STE Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
suitable for application-specific needs; improve methods to procedurally correct or validate 3D terrain data; optimize the OWT data model specification to support traditional and non-traditional application domains				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: STE Training Simulation Software		8.874	5.752	7.197
Description: This effort matures and demonstrates technologies that support Multi-Domain Operations modeling and simulation configuration and scalability technologies for collective training. In addition, matures and demonstrates technologies that allow the synthesis of robust military behaviors that enable the scaling of Synthetic Training Environment (STE) collective training configurations and delivery to the Point of Need through the exploitation of emerging computing and networking technologies that optimize computing architectures for integrating components (models, behaviors, data, etc.) of the Training Simulation Software (TSS).				
FY 2021 Plans: Demonstrate enabling computing and networking technologies to deliver a complex synthetic operational environment to the point of need; validate architecture strategies for integrating components (models, behaviors, data, etc.) of the Training Simulation Software (TSS) to enable reusability, extensibility, reliability and maintainability; validate models and data representing critical aspects of the operational environment integrated in to the STE TSS in support of collective training use cases; demonstrate synthetic representations of Multi-Domain Operations to include patterns of life and cyber effects; improve the realism of military behaviors representing critical aspects of the operational environment using novel AI techniques.				
FY 2022 Plans: Will mature and demonstrate the integration of simulation architecture technologies that allow for components (models, behaviors, data, etc.) to be dynamically integrated to support collective training use cases; will demonstrate technologies to generate STE-ready behavior models from authoritative sources to facilitate reuse and reduce the cost of TSS development; will improve Operational Environment (OE) models in support of emerging TSS gaps from collective training use cases; will demonstrate emerging AI techniques to represent military behaviors against OE modeling needs.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increased to further research into AI techniques in support of developing OE models for MDO training.				
Title: Weapons Effects for STE		-	0.851	-
Description: This effort matures and demonstrates structural weapon effects and projectile penetration models and algorithms to integrate within the Army's STE. This effort provides One World Terrain with accurate representation of the effects of threat				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BE9 / <i>STE Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
weapons (such as small arms, projectiles, indirect fire, and improvised explosives device attacks) and display of realistic vulnerabilities in the battlespace. <i>FY 2021 Plans:</i> Improve performance of enhanced algorithms for predicting blast effects from various weapons and explosive events to include predicting structural damage in complex terrain; mature and provide improved algorithms for predicting large projectile fragmentation and penetration effects on critical assets. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> This task ends in FY21				
Accomplishments/Planned Programs Subtotals		21.581	12.790	13.401
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>				Project (Number/Name) BS8 / <i>Soldier Lethality Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BS8: <i>Soldier Lethality Advanced Technology</i>	-	17.500	45.200	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Congressional Interest Item funding provided for Soldier Lethality Advanced Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Soldier 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.

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

	FY 2020	FY 2021
Congressional Add: Subterranean Warfighter Advanced Technology	1.500	-
FY 2020 Accomplishments: Program Increase supported advanced research on Subterranean Warfighter Advanced Technology.		
Work executed under the direction of the Army Futures Command.		
Congressional Add: Rapid Safe Advanced Materials	6.000	-
FY 2020 Accomplishments: Program Increase supported advanced research on Rapid Safe Advanced Materials.		
Work executed under the direction of the Army Futures Command.		
Congressional Add: Multi-Spectral Sensor Mitigation	5.000	-
FY 2020 Accomplishments: Program Increase supported advanced research on Multi-Spectral Sensor Mitigation.		
Work executed under the direction of the Army Futures Command.		
Congressional Add: Helmet Pad Suspension Systems	5.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BS8 / <i>Soldier Lethality Advanced Technology</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: Program Increase supported advanced research on Helmet Pad Suspension Systems. Work executed under the direction of the Army Futures Command.		
Congressional Add: Program increase - advanced AI/AA analytics for modernization and readiness FY 2021 Plans: Conduct advanced research in Advanced AI/AA Analytics for Modernization and Readiness. Work executed by Army Futures Command.	-	10.000
Congressional Add: Program increase - small arms fire control advanced technology FY 2021 Plans: Conduct advanced research in Small Arms Fire Control Advanced Technology. Work executed by Army Futures Command.	-	8.000
Congressional Add: Program increase: Advanced technology for maneuver support and protection FY 2021 Plans: Conduct advanced research in Maneuver Support and Protection. Work executed by Army Futures Command.	-	10.000
Congressional Add: Program increase - military engineering technology for infield waste FY 2021 Plans: Conduct advanced research in Military Engineering Technology for Infield Waste. Work executed by Army Futures Command.	-	2.000
Congressional Add: Program increase - flexible LED lighting for tents and shelters FY 2021 Plans: Conduct advanced research in Flexible LED Lighting for Tents and Shelters. Work executed by Army Futures Command.	-	5.200
Congressional Add: Program increase FY 2021 Plans: Conduct advanced research in Soldier Lethality Advanced Technology. Work executed by Army Futures Command.	-	10.000
Congressional Adds Subtotals	17.500	45.200

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603118A / <i>Soldier Lethality Advanced Technology</i>	Project (Number/Name) BS8 / <i>Soldier Lethality Advanced Technology</i>
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	136.544	196.055	23.403	-	23.403	-	-	-	-	-	-
BK8: <i>Robotics for Engineer Operations Adv Tech</i>	-	1.922	4.194	6.221	-	6.221	-	-	-	-	-	-
BK9: <i>Ground System Fluids and Fuels Adv Tech</i>	-	2.031	1.684	1.745	-	1.745	-	-	-	-	-	-
BL3: <i>Explosives Forensics Advanced Technology</i>	-	1.954	2.002	2.096	-	2.096	-	-	-	-	-	-
BL6: <i>Expedient Passive Protection Advanced Technology</i>	-	3.643	3.051	0.494	-	0.494	-	-	-	-	-	-
BL8: <i>Power Projection in A2AD Environments Adv Tech</i>	-	0.882	1.220	2.970	-	2.970	-	-	-	-	-	-
BM1: <i>Protection from Advanced Weapon Effects Adv Tech</i>	-	1.912	2.104	5.868	-	5.868	-	-	-	-	-	-
BO3: <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	-	124.200	181.800	-	-	-	-	-	-	-	-	-
CJ9: <i>Ground Enabling University Adv Development</i>	-	-	-	4.009	-	4.009	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE matures and demonstrates ground movement and maneuver technologies that support and enable the Army's modernization priority for the Next Generation of Combat Vehicles. This PE also matures, integrates and demonstrates advanced technologies that are necessary and foundational for legacy and future ground platforms and ground maneuver. These technology areas include: robotic and autonomous Army Combat Engineer equipment, liquid logistics (i.e., fuels, lubricants, and oils) and related monitoring and distribution, forensic analysis of explosives and other chemical materials, rapidly deployable passive protection technologies, entry and maneuver assessment technologies and structural hardening technologies to protect personnel and critical assets from advanced weapon effects.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>
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Work in this PE complements PE 0602144A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	136.793	14.795	19.583	-	19.583
Current President's Budget	136.544	196.055	23.403	-	23.403
Total Adjustments	-0.249	181.260	3.820	-	3.820
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	124.200	181.800			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-124.200	-			
• SBIR/STTR Transfer	-0.249	-0.540			
• Adjustments to Budget Years	-	-	3.820	-	3.820

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

Project: BO3: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

Congressional Add: *Electrical System Safety and Reliability*

Congressional Add: *Cold Regions Research*

Congressional Add: *High-Performance Concrete Technology*

Congressional Add: *Lightweight Airfield Matting*

Congressional Add: *Secure Management of Energy Generation and Storage*

Congressional Add: *Rapid Low Energy Mobile Manufacturing*

Congressional Add: *Composite Flywheel Technology*

Congressional Add: *Lead-Acid Battery Life Extension*

Congressional Add: *Robotic Construction Equipment*

Congressional Add: *Terrain Conditions Forecasting*

Congressional Add: *Environmental Sensors for Explosives*

Congressional Add: *Robotic 4-D Printing of Geopolymer-Based Composites*

Congressional Add: *Waste to Energy Disposal*

	FY 2020	FY 2021
	5.000	5.000
	5.000	2.000
	5.000	6.000
	10.000	-
	3.000	5.000
	3.000	-
	5.000	7.000
	10.000	-
	9.700	5.000
	3.000	-
	3.000	3.000
	2.000	2.000
	3.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity	R-1 Program Element (Number/Name)		
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	PE 0603119A / Ground Advanced Technology		
Congressional Add Details (\$ in Millions, and Includes General Reductions)	FY 2020	FY 2021	
Congressional Add: <i>Advanced Polymer Development for Force Protection</i>	4.500	-	
Congressional Add: <i>Micrometeorological-Soil Synthetic Test Environment</i>	1.000	-	
Congressional Add: <i>Partnership and Technology Transfer</i>	4.000	-	
Congressional Add: <i>Sensor Systems for Underground Detection</i>	3.000	-	
Congressional Add: <i>UAS Mounted Hostile Threat Detection</i>	5.000	-	
Congressional Add: <i>Heavy Load Simulator</i>	6.000	-	
Congressional Add: <i>Measurement and Control of Frozen Surface Properties</i>	4.000	-	
Congressional Add: <i>Resilient Energy Systems</i>	2.500	-	
Congressional Add: <i>Operations in Permafrost Environment</i>	4.000	-	
Congressional Add: <i>Power Generation Technologies in Cold Regions</i>	5.000	-	
Congressional Add: <i>Sensing and Prediction of Arctic Maritime Coastal Ice Conditions</i>	5.000	-	
Congressional Add: <i>Thermosyphons</i>	2.000	-	
Congressional Add: <i>Materials and Manufacturing Technology for Cold Environments</i>	3.500	4.000	
Congressional Add: <i>Energy Technology Research in Cold and Arctic Regions</i>	4.000	-	
Congressional Add: <i>Research Facility Modernization</i>	4.000	6.000	
Congressional Add: <i>Program increase - smart intallation and community program</i>	-	5.000	
Congressional Add: <i>Program increase - flow battery demonstration</i>	-	20.000	
Congressional Add: <i>Program increase - corrosion protection and prevention</i>	-	10.000	
Congressional Add: <i>Program increase - rapid entry and sustainment for the arctic</i>	-	8.000	
Congressional Add: <i>Program increase - secure management of energy generation and storage</i>	-	5.000	
Congressional Add: <i>Program increase - water quality and resiliency</i>	-	5.000	
Congressional Add: <i>Program increase - rare earth element extraction</i>	-	5.000	
Congressional Add: <i>Program increase - organic light emitting diode</i>	-	5.000	
Congressional Add: <i>Program increase - coatings technology</i>	-	5.000	
Congressional Add: <i>Program increase - heavy load simulator</i>	-	4.200	
Congressional Add: <i>Program increase - integrated microgrids</i>	-	4.000	

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2020	FY 2021
Congressional Add: <i>Program increase - infrastructure resilience and flood assessment</i>	-	3.000
Congressional Add: <i>Program increase - single connection quick oil change system</i>	-	3.000
Congressional Add: <i>Program increase - clean modular hydro technology</i>	-	4.000
Congressional Add: <i>Program increase - accelerator technology for ground maneuver</i>	-	5.000
Congressional Add: <i>Program increase - autonomous combat engineering solutions</i>	-	5.500
Congressional Add: <i>Program increase - coastal terrain hazard research</i>	-	8.000
Congressional Add: <i>Program increase - expeditionary deployment of fully sustainable utility</i>	-	10.000
Congressional Add: <i>Program increase - graphene research</i>	-	5.000
Congressional Add: <i>Program increase - impacts of soil structures on hydrology</i>	-	4.000
Congressional Add: <i>Program increase - operational energy research</i>	-	1.300
Congressional Add: <i>Program increase - temperature insensitive high energy density lithium ion batteries</i>	-	2.500
Congressional Add: <i>Program increase - vehicle performance reliability and operations</i>	-	3.000
Congressional Add: <i>Program increase - cross-laminated timber and recycled carbon fiber materials</i>	-	1.300
Congressional Add: <i>Program increase - advanced explosion resistant window systems</i>	-	5.000
Congressional Add Subtotals for Project: BO3		124.200
Congressional Add Totals for all Projects		181.800

Change Summary Explanation

Increases in Program Element funding in Fiscal Year (FY) 2022 support new efforts in Project CJ9 (Ground Enabling University Adv Development). Funding increase is also reflective of the maturation of applied research efforts in Program Element 0602144A (Ground Technology).

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>				Project (Number/Name) BK8 / <i>Robotics for Engineer Operations Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BK8: <i>Robotics for Engineer Operations Adv Tech</i>	-	1.922	4.194	6.221	-	6.221	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding was partially realigned from this Project to Program Element (PE) 0602144A Ground Technology / Project CI2 Ground Enabling University Applied Research, as part of the Program Evaluation Groups (PEG) efficiency drill.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates robotic engineer equipment capabilities that can remotely characterize the environment and operate in the battlespace for autonomous Combat Engineer actions. This Project provides technologies for Combat Engineer mission planning, creating or reducing barriers and obstacles, as well as maintaining, repairing, and constructing expedient infrastructure. These efforts will enhance Combat Engineer missions of mobility, counter mobility, and survivability through semi-autonomous or autonomous 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 is performed 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 related to, and fully coordinated with, PE 0602144A (Ground Technology) / Project BK7 (Robotics for Engineer Operations Technology).

Work in this PE complements PE 0602114A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology), and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Robotic Integrated Engineer Operations (RIENO)	1.922	-	-
Description: This effort matures and demonstrates remote control and semi-autonomous protocols and processes on small scale construction equipment to provide information that scales to larger legacy equipment as well as assess the applicability of small scale equipment working in collaboration and coordination.			
Title: Beyond-Visual-Line-of-Sight Tele-operated Engineer Operations Demonstration	-	4.194	6.221

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BK8 / <i>Robotics for Engineer Operations Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort matures and demonstrates remote control and semi-autonomous behaviors on small scale construction equipment to provide information that scales to larger legacy equipment as well as assess the applicability of small scale equipment working in collaboration and coordination.</p> <p>FY 2021 Plans: Mature tele-operated construction equipment in Global Positioning System (GPS) denied environments; demonstrate semi-autonomous site characterization; demonstrate capabilities to remove or emplace obstacles and manipulate the environment; and mature and demonstrate interface for handheld or mobile devices for construction equipment mission planning and execution.</p> <p>FY 2022 Plans: Will demonstrate autonomous Engineer site characterization with a semantically labeled site model and change detection; will demonstrate compact track loader and mini-hydraulic excavator performing Combat Engineer tasks at Beyond-Visual-Line-of-Sight (BVLOS) standoff distances to support mobility and maneuver; will demonstrate a universal controller developed by Combat Capability Development Center Ground Vehicle Systems Center for Combat Engineer equipment.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY 2022 will support demonstration of capabilities matured for remotely operated Combat Engineer equipment</p>			
Accomplishments/Planned Programs Subtotals	1.922	4.194	6.221

<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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BK9 / <i>Ground System Fluids and Fuels Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>BK9: Ground System Fluids and Fuels Adv Tech</i>	-	2.031	1.684	1.745	-	1.745	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates liquid logistics technologies such as enhanced jet fuels, lubricants, oils, powertrain fluids, coolants, bulk fluid treatment, monitoring, metering, storage, and distribution in support of established Army regulations and requirements. This Project matures products and technologies to improve fuel efficiency, meet new hardware fluid requirements, modernize fluids, ensure bulk fluid meets quality requirements, and provide bulk fluid asset visibility, to optimize logistics and reduce logistics requirements. This Project executes the demonstration of enhanced jet fuels for ground systems, gear oils, anti-lock brake system-compatible brake fluid, smart bulk fuel metering and monitoring technologies. This Project matures liquid logistics products and technologies that are critical enablers for multi-domain operations requiring semi-independent operations to enable dispersed operations to extend operational reach, prolong endurance and allow freedom of action for the Joint Force.

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 is performed by the United States (U.S.) Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
<p>Title: Alternative Fuels and Petroleum, Oil & Lubricants</p> <p>Description: This effort focuses on reducing the logistics footprint, improving fuel efficiency, and ensuring mobility by maturing and demonstrating technologies in areas such petroleum quality monitoring, filtration, storage and distribution, hydraulic fluids; alternative fuels and fuel additives, lubricants, oil, powertrain fluids and coolants.</p>	2.031	-	-
<p>Title: Ground System Fluids and Fuels</p> <p>Description: This effort focuses on reducing the logistics footprint, improving fuel efficiency, and ensuring mobility by maturing and demonstrating technologies in areas such petroleum quality monitoring, filtration, storage and distribution, hydraulic fluids; enhanced jet fuels and fuel additives, lubricants, oil, powertrain fluids and coolants.</p> <p>Assess additional candidate synthetic fuel blends to determine their suitability for military ground systems.</p>	-	1.684	1.745

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BK9 / <i>Ground System Fluids and Fuels Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Qualify candidate fuel efficient gear oils that maintain and improve vehicle axle durability and provide extended performance time over current gear oil for military use. Develop performance requirements for a new military brake fluid that is compatible with ABS brake systems and investigate candidate fluid technologies. Integrate smart fuel metering technology into self-correcting devices that automatically report fuel quantity and conduct fuel filter effectiveness testing to establish fuel particle contamination limits for new fuel monitoring technology.</p> <p><i>FY 2021 Plans:</i> Assess the lubrication capacity of fuel additive using improved methods and component test rigs to optimize wear reduction of fuel delivery system components. Complete assessment and demonstrate anti-lock brake system compatible brake fluid in selected ground systems. Establish optimized post filter fuel particle contamination limits for new fuel monitoring technology based on fuel filter effectiveness. Validate performance of current military coolant against candidate extended performance coolants.</p> <p><i>FY 2022 Plans:</i> Will continue assessment of the lubrication capacity of fuel additive using improved methods and component test rigs for the initial fuel pump selected to optimize wear reduction of fuel delivery system components. Will conduct fuel injector testing based on the results of the fuel filter effectiveness testing to establish fuel particle contamination limits for new fuel monitoring technology. Will develop criteria and laboratory methodology to assess extended life and performance capabilities of coolants.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>			
Accomplishments/Planned Programs Subtotals	2.031	1.684	1.745

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BL3 / <i>Explosives Forensics Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BL3: <i>Explosives Forensics Advanced Technology</i>	-	1.954	2.002	2.096	-	2.096	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures instrumentation and algorithms required to provide improved point, proximity, and stand-off detection of explosives and precursor materials to enable the warfighter to integrate chemical and explosive hazard detection equipment. This Project integrates explosive detection into the family of Chemical, Biological, Radiological, and Nuclear point and stand-off sensors, alternative chemical detection modalities and algorithms that will improve the probability of detection and attribution of an explosive hazard or Home-made Explosive manufacturing/assembly location.

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 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 Project is related to, and fully coordinated with, PE 0602144A (Ground Technology) .

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

	FY 2020	FY 2021	FY 2022
Title: Detection Mechanisms for Contaminants	1.954	2.002	2.096
Description: This effort demonstrates improved point and standoff detection of military and homemade explosives and their precursors, and other chemicals and hazardous materials.			
FY 2021 Plans: Develop and demonstrate a chip-scale integrated photonic sensor for the rapid detection of narcotics, explosives, and other molecules of interest at ultra-low concentrations (less than one part per million) in trace solid or liquid residues for forensic attribution. Demonstrate a photonic integrated circuit sensor based on waveguide enhanced Raman spectroscopy and determine detection limits for select explosives and narcotics materials.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BL3 / <i>Explosives Forensics Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will further mature novel portable detection technology for further maturity and testing of realistic threats and scenarios. Will continue maturation of photonic integrated circuit (PIC) for chemical sensing to decrease size, weight and power configuration footprint. FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		1.954	2.002	2.096
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>				Project (Number/Name) BL6 / <i>Expedient Passive Protection Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BL6: <i>Expedient Passive Protection Advanced Technology</i>	-	3.643	3.051	0.494	-	0.494	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates rapidly deployable protection solutions to protect small distributed units; decision support applications and software; and tactics, techniques, and procedures to increase the survivability of personnel, critical assets, and facilities from a range of threats. Force protection technologies will be matured and demonstrated for applications in complex and urban environments to protect against advanced energetic threats, large caliber rockets and 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 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 related to, and fully coordinated with, PE 0602144A (Ground Technology) / Project BL5 (Expedient Passive Protection Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Force Protection in the Urban Environment Demonstrations	3.643	3.051	-
Description: This effort matures and demonstrates force protection solutions for urban environments focusing on the use of existing structures; rapidly deployable protection systems; decision support applications and software; and tactics, techniques, and procedures to provide protection with consideration for a complex three-dimensional threat.			
FY 2021 Plans: Demonstrate an expedient system to increase levels of protection for existing buildings against blast and indirect fire; validate a rapidly deployable force protection barrier tailored for small units operating in contested environments; provide a rapidly deployable vehicle barrier optimized for heavy vehicle threats; and demonstrate wall blast vulnerability and overhead cover design applications for existing structures.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in FY22 reflects planned lifecycle of this effort, ending in FY21.			
Title: Protection Against High Trajectory Large Caliber Rocket and Missile Threats	-	-	0.494

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BL6 / <i>Expedient Passive Protection Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort matures and demonstrates expedient force protection solutions for emerging threats such as large caliber rocket and missile weapon effects. This effort also demonstrates decision support tools to aid the warfighter in selecting protection schemes for survivability from emerging threats supporting All-Domain/Multi-Domain Operations.</p> <p>FY 2022 Plans: Will assess capabilities of legacy protective systems to protect critical assets and facilities from emerging threat weapon system effects such as large caliber rockets and missiles to establish baseline performance.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 reflects planned lifecycle of this effort, beginning in FY22.</p>			
Accomplishments/Planned Programs Subtotals	3.643	3.051	0.494

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>				Project (Number/Name) BL8 / <i>Power Projection in A2AD Environments Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BL8: <i>Power Projection in A2AD Environments Adv Tech</i>	-	0.882	1.220	2.970	-	2.970	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates remote assessment technologies to determine entry and maneuver corridors, provides 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 force projection assessments and provide all-season predictions to ensure air and ground battlespace entry and maneuver. This Project also matures and demonstrates 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.

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

Work in this Project is related to, and fully coordinated with, PE 0602144A (Ground Technology) / Project BL7 (Power Projection in A2AD Environments Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Entry and Sustainment in Complex Contested Environments Demonstrations	0.882	1.220	1.579
Description: This effort matures and demonstrates geospatial planning tools to expand engineering analysis of ground surfaces for entry, sustainment, and maneuver operations and to automate processes for selecting suitable maneuver corridors.			
FY 2021 Plans: Demonstrate site selection algorithms for rapidly identifying landing zones during air assault missions and forward arming and refueling needs; mature and demonstrate capabilities to predict off-road mobility in arctic regions.			
FY 2022 Plans: Will mature and demonstrate reconnaissance techniques and mobility algorithms for maneuver in arctic regions; and will demonstrate advanced analysis methods for classifying low-volume roads and predicting deterioration under military vehicle loadings.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BL8 / <i>Power Projection in A2AD Environments Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding increase in FY22 will support demonstration low-volume road classification and deterioration analysis tools.			
Title: Engineering for Battlespace Maneuver Demonstrations	-	-	1.391
Description: This effort demonstrates material solutions and techniques for expedient repair to rapidly repair and upgrade damaged infrastructure along mobility corridors and restaging areas to maintain and enhance freedom of maneuver achieving overmatch and tactical advantage in contested complex environments.			
FY 2022 Plans: Will demonstrate techniques for rapid soil stabilization to support military ground vehicle maneuver; and will demonstrate tactics, techniques, and procedures as well as material solutions for rapid infrastructure capacity upgrades.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase reflects the planned lifecycle progression from PE 0602144A Project BL7, beginning in FY22 to support demonstration of repair technologies and infrastructure capacity upgrades for mobility corridors and restaging areas.			
Accomplishments/Planned Programs Subtotals	0.882	1.220	2.970

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>				Project (Number/Name) BM1 / <i>Protection from Advanced Weapon Effects Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BM1: <i>Protection from Advanced Weapon Effects Adv Tech</i>	-	1.912	2.104	5.868	-	5.868	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates structural hardening solutions and force protection technologies to increase survivability of facilities and provide critical updates to protective design specifications and guidance. Additionally, this project matures and demonstrates passive protection technologies and provides protective design criteria advancements 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 conducted by the United States (U.S.) Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

This effort is related to, and fully coordinated with, PE 0602144A (Ground Technology) / Project BL9 (Protection from Advanced Weapon Effects Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Applications of Environmentally-Inspired Unconventional Countermeasures	0.237	-	-
Description: This effort will demonstrate rapidly-deployable, eco-friendly materials with spectral signatures that alter or obscure underlying target spectral signatures.			
Title: Defeat of Complex Attack Demonstrations	1.675	2.104	5.868
Description: This effort demonstrates force protection technologies that mitigate the effects of emerging peer and near peer adversaries advanced penetrating threats and high yield blast effects by optimizing high-performance, logistically feasible material solutions and processes.			
FY 2021 Plans: Optimize subscale hardening solutions against emerging complex weapon attack scenarios; validate enhanced or layered subscale systems for reduced structural thickness with improved performance.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BM1 / <i>Protection from Advanced Weapon Effects Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will demonstrate optimized subscale hardening solutions against emerging complex weapon attack scenarios; and optimize damage prediction and system performance for full-scale demonstration. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase reflects the planned lifecycle progression from optimizing subscale hardening elements to supporting large-scale demonstrations of layered hardening solutions with multiple full-scale live-fire weapons.				
Accomplishments/Planned Programs Subtotals		1.912	2.104	5.868
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BO3: <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	-	124.200	181.800	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note
Congressional Interest Item funding provided for Military Engineering Technology Demonstration.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Military Engineering Technology Demonstration.

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 2020	FY 2021
<p><i>Congressional Add:</i> Electrical System Safety and Reliability</p> <p><i>FY 2020 Accomplishments:</i> Program Increase supported advanced research on Electrical System Safety and Reliability.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><i>FY 2021 Plans:</i> Program Increase supported advanced research on Electrical System Safety and Reliability.</p> <p>Work executed by Army Futures Command.</p>	5.000	5.000
<p><i>Congressional Add:</i> Cold Regions Research</p> <p><i>FY 2020 Accomplishments:</i> Program Increase supported advanced research on Cold Regions Research.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p><i>FY 2021 Plans:</i> Program Increase supported advanced research on Cold Regions Research.</p> <p>Work executed by Army Futures Command.</p>	5.000	2.000
<p><i>Congressional Add:</i> High-Performance Concrete Technology</p>	5.000	6.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2020 Accomplishments: Program Increase supported advanced research on High-Performance Concrete Technology.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Program Increase supported advanced research on High-Performance Concrete Technology.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: Lightweight Airfield Matting</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on Lightweight Airfield Matting.</p> <p>Work executed under the direction of the Army Futures Command.</p>	10.000	-
<p>Congressional Add: Secure Management of Energy Generation and Storage</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on Secure Management of Energy Generation and Storage.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Program Increase supported advanced research on Secure Management of Energy Generation and Storage.</p> <p>Work executed by Army Futures Command.</p>	3.000	5.000
<p>Congressional Add: Rapid Low Energy Mobile Manufacturing</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on Rapid Low Energy Mobile Manufacturing.</p> <p>Work executed under the direction of the Army Futures Command.</p>	3.000	-
<p>Congressional Add: Composite Flywheel Technology</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on Composite Flywheel Technology.</p>	5.000	7.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supported advanced research on Composite Flywheel Technology.			
Work executed by Army Futures Command.			
Congressional Add: Lead-Acid Battery Life Extension FY 2020 Accomplishments: Program Increase supported advanced research on Lead-Acid Battery Life Extension.		10.000	-
Work executed under the direction of the Army Futures Command.			
Congressional Add: Robotic Construction Equipment FY 2020 Accomplishments: Program Increase supported advanced research on Robotic Construction Equipment.		9.700	5.000
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supported advanced research on Robotic Construction Equipment			
Work executed by Army Futures Command.			
Congressional Add: Terrain Conditions Forecasting FY 2020 Accomplishments: Program Increase supported advanced research on Terrain Conditions Forecasting.		3.000	-
Work executed under the direction of the Army Futures Command.			
Congressional Add: Environmental Sensors for Explosives FY 2020 Accomplishments: Program Increase supported advanced research on Environmental Sensors for Explosives.		3.000	3.000
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supported advanced research on Environmental Sensors for Explosives.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Robotic 4-D Printing of Geopolymer-Based Composites FY 2020 Accomplishments: Program Increase supported advanced research on Robotic 4-D Printing of Geopolymer-Based Composites.	2.000	2.000
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supported advanced research on Robotic 4-D Printing of Geopolymer-Based Composites.		
Work executed by Army Futures Command.		
Congressional Add: Waste to Energy Disposal FY 2020 Accomplishments: Program Increase supported advanced research on Waste to Energy Disposal.	3.000	-
Work executed under the direction of the Army Futures Command.		
Congressional Add: Advanced Polymer Development for Force Protection FY 2020 Accomplishments: Program Increase supported advanced research on Advanced Polymer Development for Force Protection.	4.500	-
Work executed under the direction of the Army Futures Command.		
Congressional Add: Micrometeorological-Soil Synthetic Test Environment FY 2020 Accomplishments: Program Increase supported advanced research on Micrometeorological-Soil Synthetic Test Environment.	1.000	-
Work executed under the direction of the Army Futures Command.		
Congressional Add: Partnership and Technology Transfer FY 2020 Accomplishments: Program Increase supported advanced research on Partnership and Technology Transfer.	4.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Sensor Systems for Underground Detection FY 2020 Accomplishments: Program Increase supported advanced research on Sensor Systems for Underground Detection.	3.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: UAS Mounted Hostile Threat Detection FY 2020 Accomplishments: Program Increase supported advanced research on UAS Mounted Hostile Threat Detection.	5.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Heavy Load Simulator FY 2020 Accomplishments: Program Increase supported advanced research on Heavy Load Simulator.	6.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Measurement and Control of Frozen Surface Properties FY 2020 Accomplishments: Program Increase supported advanced research on Measurement and Control of Frozen Surface Properties.	4.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Resilient Energy Systems FY 2020 Accomplishments: Program Increase supported advanced research on Resilient Energy Systems.	2.500	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Operations in Permafrost Environment FY 2020 Accomplishments: Program Increase supported advanced research on Operations in Permafrost Environment.	4.000	-	

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Power Generation Technologies in Cold Regions FY 2020 Accomplishments: Program Increase supported advanced research on Power Generation Technologies in Cold Regions.	5.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Sensing and Prediction of Arctic Maritime Coastal Ice Conditions FY 2020 Accomplishments: Program Increase supported advanced research on Sensing and Prediction of Arctic Maritime Coastal Ice Conditions.	5.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Thermosyphons FY 2020 Accomplishments: Program Increase supported advanced research on Thermosyphons.	2.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Materials and Manufacturing Technology for Cold Environments FY 2020 Accomplishments: Program Increase supported advanced research on Materials and Manufacturing Technology for Cold Environments.	3.500	4.000	
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Conduct advanced research in Materials and Manufacturing Technology for Cold Environments.			
Work executed by Army Futures Command.			
Congressional Add: Energy Technology Research in Cold and Arctic Regions FY 2020 Accomplishments: Program Increase supported advanced research on Energy Technology Research in Cold and Arctic Regions.	4.000	-	
Work executed under the direction of the Army Futures Command.			
Congressional Add: Research Facility Modernization	4.000	6.000	

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: Program Increase supported advanced research on Research Facility Modernization. Work executed under the direction of the Army Futures Command.		
FY 2021 Plans: Program Increase supported advanced research on Research Facility Modernization. Work executed under the direction of the Army Futures Command.		
Congressional Add: Program increase - smart intallation and community program FY 2021 Plans: Program Increase supported advanced research on Smart Installation and Community Program. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase - flow battery demonstration FY 2021 Plans: Program Increase supported advanced research on Flow Battery Demonstration. Work executed by Army Futures Command.	-	20.000
Congressional Add: Program increase - corrosion protection and prevention FY 2021 Plans: Program Increase supported advanced research on Corrosion Protection and Prevention. Work executed by Army Futures Command.	-	10.000
Congressional Add: Program increase - rapid entry and sustainment for the arctic FY 2021 Plans: Program Increase supported advanced research on Rapid Entry and Sustainment for the Arctic. Work executed by Army Futures Command.	-	8.000
Congressional Add: Program increase - secure management of energy generation and storage FY 2021 Plans: Program Increase supported advanced research on Secure Management of Energy Generation and Storage. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase - water quality and resiliency	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2021 Plans: Program Increase supported advanced research on Water Quality and Resiliency.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: Program increase - rare earth element extraction</p> <p>FY 2021 Plans: Program Increase supported advanced research on Rare Earth Element Extraction.</p> <p>Work executed by Army Futures Command.</p>	-	5.000
<p>Congressional Add: Program increase - organic light emitting diode</p> <p>FY 2021 Plans: Program Increase supported advanced research on Organic Light Emitting Diode.</p> <p>Work executed by Army Futures Command.</p>	-	5.000
<p>Congressional Add: Program increase - coatings technology</p> <p>FY 2021 Plans: Program Increase supported advanced research on Coatings Technology.</p> <p>Work executed by Army Futures Command.</p>	-	5.000
<p>Congressional Add: Program increase - heavy load simulator</p> <p>FY 2021 Plans: Program Increase supported advanced research on Heavy Load Stimulator.</p> <p>Work executed by Army Futures Command.</p>	-	4.200
<p>Congressional Add: Program increase - integrated microgrids</p> <p>FY 2021 Plans: Program Increase supported advanced research on Integrated Microgrids.</p> <p>Work executed by Army Futures Command.</p>	-	4.000
<p>Congressional Add: Program increase - infrastructure resilience and flood assessment</p> <p>FY 2021 Plans: Program Increase supported advanced research on Infrastructure Resilience and Flood Assessment.</p> <p>Work executed by Army Futures Command.</p>	-	3.000
<p>Congressional Add: Program increase - single connection quick oil change system</p>	-	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
FY 2021 Plans: Program Increase supported advanced research on Single Connection Quick Oil Change System. Work executed by Army Futures Command.		
Congressional Add: Program increase - clean modular hydro technology FY 2021 Plans: Program Increase supported advanced research on Clean Modular Hydro Technology. Work executed by Army Futures Command.	-	4.000
Congressional Add: Program increase - accelerator technology for ground maneuver FY 2021 Plans: Program Increase supported advanced research on Accelerator Technology for Ground Maneuver. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase - autonomous combat engineering solutions FY 2021 Plans: Program Increase supported advanced research on Autonomous Combat Engineering Solutions. Work executed by Army Futures Command.	-	5.500
Congressional Add: Program increase - coastal terrain hazard research FY 2021 Plans: Program Increase supported advanced research on Costal Terrain Hazard Research. Work executed by Army Futures Command.	-	8.000
Congressional Add: Program increase - expeditionary deployment of fully sustainable utility FY 2021 Plans: Program Increase supported advanced research on Expeditionary Deployment of Fully Sustainable Utility. Work executed by Army Futures Command.	-	10.000
Congressional Add: Program increase - graphene research FY 2021 Plans: Program Increase supported advanced research on Graphene Research.	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - impacts of soil structures on hydrology FY 2021 Plans: Program Increase supported advanced research on Impacts of Soil Structures on Hydrology.	-	4.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - operational energy research FY 2021 Plans: Program Increase supported advanced research on Operational Energy Research.	-	1.300
Work executed by Army Futures Command.		
Congressional Add: Program increase - temperature insensitive high energy density lithium ion batteries FY 2021 Plans: Program Increase supported advanced research on Temperature Insensitive High-Energy Density Lithium-Ion Batteries.	-	2.500
Work executed by Army Futures Command.		
Congressional Add: Program increase - vehicle performance reliability and operations FY 2021 Plans: Program Increase supported advanced research on Vehicle Performance Reliability and Operations.	-	3.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - cross-laminated timber and recycled carbon fiber materials FY 2021 Plans: Program Increase supported advanced research on Cross-Laminated Timber and Recycled Carbon Fiber Materials.	-	1.300
Work executed by Army Futures Command.		
Congressional Add: Program increase - advanced explosion resistant window systems FY 2021 Plans: Program Increase supported advanced research on Advanced Explosion Resistant Window Systems.	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) BO3 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Adds Subtotals	124.200	181.800

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>				Project (Number/Name) CJ9 / <i>Ground Enabling University Adv Development</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>CJ9: Ground Enabling University Adv Development</i>	-	-	-	4.009	-	4.009	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In FY2022, this is a New Project with funding realigned from PE 0602145 BF8 Artificial Intelligence and Machine Learning Tech.

A. Mission Description and Budget Item Justification

The Project leverages advanced developments and technological innovations 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, by accelerating experiments and demonstrations focused on getting technology to the warfighter more quickly. This Project performs advanced research and development 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 experimentation and demonstration of various advanced 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 advanced research and demonstration 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 0620145A (Ground Technology), PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0603462A (Next Generation Combat Vehicle Advanced Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Robust autonomous capabilities for ground vehicles	-	-	2.209

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) CJ9 / <i>Ground Enabling University Adv Development</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort demonstrates and integrates Artificial Intelligence/Machine Learning (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. Work 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.</p> <p>FY 2022 Plans: Will further mature, integrate and demonstrate use of 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 identify terrain features in images and transfer of simulator-learned behaviors to developmental ground platforms. Mature and demonstrate methods of shared control (between human operators and AI/ML systems) that increase overall autonomous system performance with human input.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding was realigned from PE 0602145 BF8 Artificial Intelligence and Machine Learning Tech</p>			
<p>Title: Human-robot/AI interactions</p> <p>Description: This effort demonstrates and integrates systems involving physical and cognitive levels of interactions between humans and robots, with the use of reinforcement learning (an area of Machine Learning (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 further mature, integrate and demonstrate use of 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 mature and demonstrate 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 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding was realigned from PE 0602145 BF8 Artificial Intelligence and Machine Learning Tech</p>	-	-	1.800
Accomplishments/Planned Programs Subtotals	-	-	4.009

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

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603119A / <i>Ground Advanced Technology</i>	Project (Number/Name) CJ9 / <i>Ground Enabling University Adv Development</i>

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603134A / <i>Counter Improvised-Threat Simulation</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	24.087	24.747	-	24.747	-	-	-	-	-	-
CD3: <i>Counter Improvised-Threat Simulation</i>	-	-	24.087	24.747	-	24.747	-	-	-	-	-	-

Note

This Program Element is a New Start for Fiscal Year 2021 (FY21).

A. Mission Description and Budget Item Justification

This Program Element (PE) develops technology for detecting and defeating Improvised Explosive Devices (IEDs). 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.

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 0603134BR, Counter Improvised Threat Simulation.

B. Program Change Summary (\$ in Millions)

	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>
Previous President's Budget	0.000	25.000	25.000	-	25.000
Current President's Budget	0.000	24.087	24.747	-	24.747
Total Adjustments	0.000	-0.913	-0.253	-	-0.253
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-0.913			
• Adjustments to Budget Years	-	-	-0.253	-	-0.253

Change Summary Explanation

This PE is realigned in FY21 from PE 0603134BR Counter Improvised-Threat Simulation as a result of the transfer of Counter-IED (C-IED) Research, Development, Test, and Evaluation (RDTE) activities to the Army and is fully coordinated with the Under Secretary of Defense for Research and Engineering (USD/R&E) and Defense Threat Reduction Agency (DTRA).

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603134A / Counter Improvised-Threat Simulation				Project (Number/Name) CD3 / Counter Improvised-Threat Simulation			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CD3: Counter Improvised-Threat Simulation	-	-	24.087	24.747	-	24.747	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This Project is a New Start for Fiscal Year 2021 (FY21).

A. Mission Description and Budget Item Justification

This Project develops technology for detecting and defeating improvised explosive devices (IEDs). The goal of this research is to increase the ability of deployed forces to positively identify IEDs with minimal false alarms and increase the rate of advance of deployed forces as well as to identify vehicle and personnel borne IEDs at fixed sites. Additionally the objective is to positively neutralize or mitigate the effects of IEDs with minimal collateral damage.

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 0603134BR, Counter Improvised Threat Simulation.

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

	FY 2020	FY 2021	FY 2022
Title: Standoff Detection of IED Threats in All Environments	-	9.470	10.143
<p>Description: This effort develops technology to detect IED threats at standoff distances. Technologies include electro-optical, radar, light detection and ranging (LIDAR), atomic magnetometer and other technologies applicable to detecting IEDs and their components that can be integrated on dismounted Soldiers, ground, water-based and aerial systems or at fixed sites. This effort also develops technologies and network techniques to detect the electronic signature of radio-controlled IEDs. Technologies will be evaluated on their ability to detect IEDs and their components within infrastructure, on or under ground and water, and attached to vehicles or personnel. The goal for these technologies is to achieve high probabilities of detection while minimizing false alarms from naturally occurring and man-made entities.</p> <p>FY 2021 Plans: Matures and demonstrates sensor technologies including: electro-optical, radar, light range and distance (LIDAR), atomic magnetometer and other technologies applicable to detecting IEDs and their components. Evaluates sensing technologies on their ability to detect IEDs and their components through materials such as walls and garments. Integrates sensor technologies on dismounted Soldiers, ground, water based and aerial systems or at fixed sites to evaluate detection performance. Evaluates</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603134A / <i>Counter Improvised-Threat Simulation</i>	Project (Number/Name) CD3 / <i>Counter Improvised-Threat Simulation</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>detection of radio controlled IEDs using advanced network techniques. Demonstrates detection of IEDs on or under ground, in littoral environments, and attached to vehicles or personnel in all environments.</p> <p>FY 2022 Plans: Will further mature electro-optical/infrared and radio frequency sensor technologies applicable to detecting IEDs and their components in simulated environments. Will validate detection of radio-controlled IEDs using advanced network techniques. Will integrate sensor technologies on Soldier-borne, ground, and aerial platforms or at fixed sites to determine detection performance. Will demonstrate and assess detection of IEDs or their components when buried, camouflaged or attached to vehicles or personnel in various conditions.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: IED Neutralization, Prevention and Mitigation</p> <p>Description: This effort develops technology critical to neutralizing and mitigating the effects of IEDs at standoff distances. Technologies include directed energy sources, energetic or kinetic effectors, encasement of the threat and Soldier, platform and base protection technologies. These technologies will be demonstrated to neutralize IEDs in place and protect soldiers and equipment from the effects of IEDs. This effort also explores advanced techniques to robotically manipulate IEDs. The goal for these technologies is to achieve high probabilities of avoiding the IED's effects by friendly forces.</p> <p>FY 2021 Plans: Matures and demonstrates high power microwave IED neutralization technology previously matured by the Defense Threat Reduction Agency. Develops novel encasement technologies to prevent IED function. Develops energetic and kinetic effector technologies to neutralize IEDs or mitigate IED effects. Develops protection technologies to mitigate the effects of IEDs to Soldiers, materiel and bases. Develops techniques to robotically manipulate IEDs.</p> <p>FY 2022 Plans: Will mature energetic, directed energy and kinetic effector technologies to neutralize IEDs or mitigate IED effects. Will optimize protection approaches to mitigate the effects of IEDs to Soldiers, materiel and bases. Will demonstrate novel C-IED mitigation capabilities in militarily relevant environments.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort for reduced research on high power microwave IED neutralization technology</p>		-	5.319	5.000
<p>Title: Enabling C-IED Technologies</p>		-	9.298	9.604

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603134A / <i>Counter Improvised-Threat Simulation</i>	Project (Number/Name) CD3 / <i>Counter Improvised-Threat Simulation</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort develops technologies that support the detection, prevention, neutralization and mitigation of IED threats. Technologies include data sciences including sensor processing algorithms, integration of sensor data, data processing and analytics, threat forecasting, and autonomous maneuver. Techniques will be demonstrated to determine detection of IED threats and to identify trends to forecast probabilities of encountering or attributing IEDs based on operational data and machine learning techniques. The goals for these technologies is to achieve high probabilities of detecting, predicting and attributing IEDs threats.</p> <p>FY 2021 Plans: Advances sensor processing techniques to detect IED threats. Analyzes data from multiple sensor systems to determine the ability to detect, attribute and predict emplacement of IED threats. Applies autonomous system maneuver for small air and ground platforms to improve detection of IED threats. Uses modeling and simulation to support IED detection and forecasting data analytics.</p> <p>FY 2022 Plans: Will integrate advanced sensor processing techniques with appropriate sensor modalities and evaluate their ability to detect IED threats with reduced false alarms. Will analyze data from multiple sources to determine the signature attributes of threats and to identify the means to exploit these signatures to detect IED threats. Will apply machine learning and emerging data analysis techniques and algorithms to autonomously detect threats with limited operator input. Will analyze techniques to employ multi-sensor data inputs and networked sensor feeds to improve performance capabilities when compared to single sensor solutions.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
Accomplishments/Planned Programs Subtotals	-	24.087	24.747

<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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603386A / <i>Biotechnology for Materials - Advanced Research</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	-	53.736	-	53.736	-	-	-	-	-	-
CP7: <i>Biotechnology Demonstration and Evaluation</i>	-	-	-	53.736	-	53.736	-	-	-	-	-	-

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this Program Element (PE) is created to focus on broad biotechnology efforts in collaboration with Joint Service partners supporting Tri-Service Biotechnology for a Resilient Supply Chain efforts.

A. Mission Description and Budget Item Justification

This PE matures and demonstrates novel biotechnological methods, processes, and materials to enhance military supply chain resilience. 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. The Army supports this Tri-Service effort under this PE with collaboration among sister Services and select allied partners to support a robust pipeline for biotechnology related manufacturing. Advanced research projects optimize and rapidly demonstrate future novel biotechnologies for disruptive breakthrough capabilities. This PE provides bio-engineered and biosynthetic materials to ensure domestic sourcing of critical products in the defense supply chain. Also under this PE, efforts mature and demonstrate rapid prototyping methods for rapid testing of bio-derived materials as well as optimize models for the design and bio-security of bio-engineered materials for defense applications.

Creation of this PE facilitates the Army's central management of the Joint Service T-BRSC effort and ensures traceability of funding. The coordinated strategy of T-BRSC supports a robust pipeline for biotechnology related manufacturing for defense needs. The Army recognizes emerging biotechnologies as a persistent technology that will continue to evolve to meet the anticipated challenges of the future operating environment. This PE creation is necessary for the broad planned initiatives under this effort as no existing Army S&T Project has the requisite programmatic scope of T-BRSC.

This PE is coordinated with PE 0602386A (Biotechnology for Materials - Applied Research).

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 PE is performed by the United States (US) Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603386A / <i>Biotechnology for Materials - Advanced Research</i>
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B. Program Change Summary (\$ in Millions)	<u>FY 2020</u>	<u>FY 2021</u>	<u>FY 2022 Base</u>	<u>FY 2022 OCO</u>	<u>FY 2022 Total</u>
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	53.736	-	53.736
Total Adjustments	0.000	0.000	53.736	-	53.736
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	53.736	-	53.736

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603386A / <i>Biotechnology for Materials - Advanced Research</i>				Project (Number/Name) CP7 / <i>Biotechnology Demonstration and Evaluation</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>CP7: Biotechnology Demonstration and Evaluation</i>	-	-	-	53.736	-	53.736	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this new Project is created to support the Army's central management of Tri-Service Biotechnology for a Resilient Supply Chain (T-BRSC) efforts.

A. Mission Description and Budget Item Justification

This Project collaborates with Joint Service partners to mature, optimize, and demonstrate novel biotechnologies and related methods to establish a domestic resilient supply chain for defense needs. Advanced research validates and provides bio-derived, bio-functionalized, and bio-manufactured materials. This Project matures and demonstrates high-throughput screening and small-scale prototyping, enhances material performance, and exploits biotechnologies to provide drop-in replacements and materials with enhanced properties for defense applications. Areas of focus may include high density, high performance fuels for high speed weapons, bio-based propellants, optical materials, and bio-derived systems that sense and respond to the presence of contaminants.

This Project is coordinated with PE 0602386A (Biotechnology for Materials - Applied Research) / CP6 (Foundational Biotechnology Design and Dev).

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 2020	FY 2021	FY 2022
Title: Biosynthetic Material Demonstration	-	-	53.736
Description: This task matures and demonstrates novel and emerging biotechnologies related to bio-engineered or bio-manufactured materials to address vulnerabilities in the critical material supply chain for military needs.			
FY 2022 Plans: ? Provide Tri-Service rapid prototyping capability for the rapid prototyping and evaluation of bio-products for defense applications to compress the timeline for bio-material development, prototyping, and qualification in support of accelerating transitions. These capabilities include high-throughput screening and small-scale prototyping, small scale material purification, and a DoD custom capacity for rapid screening and evaluation.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603386A / <i>Biotechnology for Materials</i> - <i>Advanced Research</i>	Project (Number/Name) CP7 / <i>Biotechnology Demonstration and Evaluation</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
? Exploit biomanufacturing to provide mission-critical materials and reduce cost and burden of logistics for supply and resupply. Mature bio-manufactured drop-in replacement of high performance fuel by optimizing and validating high density, high performance fuel blends for high speed weapons in support of hypersonic flight.			
? Exploit the agility and flexibility in bio-manufacturing capabilities to address gaps in material performance and demonstrate enhanced material and system performance for ensured operational dominance in contested environments. Mature fire-resistant coating for high-temperature, fire-resistant composite materials in support of long-range missile cases and hypersonic flight.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> This project is a new start in FY 2022.			
Accomplishments/Planned Programs Subtotals	-	-	53.736

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	25.492	43.357	31.426	-	31.426	-	-	-	-	-	-
6CY: Autonomous Cyber Advanced Technology	-	6.000	5.995	9.304	-	9.304	-	-	-	-	-	-
7CY: Decoy and Deterrence Advanced Technology	-	0.186	-	-	-	-	-	-	-	-	-	-
8CY: Information Trust Advanced Technology	-	3.052	10.900	15.876	-	15.876	-	-	-	-	-	-
9CY: Network Access and Effects Advanced Technology	-	1.431	4.464	4.347	-	4.347	-	-	-	-	-	-
CB4: Offensive Cyber Operations (OCO) Mirror Adv Tech	-	4.823	1.998	1.899	-	1.899	-	-	-	-	-	-
CB6: C3I Cyber Advanced Development (CA)	-	10.000	20.000	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE matures and demonstrates technologies for offensive and defensive cyber operations in tactical environments. Efforts optimize devices, techniques, services, software and algorithms to enable cyber situational understanding and Cyber Electromagnetic Activities (CEMA). For offensive cyber, efforts demonstrate integrated electronic attack (EA) and CEMA hardware and software to execute force protection (FP), EA, electronic surveillance (ES), signals intelligence (SIGINT), electronic warfare (EW) and cyber missions in a dynamic, distributed and coordinated fashion. For defensive cyber, efforts demonstrate hardware and software to protect tactical wired and wireless networks against modern cyber attacks and focuses on configuration, operation, monitoring, data integrity, and defense in bandwidth constrained tactical environments while reducing the operator workload required to conduct these functions.

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603457A / <i>C3I Cyber Advanced Development</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	23.769	23.357	28.773	-	28.773
Current President's Budget	25.492	43.357	31.426	-	31.426
Total Adjustments	1.723	20.000	2.653	-	2.653
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	10.000	20.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-8.277	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	2.653	-	2.653

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

Project: CB6: *C3I Cyber Advanced Development (CA)*

Congressional Add: *Program Increase*

Congressional Add: *Program increase - high bandwidth cryptomodule enhancements and certification*

Congressional Add: *Program increase - low SWAP software-defined MFEW*

Congressional Add Subtotals for Project: CB6

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	10.000	-
	-	10.000
	-	10.000
Congressional Add Subtotals for Project: CB6	10.000	20.000
Congressional Add Totals for all Projects	10.000	20.000

Change Summary Explanation

0603457A- Increases in Program Element funding in Fiscal Year (FY) 2022 is due to an increase of funds that were transitioned from applied research efforts in Program Element 0602213A (C3I Applied Cyber); specifically projects CY6 and CY8.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development				Project (Number/Name) 6CY / Autonomous Cyber Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
6CY: Autonomous Cyber Advanced Technology	-	6.000	5.995	9.304	-	9.304	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 funding is realigned from:
 PE 0603463A (Network C3I Advanced Technology) Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech)
 PE 0602213A (C3I Applied Cyber) Project CY8 (Cyber Security App Research and Exper Partner Tech)

A. Mission Description and Budget Item Justification

This Project will demonstrate defensive effects to adversarial use of artificial intelligence (AI) and machine learning (ML) to avoid detection and deceive our automated technologies driving the network decisions. This Project provides cyber autonomy through science & technology advancements. Work in this project complements PE 0602213A (C3I Applied Cyber) Project CY6 (Autonomous Cyber Technology)

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Autonomous Cyber	6.000	5.995	9.304
Description: This effort will develop proof-of-concept sensors that can adapt to and autonomously react to adversary cyber-attack and develop a cyber response course of action decision aid for cyber defenders to validate correctness of actions and to speed response decisions.			
FY 2021 Plans: Mature and demonstrate proof-of-concept cyber response course of action decision aid software that will ingest and correlate event feeds from existing sensors, cybersecurity applications, and services to provide intuitive recommendations to the S6 Cyber Electromagnetic Activities (CEMA) personnel for use in countering adversarial cybersecurity events. This technology will ease the burden of knowledge, validate correctness of actions, and speed response decisions.			
FY 2022 Plans: Will validate the interoperable AI/ML based cyber defense decision aid architecture supporting warfighter planning in a high-fidelity cyber emulation environment; will demonstrate significant performance improvements in cyber response course of action decision			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 6CY I Autonomous Cyber Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
aid software while optimizing the ingestion and correlation of event feeds from existing sensors, cybersecurity applications, and services to provide intuitive recommendations to the S6 Cyber Electromagnetic Activities (CEMA) personnel for use in countering adversarial cybersecurity events in a high-fidelity cyber emulation environment. This technology will ease the burden of knowledge, validate correctness of actions, and speed response decisions. FY 2021 to FY 2022 Increase/Decrease Statement: Funding in this effort was realigned from PE 0603463A Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech) and PE 0602213A (C3I Applied Cyber) Project CY8 (Cyber Security App Research and Exper Partner Tech) to increase efforts to improve and demonstrate cyber response course of action decision aid software.				
Accomplishments/Planned Programs Subtotals		6.000	5.995	9.304
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 7CY / Decoy and Deterrence Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>7CY: Decoy and Deterrence Advanced Technology</i>	-	0.186	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project demonstrates disruption of enemy cyber attacked through the use of cyber decoy applications with realistic user behavior algorithms, such as software that creates fake users, applications, systems, documents, networks, and communication traffic.

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 2020	FY 2021	FY 2022
Title: Decoy and Deterrence Advanced Technology	0.186	-	-
Description: This Project demonstrates disruption of enemy cyber attacked through the use of cyber decoy applications with realistic user behavior algorithms, such as software that creates fake users, applications, systems, documents, networks, and communication traffic.			
Accomplishments/Planned Programs Subtotals	0.186	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development				Project (Number/Name) 8CY I Information Trust Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
8CY: Information Trust Advanced Technology	-	3.052	10.900	15.876	-	15.876	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding in this Project was realigned from:
 Program Element (PE) 0602146A (Network C3I Technology) Project AP7 (Comms/Horiz Int for Army Mod Priorities Tech)
 PE 0603463A Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech)

A. Mission Description and Budget Item Justification

This Project demonstrates enhanced awareness of the information's "provenance" from originator to consumer (e.g. sensor to shooter) in the presence of cyber-attacks, such as an attempt to manipulate data traversing the network. Work in this Project complements PE 06022213A C3I Applied Cyber, Project 2CY Information Trust 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 2020	FY 2021	FY 2022
Title: Information Trust Advanced Technology	3.052	3.500	4.507
Description: This Project demonstrates enhanced awareness of the information's "provenance" from originator to consumer (e.g. sensor to shooter) in the presence of cyber-attacks, such as an attempt to manipulate data traversing the network.			
FY 2021 Plans: Mature and demonstrate the authentication service that helps determine and track user trust values within a block chain architecture.			
FY 2022 Plans: Will mature and demonstrate the specification based fixed format message checking and machine learning based integrity services that ensure the integrity of a messages data, origin, and chain of custody as it traverses the network; will mature and demonstrate the authentication service proof-of-concept that helps determine and track user trust values within a block chain architecture; will implement and mature technology to create a suitable de-centralized lightweight block chain algorithm that can be leveraged to ensure a secure distributed ledger of messages and associated risk with automated analysis of attempted			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 8CY I Information Trust Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
malicious modification; will optimize user and role-based authentication services and demonstrate within high fidelity cyber emulation environment. FY 2021 to FY 2022 Increase/Decrease Statement: Funding in this effort was realigned from PE 0603463A Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech) for demonstration of the authentication service.				
Title: Agile Virtual Enclave Description: To develop a Multi-Level Security (MLS) Access Guard to reduce hardware infrastructure required for US Government owned systems and develop a Mission Partner Environment (MPE) transfer cross domain solution (CDS) to enable data sharing with coalition partners. FY 2021 Plans: Mature, optimize and demonstrate a MLS access guard implementation that leverages virtual container techniques to allow users to access different levels of classified data from a common hardware platform; mature and demonstrate a Transfer Guard implementation that supports MPEs and allows access to common services and mission command as part of a network package that is reliable, protected and configurable to mission requirements for multiple security classification information requirements that enable seamless preparation and conduct of unified land operations. FY 2022 Plans: Will integrate a demonstrable baseline Cross Domain Solution (CDS) which will incorporate Multi Single Level Security (MSL) Access Guard with the Mission Partner Environment (MPE) Transfer Guard solution. Will conduct a validation and verification evaluations and field tests, on the final Integrated CDS deliverable in order to prove out the technology. Will mature all supporting documentation generated throughout the length of the Agile Virtual Enclave (AVE) program to include Preliminary Design Reviews (PDRs) and Capabilities Design Document (CDDs) for all the deliverables. Will mature a generalized solution for use on MSL Access Guard platform with potential for adaptation across Armed Forces systems and will incorporate it into the final deliverable. FY 2021 to FY 2022 Increase/Decrease Statement: Funding in this effort was realigned from PE 0602146A Project AP7 (Comms/Horiz Int for Army Mod Priorities Tech) to mature and demonstrate technology to develop a MLS Access Guard for data sharing in a mission partner environment with a reduced hardware footprint.		-	7.400	11.369
Accomplishments/Planned Programs Subtotals		3.052	10.900	15.876
C. Other Program Funding Summary (\$ in Millions) N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 8CY / Information Trust Advanced 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development				Project (Number/Name) 9CY / Network Access and Effects Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
9CY: Network Access and Effects Advanced Technology	-	1.431	4.464	4.347	-	4.347	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced mission management tools and workflows, to promote efficient selection and sequencing of effects to support the agile deployment and execution of Offensive Cyber Operations / Radio Frequency (RF) Enabled capabilities. Work in this project complements PE 0602213A (C3I Applied Cyber) Project 3CY (Network Access and Effects 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 2020	FY 2021	FY 2022
Title: Offensive Cyber Enabling Mission Support	1.431	4.464	4.347
Description: This effort matures and demonstrates advanced mission management tools and workflows, to promote efficient selection and sequencing of effects to support the agile deployment and execution of Offensive Cyber Operations/Radio Frequency (RF) Enabled capabilities.			
FY 2021 Plans: Mature and optimize protocol-based access offensive cyber operations techniques and demonstrate D4M effects launched from tactical RF platforms against specific targets of interest in a suitable environment			
FY 2022 Plans: Will mature and demonstrate OCO/RF enabled access and effects vectors against validated targets of interest; optimize assisted technique development for expedited vulnerability discovery against validated Adversary Command, Control, Communication, Computers, and Intelligence (AC4I) targets of interest; and mature decision aids for optimization of RF enabled techniques in support of the Commander's desired intent.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.431	4.464	4.347

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 9CY / Network Access and Effects Advanced 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development				Project (Number/Name) CB4 / Offensive Cyber Operations (OCO) Mirror Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CB4: <i>Offensive Cyber Operations (OCO) Mirror Adv Tech</i>	-	4.823	1.998	1.899	-	1.899	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates methods, tools and techniques to enable rapid instantiation of an operationally relevant cyberspace environment supporting critical Offensive Cyber Operations (OCO) mission functions to include but not limited to development, exercise, mission rehearsal and provide technical reach back to units during operations. Work in this project complements PE 0602213A (C3I Applied Cyber) Project 5CY (Offensive Cyber Operations (OCO) Mirror Technology).

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Offensive Cyber Operations Mirror	2.000	1.998	1.899
Description: This effort matures and demonstrates methods, tools and techniques to enable rapid instantiation of an operationally relevant cyberspace environment supporting critical OCO mission functions to include but not limited to development, exercise, mission rehearsal and provide technical reach back to units during operations.			
FY 2021 Plans: Mature and demonstrate initial increment of an interactive modeling and simulation capability within rapid response environment; and mature and demonstrate validated mirror capabilities within an interactive, behavior based modeling and simulation environment.			
FY 2022 Plans: Will mature and demonstrate incremental modeling and simulation (M&S) software and optimize fidelity driven Development Security Operations (DevSecOps) with exemplar OCO/Radio Frequency (RF) firing platforms; demonstrate information operations social influence mission functions within relevant environment; and optimizes the ?body of evidence? necessary to achieve an accredited rapid response enclave in support of DevSecOps utilization of tactical OCO/RF Enabled platforms at mission speed.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) CB4 / Offensive Cyber Operations (OCO) Mirror Adv Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.			
Title: Non-Kinetic Kill Chain Architecture Description: This effort matures architectures and virtual testbeds to demonstrate offensive cyber capabilities in a multi-domain, contested environment.	2.823	-	-
Accomplishments/Planned Programs Subtotals	4.823	1.998	1.899

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development				Project (Number/Name) CB6 / C3I Cyber Advanced Development (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CB6: C3I Cyber Advanced Development (CA)	-	10.000	20.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
Congressional Interest Item funding provided for C3I Cyber Advanced Development.

A. Mission Description and Budget Item Justification
Congressional Interest Item funding provided for C3I Cyber Advanced Development.

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 2020	FY 2021
Congressional Add: Program Increase	10.000	-
FY 2020 Accomplishments: Congressional Interest Item in support of cyber advanced technology development.		
Congressional Add: Program increase - high bandwidth cryptomodule enhancements and certification	-	10.000
FY 2021 Plans: Conduct advanced research in High Bandwidth Cryptomodule Enhancements and Certification. Work executed by Army Futures Command.		
Congressional Add: Program increase - low SWAP software-defined MFEW	-	10.000
FY 2021 Plans: Conduct advanced research in Low SWAP Software-Defined MFEW. Work executed by Army Futures Command.		
Congressional Adds Subtotals	10.000	20.000

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

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) CB6 / C3I Cyber Advanced Development (CA)

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603461A / High Performance Computing Modernization Program
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	217.389	221.161	189.123	-	189.123	-	-	-	-	-	-
DS7: High Performance Computing Modernization Program	-	217.389	181.161	189.123	-	189.123	-	-	-	-	-	-
DW5: HIGH PERF COMP MODERN (HPCM) (CA)	-	-	40.000	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of Department of Defense (DoD) scientists and engineers by: (1) demonstrating and maturing the most advanced, leading-edge computational architectures while exploiting the resulting systems by employing complementary specialized expertise; (2) demonstrating and maturing the Defense Research and Engineering Network (DREN), which investigates, demonstrates, and matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD Research, Development, Test, and Evaluation (RDTE) community; and (3) leveraging specialized expertise from DoD, other federal departments and agencies, industry, and academia to demonstrate and mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities to demonstrate and mature emerging technologies that address the supercomputing requirements of the DoD RDTE community in the areas of hardware, software, and programming environments. All HPCMP sites are interconnected to each other, the DoD High Performance Computing (HPC) RDTE community, and other major defense sites via the DREN, a research network which investigates, demonstrates, and matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to protect the intellectual property of the DoD and its contract entities as they employ HPCMP capabilities. The HPCMP's software application effort (a) optimizes, enhances, demonstrates, and matures critical DoD physics-based and engineering software to allow scientists and engineers to execute calculations with precision and efficiency on leading-edge supercomputers, (b) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates and matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate and mature horizontal technologies that are exploited across the DoD RDTE community, ensuring the DoD maintains the most advanced research and development ecosystem in computationally-intensive modeling and design.

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603461A / <i>High Performance Computing Modernization Program</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	224.755	188.024	191.463	-	191.463
Current President's Budget	217.389	221.161	189.123	-	189.123
Total Adjustments	-7.366	33.137	-2.340	-	-2.340
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	40.000	40.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-40.000	-			
• SBIR/STTR Transfer	-7.366	-6.863			
• Adjustments to Budget Years	-	-	-2.340	-	-2.340

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

Project: DS7: High Performance Computing Modernization Program

Congressional Add: *Program Increase*

Congressional Add Subtotals for Project: DS7

Project: DW5: HIGH PERF COMP MODERN (HPCM) (CA)

Congressional Add: *Program increase*

Congressional Add Subtotals for Project: DW5

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	40.000	-
Congressional Add Subtotals for Project: DS7	40.000	-
	-	40.000
Congressional Add Subtotals for Project: DW5	-	40.000
Congressional Add Totals for all Projects	40.000	40.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603461A / High Performance Computing Modernization Program				Project (Number/Name) DS7 / High Performance Computing Modernization Program			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
DS7: High Performance Computing Modernization Program	-	217.389	181.161	189.123	-	189.123	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The High Performance Computing Modernization Program (HPCMP) addresses the supercomputing requirements of Department of Defense (DoD) scientists and engineers by (1) demonstrating and maturing the most advanced, leading-edge computational architectures and exploiting the resulting systems by employing complementary specialized expertise; (2) demonstrating and maturing the Defense Research and Engineering Network (DREN) which investigates, demonstrates, and matures leading-edge digital networking and security technologies to securely deliver computational capabilities to the distributed DoD Research, Development, Test, and Evaluation (RDTE) and acquisition engineering communities; and (3) leveraging specialized expertise from DoD, other federal departments/agencies, industry, and academia to demonstrate and mature leading-edge software application codes. DoD Supercomputing Resource Centers (DSRCs) provide extensive computational capabilities and demonstrate and mature emerging technologies that address the supercomputing requirements of the DoD RDTE and acquisition engineering communities in the areas of hardware, software, and programming environments. HPCMP sites are interconnected to each other, the DoD High Performance Computing (HPC) RDTE community, and other major defense sites via DREN, a research network which investigates, demonstrates, and matures (a) state-of-the-art digital networking technologies to ensure a robust distributed environment and (b) the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities as they employ HPCMP advanced capabilities. The HPCMP's software application effort (a) optimizes, enhances, demonstrates, and matures critical DoD physics-based and engineering software to allow scientists and engineers to execute calculations with precision and efficiency on leading-edge supercomputers, (b) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (c) demonstrates and matures leading-edge computational technology from academia and industry. These synergistic activities collectively demonstrate and mature horizontal technologies that are exploited throughout the DoD RDTE and acquisition engineering communities, ensuring the DoD maintains the most advanced research ecosystem in the areas of computationally-intensive modeling and design.

The work cited 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 2020	FY 2021	FY 2022
Title: Department of Defense Supercomputing Resource Centers	95.167	95.975	100.194
Description: The effort investigates, demonstrates, and matures general and special-purpose supercomputing environments that incorporate the most advanced, leading-edge computational architectures, distributed mass storage technologies, and data analysis methodologies; employs complementary specialized expertise to mature and exploit these environments; enables the DoD RDTE and acquisition engineering communities to effectively and efficiently investigate, demonstrate, and mature a broad range of technologies through advanced computational methods.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / <i>High Performance Computing Modernization Program</i>	Project (Number/Name) DS7 / <i>High Performance Computing Modernization Program</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p><i>FY 2021 Plans:</i> Continue to accelerate technology capabilities with a suite of supercomputers to address DoD priorities that satisfy the diverse needs of DoD stakeholders including security, workload, and architecture requirements. Continue to enhance and exploit the advanced capabilities of previously demonstrated supercomputers to conduct complex, tightly-coupled, large-scale, scientific calculations to address DoD challenges in the essential computational domains. Demonstrate the potential benefits of multiple architectures (scientific, analytics, machine learning, etc.) that are tightly-integrated and incorporate leading-edge processors, memory, disk I/O, interconnect, and OS capabilities. Demonstrate new mechanisms to access and reduce barriers to supercomputers. Leverage data-intensive supercomputing architectures for DoD use cases in machine learning, artificial intelligence, and data sciences.</p> <p><i>FY 2022 Plans:</i> Will complete integration of commercial cloud computing, making it broadly available to the entire HPCMP user community. Will integrate data-centric center methodologies into our supercomputing centers. Will continue to accelerate technology capabilities with a suite of supercomputers and high-end computing services to address DoD priorities that satisfy the diverse needs of DoD stakeholders including security, workload, and architecture requirements. Will continue to demonstrate the potential benefits of multiple architectures (scientific, analytics, machine learning, etc.) that incorporate leading-edge processors, accelerators, memory, data I/O (input/output), interconnect, and OS (operating system) capabilities. Will continue to demonstrate new mechanisms to access and reduce barriers to supercomputers. Will continue to leverage data-intensive supercomputing architectures for DoD use cases in machine learning, artificial intelligence, and data sciences. Will implement new capabilities for secure shared highly-classified supercomputing, transportable data-intensive computing at the tactical edge, and persistent data services.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects the planned lifecycle of this effort.</p>				
<p><i>Title:</i> Defense Research and Engineering Network</p> <p><i>Description:</i> This effort investigates, demonstrates, and matures state-of-the-art digital networking technologies to ensure a robust distributed environment among HPCMP sites, the DoD HPC RDTE and acquisition engineering communities, and other major defense sites; investigates, demonstrates, and matures the most advanced digital security capabilities to effectively protect the intellectual property of the DoD and its contract entities as they employ HPCMP advanced capabilities; employs complementary specialized expertise to mature and exploit this environment.</p> <p><i>FY 2021 Plans:</i> Continue to refine and exploit DREN (an advanced digital DoD research network) which provides robust, high-bandwidth, low-latency, low-jitter connectivity among the HPCMP and DoD RDTE communities with specific efforts targeted at the unique</p>		30.152	31.770	33.165

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / <i>High Performance Computing Modernization Program</i>	Project (Number/Name) DS7 / <i>High Performance Computing Modernization Program</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>requirements of the T&E and Acquisition Engineering communities. Finalize the strategic technical planning and acquisition strategy development for DREN IV, the follow-on to DREN III, with next-generation technical capabilities and significantly increased bandwidths to support the HPCMP and DoD RDTE communities; complete source selection for DREN IV. Complete and fine tune the IAP Security Gateway Enhancement Project to enhance HPCMP's DISA-accredited Tier 2 cybersecurity service provider capability to effectively protect the intellectual property of the DoD and its contract entities as they utilize HPCMP advanced capabilities. Continue to mature the advanced network technologies and complex cybersecurity mechanisms required to implement logically-separated networked COIs at multiple classification levels.</p> <p>FY 2022 Plans: Will continue to refine and exploit DREN (an advanced digital DoD wide area research network and part of the DoD Information Network backbone) which provides robust, high-bandwidth, low-latency, low-jitter, and full-service network connectivity among the HPCMP and DoD RDTE/Acquisition Engineering (AE) communities with specific efforts targeted at the unique requirements of the T&E and AE communities. Will complete source selection activities for DREN 4, initiated in FY21, leading to a contract award for commercial wide area network services. DREN 4 is the follow-on contract to DREN III, and will provide next-generation technical capabilities and significantly increased bandwidths to support the HPCMP and DoD RDTE/AE communities. Will continue to enhance and refine the protection of all external DREN boundaries to enhance the HPCMP's DISA-accredited Tier 2 cybersecurity service provider capability to effectively protect the intellectual property of the DoD and its contract entities as they utilize HPCMP advanced capabilities. Will establish and enhance network transport to the commercial cloud for those HPCMP and DoD RDTE/AE communities moving computation, data storage, and other requirements to the cloud environment. Will continue to mature the advanced network technologies and complex cybersecurity mechanisms required to implement logically-separated networked COIs (communities of interest) at multiple classification levels.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.</p>				
<p>Title: Software Applications</p> <p>Description: This effort optimizes, enhances, demonstrates, and matures software applications to provide for the adaptation of widely used applications and algorithms to address RDTE and acquisition engineering communities requirements. The Computational Research Engineering Acquisition Tools and Environments (CREATE) initiative demonstrates and matures advanced application codes to allow scientists and engineers to use supercomputers to design and analyze virtual prototypes of DoD ships, fixed-wing aircraft, rotorcraft, ground vehicles, and radio frequency (RF) antennas; HPCMP Institutes demonstrate and mature advanced supercomputing application codes to address critical high-impact DoD challenges (e.g. blast protection for platforms and personnel, high-power microwaves and lasers, munition sensitivities, and mobile network designs/prototypes); High Performance Computing Applications Software Initiative (HASI) projects address the need to mature and refine critical DoD software that can take advantage of new and emerging hardware advances; the Frontier initiative represents and supports</p>		52.070	53.416	55.764

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / <i>High Performance Computing Modernization Program</i>	Project (Number/Name) DS7 / <i>High Performance Computing Modernization Program</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>the DoD's highest-priority, highest-impact, most demanding computational work, both from a technical and mission-relevance standpoint; the Productivity, Enhancement, Technology Transfer, and Training (PETTT) initiative (1) optimizes and enhances critical DoD physics based and engineering software to allow scientists and engineers to execute scientific calculations with precision and efficiency on leading-edge supercomputers, (2) demonstrates and matures immersive collaborative programming environments to improve science and engineering workflows, and (3) demonstrates and matures leading-edge computational technology from academia and industry.</p> <p>FY 2021 Plans: Continue to mature and enhance multi-disciplinary software technology in support of current and future defense programs. For aeronautical systems of all types (i.e., fixed and rotary-wing aircraft, munitions, missiles, rockets, etc.), this endeavor continues to mature model-centric conceptual design software technology to support pre Milestone-A Defense acquisition processes, enabling application of physics-based analysis of alternatives, technology trade-space exploration, and analysis of cost implications. Continue implementation of foundational software improvements necessary to begin development of physics-based design analysis tools for future hypersonic weapon systems (High Speed Strike, Tactical Boost-Glide, and Manned/ Unmanned Conventional Prompt Global Strike). For fixed-wing aircraft, a) continue incorporating new generation of high order accuracy solvers; b) continue implementing hypersonic terminal maneuvers; and c) continue incorporating hypersonic long-duration/heat soak algorithms. For rotorcraft, continue aeromechanics analysis associated with maneuvers, airframe-propulsion system integration, and weapons carriage and release, as well as infrared suppression analysis, chaff trajectory prediction, debris ingestion analysis, and loads prediction capability necessary for structural airworthiness assessments. RF antenna design and analysis continue to mature computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; continue demonstrating capability for assessment of electromagnetic hazards on ordnance and optimizing computational methods for electronic warfare assessments and evaluation of multiple antenna systems on a single platform. Continue to include efforts in aircraft radar signature prediction capabilities that effectively include propulsion system inlet and exhaust. Continue efforts to incorporate high-resolution (X- Band frequencies) virtual test and analysis capabilities for fighter-scale aircraft. For Naval Ships (surface and submarine), continue incorporation of; a) hullform optimization; b) multi-hull seakeeping capabilities; and c) virtual ship powering algorithms. Continue to incorporate 6-D0F submarine maneuvering. For Ground Vehicles will continue to expand autonomy capabilities.</p> <p>FY 2022 Plans: Will continue to mature and enhance multi-disciplinary software technology in support of current and future defense programs, establishing a foundation for powerful decision support applications synthesized using machine learning methodologies. Multi-disciplinary technology for aeronautical systems of all types (i.e., fixed and rotary-wing aircraft, munitions, missiles, rockets, etc.), this endeavor will continue to mature model-centric conceptual design software technology to support Pre-Milestone-A Defense acquisition processes, enabling application of physics-based analysis of alternatives, technology trade-space exploration, and</p>				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / High Performance Computing Modernization Program	Project (Number/Name) DS7 / High Performance Computing Modernization Program
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B. Accomplishments/Planned Programs (\$ in Millions)

<p>analysis of cost implications. Will continue mature software improvements necessary to deploy production quality physics-based design analysis tools for future hypersonic weapon systems (High Speed Strike, Tactical Boost-Glide, and Manned/Unmanned Conventional Prompt Global Strike). For fixed-wing aircraft, a) will continue incorporating new generation of high order accuracy solvers; b) will continue implementing hypersonic terminal maneuvers; and c) will continue incorporating hypersonic long-duration/heat soak algorithms. For rotorcraft, will continue aeromechanics analysis associated with maneuvers, airframepropulsion system integration, and weapons carriage and release, as well as infrared suppression analysis, chaff trajectory prediction, debris ingestion analysis, and loads prediction capability necessary for structural airworthiness assessments. RF antenna design and analysis will continue to mature computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; will continue demonstrating capability for assessment of electromagnetic hazards on ordnance and optimizing computational methods for electronic warfare assessments and evaluation of multiple antenna systems on a single platform. Will continue to include efforts in aircraft radar signature prediction capabilities that effectively include propulsion system inlet and exhaust. Will continue efforts to incorporate high-resolution (XBand frequencies) virtual test and analysis capabilities for fighter-scale aircraft. For Naval Ships (surface and submarine), will continue incorporation of; a) hullform optimization; b) multi-hull seakeeping capabilities; and c) virtual ship powering algorithms. Will continue to incorporate 6-D0F (6-degree of freedom) submarine maneuvering. Will continue development of ship shock virtual test and analysis capabilities. For Ground Vehicles will continue to expand autonomy capabilities associated with ground mobility test requirements. Will execute fact finding investigations to more fully understand how physics-informed machine learning can impact DoD priorities and effectively support decision makers throughout weapon system development, deployment, and operation life-cycle.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.</p>	FY 2020	FY 2021	FY 2022
Accomplishments/Planned Programs Subtotals	177.389	181.161	189.123

	FY 2020	FY 2021
Congressional Add: Program Increase	40.000	-
FY 2020 Accomplishments: Program Increase supported advanced research on High Performance Computing.		
Congressional Adds Subtotals	40.000	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603461A / <i>High Performance Computing Modernization Program</i>	Project (Number/Name) DS7 / <i>High Performance Computing Modernization Program</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603461A / High Performance Computing Modernization Program				Project (Number/Name) DW5 / HIGH PERF COMP MODERN (HPCM) (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
DW5: HIGH PERF COMP MODERN (HPCM) (CA)	-	-	40.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This project enables the Defense Research, Development, Test and Evaluation (RDT&E) community to resolve critical scientific and engineering problems more quickly, and with more precision, using advanced, physics-based computer simulation supported by high performance computing (HPC) technology. The computational expertise and resources enable Department of Defense (DoD) personnel to analyze phenomena that are often impossible, not cost effective, too time-consuming, or too dangerous to study any other way. The High Performance Computing Modernization Program (HPCMP) supports the requirements of the DoD's scientists and engineers in three major areas of effort: supercomputing resource centers, the Defense Research and Engineering Network (DREN), and software applications. DoD Supercomputing Resource Centers (DSRCs) provide extensive capabilities and demonstrate new technologies that address user requirements for hardware, software, and programming environments. Efforts of the DSRCs are augmented by dedicated HPC project investments (DHPis) that address near real-time and real-time HPC requirements. All sites in the HPC Modernization Program are interconnected to one another, the user community, and major defense sites via the DREN, a research network which matures and demonstrates state-of-the-art computer network technologies. The Software Application effort optimizes and improves the performance of critical common DoD applications programs to run efficiently on advanced HPC systems, matures and demonstrates leading-edge computational technology from academic and commercial partners, and provides collaborative programming environments.

The work cited 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 2020	FY 2021
Congressional Add: Program increase	-	40.000
FY 2021 Plans: Program Increase supports advanced research on High Performance Computing.		
Congressional Adds Subtotals	-	40.000

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)					PE 0603462A / Next Generation Combat Vehicle Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	255.386	302.209	164.951	-	164.951	-	-	-	-	-	-
BF2: Autonomous Ground Resupply (AGR) Adv Tech	-	18.000	18.574	-	-	-	-	-	-	-	-	-
BF4: Combat Vehicle Robotics Adv Tech	-	9.884	8.504	26.777	-	26.777	-	-	-	-	-	-
BF5: Adv Lethality & Accuracy Sys for Med Cal Adv Tech	-	1.918	-	-	-	-	-	-	-	-	-	-
BF7: Crew Augmentation and Optimization Adv Tech	-	3.712	4.411	3.768	-	3.768	-	-	-	-	-	-
BG1: Sensors for Auto Oper and Survivability Adv Tech	-	11.030	13.954	10.733	-	10.733	-	-	-	-	-	-
BG3: Modeling and Simulation for MUMT Advanced Tech	-	3.499	3.241	5.188	-	5.188	-	-	-	-	-	-
BG4: Adv Mobility Experimental Prototype Adv Tech Demo	-	8.380	3.760	2.819	-	2.819	-	-	-	-	-	-
BG5: Extended Line of Sight (ELOS) Advanced Technology	-	10.419	1.396	-	-	-	-	-	-	-	-	-
BG7: Ground Systems Active Defense (GSAD) Advanced Tech	-	23.774	48.196	52.172	-	52.172	-	-	-	-	-	-
BG9: Obscuration Advanced Technology	-	2.958	9.774	2.608	-	2.608	-	-	-	-	-	-
BH1: Survivability Systems Controls Advanced Technology	-	12.487	13.680	-	-	-	-	-	-	-	-	-
BH3: C4ISR Modular Autonomy Advanced Technology	-	5.941	-	-	-	-	-	-	-	-	-	-
BH4: Ground Vehicle Holistic Defense Adv Tech	-	-	-	0.034	-	0.034	-	-	-	-	-	-
BH6: Platform Electrification and Mobility Adv Tech	-	4.775	24.006	24.891	-	24.891	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>											
BH8: <i>Enhanced VETRONICS Advanced Technology</i>	-	12.398	12.009	14.989	-	14.989	-	-	-	-	-	-
BI1: <i>Protection for Autonomous Systems Adv Tech</i>	-	3.931	-	-	-	-	-	-	-	-	-	-
BI3: <i>Sensor Protection Advanced Technology</i>	-	1.438	1.752	1.645	-	1.645	-	-	-	-	-	-
BI5: <i>Materials Application and Integration Adv Tech</i>	-	3.476	5.286	4.947	-	4.947	-	-	-	-	-	-
BJ1: <i>Vehicle System Security Advanced Technology</i>	-	1.199	1.444	2.455	-	2.455	-	-	-	-	-	-
BJ6: <i>Hydrogen Based Combat System Advanced Technology</i>	-	0.519	-	-	-	-	-	-	-	-	-	-
BJ8: <i>Detection of Explosive Hazards Advanced Technology</i>	-	4.919	-	-	-	-	-	-	-	-	-	-
BK1: <i>Autonomous Mobility Adv Tech</i>	-	9.308	8.470	6.244	-	6.244	-	-	-	-	-	-
BK4: <i>Next Gen Intelligent Fire Control(NG-IFC) Adv Tech</i>	-	0.432	8.903	1.727	-	1.727	-	-	-	-	-	-
BK6: <i>Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech</i>	-	0.489	3.026	-	-	-	-	-	-	-	-	-
BP6: <i>Ground Vehicle Advanced Technology(CA)</i>	-	100.500	108.000	-	-	-	-	-	-	-	-	-
BZ9: <i>Smart Targeting Environment for Lower Level Assets</i>	-	-	3.823	3.954	-	3.954	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE executes development, and demonstration for the Army's modernization priority for the Next Generation of Combat Vehicles. This PE matures, integrates and demonstrates combat vehicle technologies that enable the Army to have a smarter, faster, more lethal, more precise, more protected, and more adaptable force. Technology development builds upon the foundational vehicle architectures to support the Next Generation of Combat Vehicles, to include autonomy architecture,

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>
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power architecture, vehicle electronic architecture, physical architecture, lethality architecture and vehicle protection architecture. Technologies developed, matured, and demonstrated will 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 0602145A (Next Generation Combat Vehicle Technology), PE 0602146A (Network C3I Technology), PE 0602782A (Command, Control, Communications Technology), PE 0603116A (Lethality Advanced Technology), PE 0603119A (Ground Advanced Technology), PE 0603463A (Network C3I Advanced Technology), PE 0604115A (Technology Maturation Initiatives), and PE 0708045A (End Item Industrial Preparedness Activities). Work in this PE also transitions to PE 0603645A (Armored Systems Modernization Adv Dev) and PE 0604017A (Robotics Development).

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

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	260.535	199.358	196.039	-	196.039
Current President's Budget	255.386	302.209	164.951	-	164.951
Total Adjustments	-5.149	102.851	-31.088	-	-31.088
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	100.500	108.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-99.179	-			
• SBIR/STTR Transfer	-6.470	-5.149			
• Adjustments to Budget Years	-	-	-31.088	-	-31.088

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

Project: BP6: *Ground Vehicle Advanced Technology(CA)*

Congressional Add: *Additive Manufacturing for Jointless Hull*

Congressional Add: *Carbon Fiber and Graphite Foam Technology*

Congressional Add: *Hydrogen Fuel Cells*

	FY 2020	FY 2021
	20.000	10.000
	10.000	10.000
	10.000	10.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>
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<u>Congressional Add Details (\$ in Millions, and Includes General Reductions)</u>	FY 2020	FY 2021
Congressional Add: <i>ATE5.2 Engine Development</i>	5.000	10.000
Congressional Add: <i>Additive Manufacturing of Critical Components</i>	5.000	5.000
Congressional Add: <i>Advanced Water Harvesting Technology</i>	5.000	-
Congressional Add: <i>Advanced High Strength and Lightweight Steels</i>	3.000	-
Congressional Add: <i>Combat Vehicle Weight Reduction Initiative</i>	8.000	10.000
Congressional Add: <i>Virtual and Physical Prototyping</i>	8.000	10.000
Congressional Add: <i>HMMWV Augmented Reality System</i>	5.000	-
Congressional Add: <i>Health Usage Monitoring for HMMWV</i>	3.000	-
Congressional Add: <i>HMMWV Autonomy</i>	5.000	3.000
Congressional Add: <i>HMMWV Torque Monitoring</i>	2.000	-
Congressional Add: <i>HMMWV Automotive Enhancements</i>	7.500	5.000
Congressional Add: <i>Additive Manufacturing</i>	4.000	-
Congressional Add: <i>Program increase - combat vehicle blast testing</i>	-	6.000
Congressional Add: <i>Program increase - advanced adhesives</i>	-	5.000
Congressional Add: <i>Program increase - combat vehicle lithium 6T battery development</i>	-	5.000
Congressional Add: <i>Program increase - vehicle technology readiness levels</i>	-	2.000
Congressional Add: <i>Program increase - 10X technology demonstration</i>	-	8.000
Congressional Add: <i>Program increase - HMMWV augmented reality HUD</i>	-	5.000
Congressional Add: <i>Program increase - Operator?in?the?loop virtual and physical prototyping</i>	-	4.000
Congressional Add Subtotals for Project: BP6	100.500	108.000
Congressional Add Totals for all Projects	100.500	108.000

Change Summary Explanation

FY2022 funding change due to realignment of funds to higher priority modernization efforts in PE 0602181A All Domain Convergence Applied Research and PE 0603041A All Domain Convergence Advanced Technology.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BF2 / Autonomous Ground Resupply (AGR) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BF2: Autonomous Ground Resupply (AGR) Adv Tech	-	18.000	18.574	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

Autonomous Ground Resupply (AGR) will mature and demonstrate an improved ground supply distribution system across multiple levels of strategic and tactical sustainment operations. The effort will equip existing military ground vehicles with scalable robotic technology through the integration of modular kits, common interfaces, and a common architecture to improve inter-node supply movement. Further, the system will modernize and optimize the operations within the supply nodes to improve accountability and throughput. The objective of AGR is to integrate new and emerging technologies into the Army's sustainment system to improve throughput, accountability, and safety and provide the Warfighter with the flexibility needed to meet future needs.

The work under this Project will transition to the Leader Follower Program of Record (PoR). The architecture and safety work under this Project also lays the groundwork for the Army Modernization Priority Next Generation Combat Vehicle (NGCV).

This Project matures and demonstrates simulation tools that predict autonomous vehicle performance. This Project matures and demonstrates a real-time simulator that provides the ability to design and assess ground vehicle autonomous behaviors in adverse environmental conditions, reducing the need for field testing. These simulation 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 Army Modernization Priority Next Generation Combat Vehicle.

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

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), and transitions to PE 0604017A (Robotics Development).

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

	FY 2020	FY 2021	FY 2022
Title: Architecture and Standards	7.177	7.236	-
Description: This effort matures and validates the government-owned autonomous architecture for an inclusive military library of behaviors that are non-proprietary and modular format to allow for design and development of payloads across the enterprise. This architecture allows the development and implementation of the same government owned software across multiple robotic systems. This will enable interoperability and modularity within systems and will lay the foundation for an affordable			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF2 / <i>Autonomous Ground Resupply (AGR) Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
and sustainable lifecycle management model. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).			
<p><i>FY 2021 Plans:</i> Mature and validate the government-owned autonomous architecture, the autonomous behaviors in the government-owned software library, and improvements to the government-managed interoperability profile standard. Validate the fail-safe architecture utilizing autonomous testing methodologies and procedures and demonstrate that standardized interfaces are enforced between unmanned platforms, payloads, controllers and wireless communication devices through field testing and Soldier experimentation events. Develop documentation for transition to Program Executive Office Combat Support and Combat Service Support in support of Leader Follower Program of Record and to the Next Generation Combat Vehicle.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Program ends in FY21.</p>			
<p><i>Title:</i> Hardware and Hardware-in-the-loop/Software-in-the-loop (HIL/SIL)</p> <p><i>Description:</i> The HIL/SIL is a test system that uses real-time, physics-based models of the vehicle (multi-body dynamics), sensor systems (optics/signal processing and positioning), platform mobility (vehicle-terrain interaction) and weather/environment to provide a "virtual proving ground" for the AGR system. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p><i>FY 2021 Plans:</i> Mature and demonstrate HIL and SIL configurations to optimize AGR sub-systems throughout the full range of environmental conditions that are controllable and repeatable within a validated simulation environment to optimize autonomous performance. Use HIL and SIL capability to rapidly integrate and simulate advanced software behaviors prior to conducting field testing. Improve and validate HIL and SIL system configurations in the laboratory before field testing and Soldier experimentation to reduce costs, save time and decrease risk for the Leader Follower Program of Record. Provide documentation for transition to Program Executive Office Combat Support and Combat Service Support in support of Leader Follower Program of Record and to the Next Generation Combat Vehicle.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Program ends in FY21.</p>	5.999	4.519	-
<p><i>Title:</i> Soldier Experimentation</p> <p><i>Description:</i> In conjunction with the Army Training and Doctrine Command (TRADOC) and Army Test and Evaluation Command (ATEC), this effort will employ unmanned systems in an operational evaluation to test the system in real word applications and environments. After the lab testing is complete and a safety test performed by ATC, then the soldier will provide the final test to</p>	4.537	6.338	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF2 / <i>Autonomous Ground Resupply (AGR) Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>determine if AGR is useful and rugged enough to enable the soldiers to increase through put on actual missions. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p>FY 2021 Plans: Mature and validate safety documentation to demonstrate the employment of leader follower autonomous capability including advanced software behaviors in an operational evaluation to obtain Soldier feedback. Collaborate with TRADOC and ATEC to obtain a safety release to enable Soldiers and Marines to utilize AGR equipment in relevant operational environments.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Program ends in FY21.</p>				
<p>Title: Simulation Tools for Autonomous Ground Resupply</p> <p>Description: This effort matures and demonstrates a real-time and high-fidelity, hardware and software-in-the-loop simulation environment for evaluation of autonomous systems, and algorithm design and development for the same; demonstrates novel analysis methods for modeling and simulation to provide enhanced demonstrations of autonomous ground vehicles to include adverse environmental conditions.</p> <p>FY 2021 Plans: Mature and demonstrate simulation environments for algorithm design and development to predict autonomous vehicle system performance in multiple adverse environmental conditions and provide improved analytical tools for optimizing sensor configurations for autonomous behavior for autonomous ground resupply.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Program ends in FY21.</p>		0.287	0.481	-
Accomplishments/Planned Programs Subtotals		18.000	18.574	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BF4 / Combat Vehicle Robotics Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BF4: <i>Combat Vehicle Robotics Adv Tech</i>	-	9.884	8.504	26.777	-	26.777	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates innovative enabling 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.). Project focus areas include Platform Electronic Control and Autonomy Safety Engineering.

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

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

Work is performed by the U.S. Army Futures Command (AFC).

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), and transitions to PE 0604017A (Robotics Development).

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

	FY 2020	FY 2021	FY 2022
Title: Platform Electronic Control	7.390	4.245	11.849
Description: This effort optimizes the electronic, closed loop control of by-wire vehicle systems to provide stable, reliable, and predictable control in the presence of potential malicious or unintended commands for both wheeled and tracked unmanned vehicles.			
FY 2021 Plans: Demonstrate the smart payload-agnostic interfaces and control mechanisms into the autonomous control systems to provide robust mobility characteristics and standard inputs. Develop a robust platform with system health intelligence for monitoring the critical component state and control data streams.			
FY 2022 Plans: Will develop an optimized solution to an expanded closed loop control of drive by-wire (DBW) systems for robotic ground vehicles to improve safe platform control. Will develop a stable interface, to control autonomous ground vehicle systems, for autonomy kits and/or user interfaces (UI) while maintaining safety critical aspects of the platform. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, thereby			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF4 / <i>Combat Vehicle Robotics Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>demonstrating technical maturity. Will mature and demonstrate Robotic and Autonomy Systems (RAS) safety standards for unmanned ground vehicle systems. Will validate Ground Vehicle Robotics Safety Board published guidelines to show they meet best practices for development of safety critical software for unmanned ground vehicle systems. Validation of Ground Vehicle Robotics Safety Board processes will result in a useable safety confirmation to enable testing and reduced developmental time for testing of autonomous ground combat systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on the safety standard and optimization of DBW control for the robotic and autonomous systems will ensure readiness and validation for testing at the EET.</p>				
<p>Title: Autonomous Safety Engineering</p> <p>Description: This effort demonstrates a holistic approach to the development of Robotic and Autonomy System (RAS) Safety Standards, development of RAS Virtual Testing Procedures, and maturation of a Safety Based Design Methodology for Robotic Systems.</p>		2.494	-	-
<p>Title: Unmanned Maneuver</p> <p>Description: This effort matures and demonstrates the advanced mobility performance of autonomous systems within complex, combat scenarios to allow for the completion of mission goals in separate and teaming configurations at various levels of autonomy.</p> <p>FY 2021 Plans: Integrate advanced autonomous behaviors for the robotic combat vehicle in a manned/unmanned team mission demonstrating the off-road capability and commanded formation. Optimize the ability to operate in extreme weather conditions and on unimproved terrain while challenging the robotic assets within the complexity of a combat scenario.</p> <p>FY 2022 Plans: Will improve and demonstrate autonomous vehicle maneuvering in rough terrain. Will demonstrate the ability to detect and avoid negative obstacles, such as large holes, bodies of water, and cliffs. Will mature and demonstrate the ability to detect the characteristics of the terrain the vehicle is driving over, and optimize the combat vehicle's driving behaviors in response. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, thereby demonstrating technical maturity.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		-	2.931	9.448

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF4 / <i>Combat Vehicle Robotics Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on autonomous vehicle maneuvering in rough terrain and negotiating negative obstacles will ensure readiness and validation for testing at the EET.				
<p>Title: Soldier-Robotic Interface Integration</p> <p>Description: This effort is a focused approach to optimize control of the unmanned systems with improved performance incorporating Manned-Unmanned Teaming enabled formations and is measured against multiple phases of the combat scenario for improved operational effectiveness and overall system performance.</p> <p>FY 2021 Plans: Develop enhanced multi-vehicle, assisted autonomous control to include dynamically reconfigurable interfaces for the mission systems to increase standoff and enable force multiplication. Develop the capability to utilize and orient configurations of the control interface per the preferred operational mission, allowing the warfighter to choose the screen layout and interface assistance.</p> <p>FY 2022 Plans: Will develop an expanded operator span of control for robotic vehicles in defined mission to improve Manned /Unmanned Teaming to increase operator standoff and enable control of multiple platforms. Will demonstrate these enhancements through Engineering Evaluation Testing (EET) to ensure the autonomous technology has been fully evaluated for system safety, demonstrating technical maturity.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding is increased in FY22 for planned progression of this effort to the research being performed and evaluated at the Engineering Evaluation Test (EET). The focus on optimization of unmanned systems controls for the Soldier's ability to operate robotic vehicles will ensure readiness and validation for testing at the EET.</p>		-	1.328	5.480
Accomplishments/Planned Programs Subtotals		9.884	8.504	26.777
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BF5 / Adv Lethality & Accuracy Sys for Med Cal Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BF5: Adv Lethality & Accuracy Sys for Med Cal Adv Tech	-	1.918	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced medium caliber ammunition, weapon, fire control, and Ammunition Handling Systems (AHS) optimized for remote operation. This effort demonstrates cannon super high elevation engagement, high performance stabilization, remote ammunition loading, weapon safety and reliability, improved lethality, accuracy, ability to fire a suite of ammunition from non-lethal to lethal, and escalation of force capability in one system.

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 Modernization Priority Next Generation Combat Vehicle.

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

Work in this Project is related to and fully integrated with the efforts funded in Program Element PE0604115A (Technology Maturation Initiative).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Lethality and Accuracy System for Medium Caliber Advanced Technology	1.918	-	-
Description: This effort matures and demonstrates advanced medium caliber ammunition, weapon, fire control, and AHS optimized for remote operation. This effort demonstrates cannon-super high elevation engagement, high performance stabilization, remote ammunition loading, weapon safety and reliability, improved lethality, accuracy, ability to fire a suite of ammunition from non-lethal to lethal, and escalation of force capability in one system.			
Accomplishments/Planned Programs Subtotals	1.918	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BF7 / Crew Augmentation and Optimization Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BF7: Crew Augmentation and Optimization Adv Tech	-	3.712	4.411	3.768	-	3.768	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced technologies to enable crew augmentation and optimization for closed hatch operations of ground vehicle platforms in a complex multi-domain operations environment. This includes integration of intelligent technologies to improve dynamic tasking and full crew interactions, machine learning to improve decision aids, early warnings, reduce response times and shorten task durations, and machine learning to optimize tasking and function. Mature technologies are incorporated onto existing or prototype Army-owned technology demonstrators so that performance of the enabling technologies can be evaluated.

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 Modernization Priority Next Generation Combat Vehicle. Work in this Project is conducted by the United States (US) Army Futures Command.

Work in this PE/Project is also coordinated with work in PE 0602145A (Next Generation Combat Vehicle Technology) and PE 0602143 (Soldier Lethality Technology)

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

	FY 2020	FY 2021	FY 2022
Title: Crew Augmentation & Optimization Advanced Technology	3.712	4.411	3.768
Description: This effort focuses on optimizing crew station technologies while reducing crew sizes that will provide the same overall performance by exploiting human-machine interaction technologies, automation, machine intelligence and customization to permit soldiers to achieve performance beyond today's constrained ground vehicle environment			
FY 2021 Plans: Mature and demonstrate vehicle and crew task management and re-tasking to enhance team performance. Demonstrate effectiveness of individual vehicle operators without increasing levels of manpower for specific mission sub-sets. Demonstrate baseline teaming of crew and robotic operator configurations to permit reconfiguration of roles, improve ease of use and increase overall productivity. Validate effectiveness in an operationally-relevant, motion-based simulation environment with Soldiers.			
FY 2022 Plans: Will mature and demonstrate vehicle and crew task management at the section level to enable sharing of critical tasks between crew and robotic operators during times of high workload. Will integrate and demonstrate interface advancements in novel display technologies (i.e. helmet mounted displays) to improve situational awareness. Will demonstrate section-level teaming of crew and			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF7 / <i>Crew Augmentation and Optimization Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
robotic operator configuration to permit reconfiguration of mission roles. Will validate effectiveness in an operationally-relevant, field experiment. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort for slightly reduced demonstration efforts in FY22.				
Accomplishments/Planned Programs Subtotals		3.712	4.411	3.768
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG1: <i>Sensors for Auto Oper and Survivability Adv Tech</i>	-	11.030	13.954	10.733	-	10.733	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, optimizes, and demonstrates automated, advanced multi-function sensors and integrates threat cueing capabilities for operations in full spectrum, complex environments, for next generation manned, optionally manned, and robotic platform applications. This Project will deliver sensor payloads which provide greatly increased situational awareness (e.g. pre-shot and hostile fire detection, threat classification) in all environments for manned and unmanned ground vehicle systems.

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

Work in this 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 US Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Sensors for Autonomous Operations and Survivability Advanced Technology	9.668	-	-
Description: This effort will demonstrate aided target detection (AiTD) and aided target recognition (AiTR) for rapid search, and an automated, multi-spectral sensing capability to detect concealed threats and identify/apply countermeasures to enable decisive action and maneuver, for manned and unmanned platforms. This effort is coordinated with PE 0602145A (NGCV Technology), 0602143A (Soldier Lethality Technology), and 0603118A (Soldier Lethality Advanced Technology).			
Title: Advanced Sensors with Embedded Processing	-	8.493	5.786
Description: Matures and demonstrates advanced, multi-spectral and multi-function sensors, and image processing capabilities with improved performance in all environments and against all threats to include low-contrast targets in camouflage or in degraded conditions. Matures and demonstrates rapid detection of concealed enemy optical threat systems (visible, midwave infrared, longwave infrared) and real-time hostile fire detection (HFD) for anti-armor threats while on the move, exploiting multi-functional imaging components and embedded processing. Enables enhanced situational awareness and targeting capabilities in complex environments via manned, optionally manned, and robotic platform applications.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Mature sensor payloads with embedded Aided Target Detection and Recognition (AiTD and AiTR) algorithms for situational awareness and targeting sensors. Demonstrate sensors with multi-spectral response and embedded processing to provide real-time performance on space-constrained platforms. Continue to mature threat optics detection with targeting sensors by combining pre-shot and thirdgeneration forward looking infrared capability.</p> <p>FY 2022 Plans: Will mature low-power processing approaches for high definition (HD) sensor data to exploit imagery in degraded environments and detect threats. Will validate performance of novel uncooled infrared sensors to assess the impact of increased dynamic range, sensitivity, and higher data rates for passive hostile fire detection (HFD) of anti-armor threats. Will exploit infrared digital read out integrated circuit (DROIC) technologies for 3rd Gen Forward Looking Infrared to improve multi-spectral, multifunction targeting and threat detection for greatly enhanced range performance and increased ability to detect targets and threats in degraded environments. Will mature advanced pulsed mid-wave infrared laser technology to enable maturation of on-the-move threat optics detection capabilities.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort with reduced algorithm development.</p>				
<p>Title: Multi-Mission Payload</p> <p>Description: Matures and demonstrates sensor payloads for ground vehicle based unmanned aerial systems 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 2021 Plans: Mature multi-mission sensor payloads for small unmanned aerial system platforms using polarized and broad band electro-optic / infrared technology to provide improved cueing performance against threats that inhibit maneuver. Demonstrate sensor payloads on-the-move at low altitudes for rotary and fixed wing platforms in close combat open terrain scenarios. Mature threat cueing algorithms based on the integrated sensor payload architecture and multi-look flight paths.</p> <p>FY 2022 Plans: Will improve performance of rotary and fixed wing unmanned aerial system (UAS) payloads to enable advanced detection of threats and targets in complex environments, day or night. Will exploit feature extraction and target detection techniques to enable advanced sensing capabilities inherent in the multi-modal sensor technologies to increase detection of near-peer threats and suppress clutter. Will demonstrate advanced sensor payloads in realistic open terrain environments to establish a baseline capability to augment maneuver and protection of small unit level formations.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		-	5.461	4.947

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG1 / <i>Sensors for Auto Oper and Survivability Adv Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.			
Title: Sensors for Automated Target Recognition Advanced Research	1.362	-	-
Description: This effort demonstrates and matures the pairing of ground borne, airborne, and soldier worn sensors with artificial agents to rapidly detect and identify adversary targets.			
Accomplishments/Planned Programs Subtotals	11.030	13.954	10.733

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BG3 / Modeling and Simulation for MUMT Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG3: Modeling and Simulation for MUMT Advanced Tech	-	3.499	3.241	5.188	-	5.188	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates modeling and simulation (M&S) tools/technologies to assess and improve freedom of movement for ground forces and supports vehicle developers by addressing challenges for robotic and ground vehicles. This Project matures and demonstrates obstacle detection capabilities for autonomous systems operating in complex environments. This Project also matures and demonstrates real-time mobility decision support tools, vehicle-terrain interaction 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. 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 Army Modernization Priority Next Generation Combat Vehicle.

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 effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) / Project BG2 (Modeling and Simulation for MUMT Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Mobility in Complex Urban Environments Demonstrations	3.499	-	-
Description: This effort matures and demonstrates a real-time, hardware-in-the-loop simulator capable of rapid design and assessment of ground vehicle autonomous behaviors and integrates autonomy solutions into this tool.			
Title: Simulation Tools for CoVeR Demonstrations	-	3.241	5.188
Description: This effort matures and demonstrates M&S tools to support the development of autonomous ground vehicle platforms and components for successful maneuver in unstructured and mission relevant environments. This effort demonstrates M&S capabilities to evaluate hardware and software technologies enabling battlefield autonomy in complex and challenging environments.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG3 / <i>Modeling and Simulation for MUMT Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Mature and demonstrate desktop and high performance computing-based software-in-the-loop and hardware-in-the-loop M&S tools for operational assessments of autonomy algorithms and hardware; optimize and improve M&S tools to support autonomous vehicle platforms and component development; and optimize adaptive learning models and analytical tools for predicting impacts to maneuver in unstructured environments.</p> <p>FY 2022 Plans: Will mature and demonstrate analytical tools and adaptive learning models for predicting autonomous maneuver performance and determining alternative routes in unstructured environments; and will mature advanced algorithms to detect obstacles that affect maneuver corridors in unstructured environments.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding partially realigned from PE 0602145A (NGCV Technology) Project BG2 (Modeling and Simulation for MUMT Technology) in FY2022 to mature and demonstrate simulation tools to predict autonomous vehicle performance, and algorithms to detect obstacles in unstructured environments.</p>			
Accomplishments/Planned Programs Subtotals	3.499	3.241	5.188

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BG4 / Adv Mobility Experimental Prototype Adv Tech Demo			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG4: Adv Mobility Experimental Prototype Adv Tech Demo	-	8.380	3.760	2.819	-	2.819	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and fabricates advanced powertrain, power generation and running gear technologies into a combat vehicle that will reduce the percentage of no-go terrain for ground vehicles, increase the maneuver speeds across all traversable terrain, reduce fuel demands thus extending operation time between resupply, and provide onboard power generation to enable the integration of energy based capabilities such as directed energy weapons and electromagnetic armor.

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 Modernization Priority Next Generation Combat Vehicle.

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

This Project is coordinated with PE 0604115A (Technology Maturation Initiatives).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Mobility Experimental Prototype (AMEP) Advanced Technology	8.380	3.760	2.819
Description: This effort develops the advanced powertrain, track and running gear, and unmanned robotic technologies for integration into a ground combat vehicle to demonstrate increased mobility, increased maneuver speeds, and optionally manned capabilities in order to validate performance and capability enhancements at increased vehicle weights to inform ground combat vehicle design.			
FY 2021 Plans: Will develop field-installable suspension system to enable increased mobility performance for a specific class of combat vehicles. Will mature powertrain drive-by-wire control software to enable autonomous maneuverability.			
FY 2022 Plans: Will improve running gear performance for ground combat vehicles with gross vehicle weights up to 50 tons.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG4 / <i>Adv Mobility Experimental Prototype Adv Tech Demo</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle to conclusion of this effort in FY2022 with reduced research into powertrain drive-by-wire control software.			
Accomplishments/Planned Programs Subtotals	8.380	3.760	2.819

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BG5 / Extended Line of Sight (ELOS) Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG5: <i>Extended Line of Sight (ELOS) Advanced Technology</i>	-	10.419	1.396	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project develops a precision guided tank fire and forget 120-mm munition to engage high-value targets including heavy armor, the growing Anti-Tank Guided Munition (ATGM) threat (dismounted and mounted), and light armor at extended ranges (2 to 8 km (T), 2 to 12 km (O)).

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 Modernization Priority Next Generation Combat Vehicle.

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

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

	FY 2020	FY 2021	FY 2022
Title: Extended Line Of Sight (ELOS) Advanced Technology	10.419	1.396	-
Description: This effort demonstrates a 120-mm Tank-fired ELOS Munition that counters the growing Anti-Tank Guided Missile (ATGM) threat at extended line of sight ranges beyond current capability.			
FY 2021 Plans: Demonstrate a 120-mm tank-fired munition with the capability to seek, detect, guide, maneuver, and defeat an ATGM threat at extended range. The munition demonstrates advanced technologies including: fin stabilization; next generation seeker components; electronic guidance, navigation and control (GNC) software; and other advanced component technology.			
FY 2021 to FY 2022 Increase/Decrease Statement: This project ends in FY21.			
Accomplishments/Planned Programs Subtotals	10.419	1.396	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG5 / <i>Extended Line of Sight (ELOS) Advanced Technology</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG7: <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>	-	23.774	48.196	52.172	-	52.172	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates protection and survivability technologies to increase the survivability of ground vehicles and the protection of the Soldiers who depend on them. The tasks will focus on component maturation and demonstration and transfer products for demonstration as holistic (vehicle level) solutions. The Project will mature technologies to defeat threats throughout the timeline of a threat engagement; from obscuring a target, to actively defeat a threat and through mitigating its effects after engagement. These include the active employment of smoke, physical and electronic active protection, advanced and adaptive armors, advanced and active blast mitigation systems and adaptive interior protection.

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

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.

Work in this project will be coordinated with PE 0602145A (Next Generation Combat Vehicle Technology) and transitions to PE 0604852A (Suite of Vehicle Protection Systems - EMD).

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

	FY 2020	FY 2021	FY 2022
Title: Ground Systems Active Defense Development	10.438	-	-
Description: This effort matures and demonstrates active and adaptive component sensors and effectors which, in combination with modular Survivability Subsystem Controls (SSC) architecture, provide the ability to sense, track, respond and neutralize pacing threats prior to catastrophic terminal effects. The components/subsystems will work in tandem in an efficient manner to provide threat defeat redundancy and layered survivability to optimize protection with reduced weights. This effort matures and demonstrates modern armors that directly complement active protection technologies in order to implement sophisticated mass efficient protection mechanisms and materials investments to act as a system in order to defeat advanced threats. This effort also matures and demonstrates active blast technologies to counter underbody attacks.			
Title: Obscuration Technologies for Active Protection Systems	0.584	2.298	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Description: Research, develop, test, evaluate, and demonstrate obscurant soft-kill vehicle protection technologies to defeat the observer/gunner, anti-tank guided missiles (ATGMs), and other guided threats. Design and evaluate systems that are Modular Active Protection System (MAPS) and Survivability Subsystem Controls (SSC) compliant.</p> <p>FY 2021 Plans: Optimize payloads and demonstrate dissemination of obscurant materials for the Extended Range Obscuration System (EROS).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding was realigned in FY22 to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology. Funding decrease results in transition of mature competent technologies at TRL 5 level.</p>				
<p>Title: Active Protection Technologies</p> <p>Description: This effort demonstrates protection for light armored combat vehicles from anti-armor threat weapons such as rocket-propelled grenades (RPG), anti-tank guided missiles (ATGM), and recoilless rifle projectiles (RR).</p> <p>FY 2021 Plans: Conduct component experiments with radar, propulsion/thruster and warhead mechanisms hardware and software to verify performance meets design intent and is repeatable; begin design and development of integrated testbed for demonstration and evaluation of integrated protection system.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This work was consolidated in FY22 with other Hard Kill efforts and is now funded as part of the effort in this Project titled ?Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration?.</p>		3.304	7.098	-
<p>Title: Advanced Radar and Soft-Kill (A-RASK) Suite</p> <p>Description: This effort matures next generation vehicle radar technologies and holistic electronic warning and soft-kill countermeasure techniques to support a layered modular active protection suite and ensure the survivability of ground combat platforms in all-weather day or night conditions with 360 degree situational awareness and threat defeat.</p> <p>FY 2021 Plans: For Combat Operations Battlefield Radar: Conclude capability/tradeoff analysis based on techniques for active protection systems with 360-degree situational awareness radar technology; conclude baseline improvement of resource management and processing algorithms to support multiple combat vehicle protection capabilities and radar simulation models for hardware-in-the-loop evaluation of emerging threats and future sensor improvements and technologies; and provide analysis to ensure operation in cluttered radio frequency environments.</p>		9.448	9.778	0.974

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>For Advanced Soft Kill Countermeasures (ASKCM): Integrate laser hardware into existing soft-kill countermeasure system to defeat additional threats and to demonstrate defeat of anti-tank guided missiles as part of a layered protection system in cooperation with the Soft-Kill System Development effort in this Project.</p> <p>For Soft Kill Techniques and Effects: Execute 2nd & 3rd iterations of validation of threat hardware successfully integrated in the lab without countermeasure in the loop (dry shot demonstration). Perform laboratory validation and demonstration of two iterations of soft-kill countermeasure techniques to evaluate performance and transition techniques to the most promising soft-kill countermeasure design from the layered protection system demonstration conducted in the Soft-Kill System Development effort in this Project.</p> <p>FY 2022 Plans: Will continue to develop soft-kill countermeasure techniques and effects for additional anti-tank guided missile (ATGM) threats. Will conduct demonstrations of system capabilities with integrated techniques to assess system performance against multiple ATGM threat classes, launch profiles and distances.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY 22 funding was realigned to a higher priority modernization program.</p>				
<p>Title: Long Range Hard Kill Countermeasure (LRHK-CM)</p> <p>Description: This effort matures and demonstrates a MAPS-compliant hard-kill countermeasure system able to defeat current threats such as RPG, ATGM and future threat munitions such as kinetic energy and artillery delivered sub-munitions. This effort will optimize a complete hard-kill active protection system including munitions, launcher, sensors, and fire-control, and demonstrate capabilities through modeling and simulation and live-fire demonstrations.</p> <p>FY 2021 Plans: Conduct system trade studies by incorporating additional system, experimental, and threat data. Will mature the hard-kill countermeasure munition and incorporate effectiveness against multiple threat categories. Mature a hard-kill countermeasure launcher and integrate using the MAPS Framework and Controller on a combat vehicle, integrate existing sensor technologies and perform simulation and live-fire demonstrations.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This work was consolidated with other Hard Kill efforts in FY22 and is now funded as part of the effort in this Project titled ?Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration?.</p>		-	6.896	-
<p>Title: Soft-Kill System Development</p>		-	9.140	10.199

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021
<p>Description: This effort focuses on maturing and demonstrating soft-kill system technologies to protect combat vehicles from current and emerging ATGM threats at stand-off distances with an unlimited magazine and low collateral hazard. This capability will also enhance situational awareness to vehicle occupants by detecting and alerting when threats have been fired. Technologies will be optimized and integrated on combat vehicles using the MAPS Framework and Controller, and demonstrated in a relevant environment.</p> <p>FY 2021 Plans: Integrate the soft-kill system developed in the Advanced Radar and Soft-Kill Suite effort in this Project utilizing the MAPS Framework and Controller for system demonstration. Conduct virtual / laboratory demonstrations; assess system performance and robustness through and verify system performance in physical live-fire demonstration with the goal to alert the crew of threats being fired and providing the defeat of multiple ATGMs.</p> <p>FY 2022 Plans: Will develop and mature soft-kill subsystems such as those developed in the Advanced Radar and Soft-Kill Suite effort in this Project by delivering soft-kill capabilities, environmentally hardening, upgrading to the latest revision of the MAPS Framework (MAF), and optimizing space, weight, and power (SWAP) of the subsystems. Will begin virtual / lab demonstrations to assess subsystem performance and robustness in preparation for system integration.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: The funding increase reflects the start of next capability increment which increases scope of associated deliverables and increased virtual/lab demonstrations.</p>			
<p>Title: Advanced Threat Protection</p> <p>Description: This effort matures and integrates armor and occupant protection technology to protect against emerging both top and bottom attacks threats increasing vehicle survivability and Soldier protection.</p> <p>FY 2021 Plans: Mature test methods to evaluate Soldier protection technologies from both top and bottom attack emerging threats. Leverage modelling and simulation to evaluate protection technologies from current and future top and bottom attack threats. Demonstrate underbody technologies that provide full-spectrum protection against bottom attack threats at a reduced weight from current technology. Demonstrate top attack armor solutions and evaluate whether they interfere with vehicle operation. Validate compliance with combat vehicle architectures, perform environmental and durability testing, and demonstrate capabilities against pacing threats in a representative environment.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		-	6.294
		-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
This effort ends in FY21 with planned completion of research.				
<p>Title: Survivability Capability Characterization and Demonstration</p> <p>Description: This effort evaluates emerging protection technologies to characterize and assess their performance and maturity and potential for transition to Product Manager (PdM) Vehicle Protection System (VPS).</p> <p>FY 2021 Plans: Assess vehicle protection capability gaps, conduct a targeted market survey of emerging survivability technologies which address those gaps, request vendor proposals, and provide an experimentation venue to demonstrate performance of selected technologies in FY21 to characterize enhanced vehicle protection. Characterization data will be used to inform technology development and transition to PdM VPS.</p> <p>FY 2022 Plans: Canvas industry, academia, and government for unverified high potential / high impact survivability technologies that have applicability to current ground vehicle platform requirements. Down-select promising technologies and work with industry, academia, or government partners to begin planning for the demonstration and assessment of the technologies. Identify the technology and any other necessary resources for future demonstration.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding was partially realigned in FY22 to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.</p>		-	2.944	2.503
<p>Title: Sensors for Adaptive Armor</p> <p>Description: This effort demonstrates mature sensor technology to enable an adaptive armor system using the MAPS Framework and Controller on a combat vehicle platform. This effort matures real-time processing software, continuously refines the threat trajectory prediction algorithm and integrates sensors with an adaptive countermeasure for threat defeat to the MAPS Framework and Controller to ensure the activation of adaptive armor to protect against incoming threats.</p> <p>FY 2021 Plans: Mature the real-time processing software of sensor data, improve detect and track algorithms of the adaptive armor system and analyze/assess MAPS architecture-compliant integration on a combat vehicle platform. Perform analysis and maturation of adaptive armor countermeasure concepts.</p> <p>FY 2022 Plans:</p>		-	2.714	1.691

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will optimize real-time processing software and improve trajectory prediction algorithm of the sensor technology to enable adaptive armor systems. Will mature sensor subsystem and will perform environmental and hardening testing.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY 2022, funding decrease reflects planned reduction in research assessment of MAPS architecture-compliant integration.</p>				
<p>Title: Active Blast Mitigation Environmental and Durability Validation</p> <p>Description: This effort demonstrates mature sensor technology for an Active Blast Mitigation System (ABMS) into the MAPS Framework on a combat vehicle platform with improved countermeasure design for protection from blast events. ABMS will support a reduction of injuries caused from underbody blast events by providing a counterforce to the blast acceleration of the vehicle hull.</p> <p>FY 2021 Plans: Optimize MAPS-compliant ABMS technology using improved countermeasure design for safety and manufacturing. Develop a more effective countermeasure and improve upon the performance of prior ABMS designs.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This effort ends in FY21 with planned completion of research</p>		-	1.034	-
<p>Title: APS Residuals Protection Maturation and Complex Threat Attack Protection (CTAP)</p> <p>Description: This effort contributes to the Army's ground vehicle survivability by maturing, integrating, and demonstrating advanced technologies which physically defeat incoming threats. These technologies involve passive and reactive mechanisms that work seamlessly with active protection systems in order to increase the overall efficiency of the system. This effort will mature and demonstrate armor components that defeat residual blast and fragmentation from hard-kill active protection systems engagements with kinetic threats in order to protect vehicle occupants and critical subsystems. This effort also matures and demonstrates armor and occupant protection components that provide threat defeat for advanced and emerging threats with complex defeat mechanisms.</p> <p>FY 2022 Plans: Will mature and demonstrate component technologies developed under PE 0602145A (Next Generation Combat Vehicle Technology) Project BG6 (Advanced Concepts for Active Defense Technology) for protection against degraded threats, ballistic shields for sensors, advanced mechanisms for moving armor to protect optics, and multi-functional modular seats to protect occupants from injury. Will mature and package these component designs for durability. Will demonstrate hardened component</p>		-	-	10.082

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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>threat defeat performance through exposure to environmental conditions. Will validate that packaged component physical parameters, such as size and weight, are able to meet vehicle system-level design constraints.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This is a planned new effort in FY22 which transitions from PE 0602145A (Next Generation Combat Vehicle Technology) Project BG6 (Advanced Concepts for Active Defense Technology).</p>				
<p>Title: Controls and Architecture</p> <p>Description: This effort provides the basis for holistic (vehicle level) active defense by ensuring compatibility of active defense subsystems and systems. This effort advances the effectiveness and efficiency of the controls and architecture for active defense systems. The focus will be to enable the integration of multiple emerging survivability technologies into safe and secure configurations. This effort will conduct Size, Weight, and Power-Cooling (SWaP-C) optimization for the system components.</p> <p>FY 2022 Plans: Will build upon previous controls and architecture for Active Protection Systems (APS) efforts by advancing the intelligent decision management subsystem, cross domain management solution, active survivability safety measures, and vehicle user-interface subsystem for emerging survivability technologies. Will ensure that enhancements do not interfere with current compliant technology performance.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding for this effort has been realigned from Project BH1 Survivability Systems Controls Advanced Technology in this PE to focus on controls and architecture for APS.</p>		-	-	5.452
<p>Title: Hard Kill Active Protection System (HK APS) Development, Integration, and Demonstration</p> <p>Description: This effort matures, integrates, and demonstrates a Hard Kill Active Protection System (HK APS) capable of defeating Rocket Propelled Grenades, Anti-Tank Guided Missiles, and Recoilless Rifles ensuring the platform's ability to shoot, move and communicate after an engagement. The system will be compliant to the Modular APS Framework (MAF). This effort will optimize an HK APS that includes the following sub-systems; counter-measure, launcher, and sensors (active/passive). The HK APS capabilities will be demonstrated in a virtual and live fire demonstration in a relevant operational environment.</p> <p>Counter-measure (CM): Develops and matures CM designs that includes the following aspects: blast size, time of flight, velocity, engagement distance, accuracy, and SWaP-C. Analysis will be conducted for each counter-measure component as well as at the sub-system level. Demonstrations will be performed in the following environments: virtual, hardware in the loop, and live fire.</p>		-	-	21.271

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG7 / <i>Ground Systems Active Defense (GSAD) Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Launcher: Develops and matures launcher designs that considers the following aspects: SWaP-C, engagement speed and accuracy, number of launchers, material composition and reliability. The most mature and suitable launcher for the project will be demonstrated in the following environments: virtual, hardware in the loop, and live fire.</p> <p>Sensors: Matures the overall sensor suite design (active/passive) that considers the following aspects; radar frequency, power, weight, volume, algorithms, accuracy, search range, tracking and identification time, and passive cueing integration and optimization. The most mature and suitable sensor suite (active/passive) for the project will be demonstrated in the following environments: virtual, hardware in the loop, and live fire.</p> <p>Integration: Demonstrate the matured HK APS sub-systems on a platform in the following environments: virtual, hardware in the loop, and live fire. This will also analyze subsystem and system performance characteristics against Integrated Product Team (IPT) stakeholder requirements. Develop a performance baseline for future hard kill system evaluations.</p> <p>FY 2022 Plans: Will conduct individual Initial Design Reviews for the CM, Launcher and Sensor sub-systems, using previous efforts as a baseline, with industry and government experts. Will integrate CM, Launcher and sensor suite sub-systems based on the Initial Design Reviews including long lead components for future sub-system demonstration and validation. Will begin planning and develop sub-system models to demonstrate the sub-systems in a virtual environment. Will conduct planning for the integration of the CM, Launcher, and Sensor sub-systems into a unified HK APS onto the demonstration platform. Will execute a system level Initial Design Review including the CM, Launcher and Sensor sub-system baselines established in the sub-system Initial Design Reviews. Will begin planning and integrate an HK APS simulation to represent the system in a relevant environment using previous efforts to demonstrate the HK APS in a virtual environment.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This new effort reflects a consolidation of Active Protection Technologies and Long Range Hard Kill Countermeasure (LRHK-CM) efforts in this Project into a single collaborative effort.</p>				
Accomplishments/Planned Programs Subtotals		23.774	48.196	52.172
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BG9 / <i>Obscuration Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BG9: <i>Obscuration Advanced Technology</i>	-	2.958	9.774	2.608	-	2.608	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

The Project matures and demonstrates obscurant technologies with potential to enhance personnel and platform survivability by degrading threat force surveillance sensors and defeating the enemy's target acquisition devices, missile guidance, and directed energy weapons. Dissemination systems for new and improved obscurants are developed with the goal of providing efficient and safe screening of deployed forces. Synthetic Biology Manufacturing technologies in this project will provide Department of Defense (DoD) with the ability to manufacture products such as explosive alternatives and defense-only critical chemicals & 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 Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command.

Work in this Project is related to, and fully coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Obscuration	2.958	1.774	2.608
Description: This effort investigates, designs and demonstrates the dissemination of new and advanced obscurants. This effort will support PE 0603462 Project (Ground Systems Active Defense Advanced Technology).			
FY 2021 Plans: Validate and demonstrate dissemination materials compatible with the screening obscuration module. Demonstrate dissemination materials for the Improved Rapid Obscuration System (IROS). Optimize multi-spectral payloads to perform as obscurant countermeasures for effective vehicle protection.			
FY 2022 Plans: Will examine packing and dissemination methods of advanced obscuration materials. Will ensure that materials can be safely and efficiently disseminated, and material packing methods geared towards use in obscuration programs .			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BG9 / <i>Obscuration Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding increase reflects planned lifecycle of effort to demonstrate on two systems in FY22.			
<p>Title: Synthetic Biology Bioprocessing Facility</p> <p>Description: This effort supports the modernization of the Army's Synthetic Biology Bioprocessing Technology to manufacture pilot scale products such as explosives, obscurants and defense-only critical chemicals & materials. This effort will expedite transitioning products from the new Synthetic Biology Manufacturing Innovation Institute into technology development efforts to support the Department of Defense.</p> <p>FY 2021 Plans: Modernize bio-manufacturing facility's fermentation and downstream purification capabilities.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This effort competes in FY21 with pilot-scale facility improved to support biotechnology research activities.</p>	-	8.000	-
Accomplishments/Planned Programs Subtotals	2.958	9.774	2.608

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BH1 / <i>Survivability Systems Controls Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH1: <i>Survivability Systems Controls Advanced Technology</i>	-	12.487	13.680	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Funding for this project in Fiscal Year (FY) 2022 was realigned to Program Element (PE) 0603462A / Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech, and to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.

This Project terminates in FY2021.

A. Mission Description and Budget Item Justification

This Project advances the design and capability of the Modular Active Protection System (MAPS) framework and controller to enable integrating emerging survivability technologies into safe and secure configurations and demonstrating them in a representative operational environment. The effort will verify compliance of component sensors and effectors with the modular active protection architecture. This effort ultimately feeds demonstrations of active defense subsystems for demonstration as holistic (vehicle level) solutions. This Project is a key enabler for insertion of current and future active survivability technologies onto ground platforms in order to combat current and emerging 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 Modernization Priority Next Generation Combat Vehicle.

This work is performed by the United States (US) Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Survivability System Control	12.487	13.680	-
Description: This effort focuses on maturing and demonstrating a common and open survivability architecture and core implementation to ensure its operational effectiveness. Specifically, this effort includes extending the MAPS architecture across a broader set of active survivability capabilities and increasing the portfolio of Modular APS Framework (MAF) compliant technologies. In addition, this project will enhance the government-developed controller subsystem for performance and integration effectiveness with high speed digital signal processing and embedded systems/firmware/software which will be required due to the expanded active defense suite of sensors (e.g., electro-optic, infrared, radio frequency, magnetic, acoustic), sensor fusion, and explore synthesizing sensor data beyond situational awareness to situational understanding with context that			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH1 / <i>Survivability Systems Controls Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>can greatly enhance operational effectiveness and vehicle survivability. The activities under this effort provide incremental growth for broader threat spectrum defeat relevant to vehicle protection systems and will be aligned to capability gaps for transition to the acquisition community.</p> <p>FY 2021 Plans: Continue to build upon the foundation of the MAPS controller and artifacts to include an update to the framework and extend beyond active protection capability to a layered protection capability. Implement and demonstrate an expanded MAPS base kit derived from studies conducted in FY20. Demonstrate a reduced size-weight-and-power MAPS base kit design enabling integration for tactical wheeled vehicles and providing alternative integration solutions for combat vehicles. Expand the layering capability of multiple, future MAPS Framework compliant vehicle protection technologies developed in PE 0603462A Next Generation Combat Vehicle Advanced Technology, Project BG7 Ground System Active Defense (GSAD).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding for this project in FY22 was realigned to PE 0603462A / Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech and to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.</p> <p>.</p>				
Accomplishments/Planned Programs Subtotals		12.487	13.680	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BH3 / C4ISR Modular Autonomy Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH3: C4ISR Modular Autonomy Advanced Technology	-	5.941	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2021 this Project is realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BZ9 Smart Targeting Environment for Lower Level Assets

A. Mission Description and Budget Item Justification

This Project matures and develops software and algorithms to integrate ground and aerial Robotics and Autonomous Systems (RAS) with mission command information systems enabling commanders to more effectively plan, monitor and incorporate RAS into unit formations and missions, and assist the development of doctrine.

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

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

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

Work in this PE complements PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
<p>Title: Command of Autonomous Teams (COAT)</p> <p>Description: This effort designs, fabricates, evaluates, and integrates RAS and Manned Unmanned Teaming (MUM-T) concepts with mission command information systems and doctrine allowing commanders' the ability to plan, monitor and incorporate RAS into formations while reducing Soldier burden. This work will provide an integrated mission planning and execution capability for Next Generation Combat Vehicle, and allow RAS platforms to be quickly incorporated into mission formations and complete complex tactical tasks.</p>	3.747	-	-
<p>Title: Command and Control of Robotic and Autonomous Systems in a MDO Environment</p> <p>Description: This effort matures and virtually demonstrates the ability for commanders to synchronize robotic, autonomous, manned, and unmanned systems in support of building an agile, cross-service kill chain.</p>	2.194	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH3 / <i>C4ISR Modular Autonomy Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Accomplishments/Planned Programs Subtotals	5.941	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BH4 / Ground Vehicle Holistic Defense Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH4: Ground Vehicle Holistic Defense Adv Tech	-	-	-	0.034	-	0.034	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This was a planned Presidential Budget (PB) 2021 New Project starting in FY22

Funding for this project in Fiscal Year (FY) 2022 was partially realigned to higher priority modernization efforts in PE 0603041A All Domain Convergence Advanced Technology.

A. Mission Description and Budget Item Justification

Ground Vehicle Holistic Defense (GVHD) will be the basis for a holistic survivability design framework utilizing virtual design models in a Modeling and Simulation (M&S) environment as well as conducting hardware in the loop and live fire demonstration. This Project will inform multiple system level demonstrations to validate that layered survivability technologies are optimized to defeat emerging near-peer threats. Data collected will be used to further validate and verify M&S tools. This Project provides a design approach available to analyze and adjust the family of protection technologies for combat vehicles in relevant operational theaters.

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

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.

Work in this Project is coordinated with PE 0603462A (Next Generation Combat Vehicle Advanced Technology) Project BG7 (Ground Systems Active Defense) and transitions to PE 0604852A (Suite of Vehicle Protection Systems - EMD).

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

	FY 2020	FY 2021	FY 2022
Title: Layered Survivability Demonstration	-	-	0.034
Description: This effort will utilize virtual models in a Modeling and Simulation (M&S) environment to analyze layered survivability technologies for integration to a demonstration platform. Selected technologies will be demonstrated in a relevant environment to include, virtual, hardware/software in the loop, and live fire environments. This effort will validate that layered Survivability technologies are optimized to defeat threats consistent with the threat defeat capabilities of the selected technologies.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH4 / <i>Ground Vehicle Holistic Defense Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will conduct very limited holistic vehicle defense analysis in support of larger vehicle systems security activities found in Project BJ1 (Vehicle System Security Advanced Technology).				
FY 2021 to FY 2022 Increase/Decrease Statement: This is a new planned effort under PE 0603462A in FY22. The funding increase is to start an M&S demonstration.				
Accomplishments/Planned Programs Subtotals		-	-	0.034
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BH6 / Platform Electrification and Mobility Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH6: Platform Electrification and Mobility Adv Tech	-	4.775	24.006	24.891	-	24.891	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, integrates and demonstrates technologies to electrify both manned and unmanned Next Generation Combat Vehicle platforms. Electrification of these platforms will enable advanced onboard electrified payloads such as directed energy weapons, reduce battlefield fuel consumption, and provide new capabilities such as burst acceleration, extended silent mobility and silent watch. The effort will mature, integrate and demonstrate technologies to increase electric power such as a high voltage/temperature generator and high power/ temperature power electronics as well as technologies to reduce power demands including composite rubber band track and adaptive hydro-strut suspension.

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 electrification technology that enables 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.

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 Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command.

This work complements PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: NGCV Platform Electrification & Mobility Advanced Technology	4.775	-	-
Description: This effort develops and demonstrates scalable electrification architecture, electronics and mobility components required to electrify both manned and unmanned Next Generation Combat Vehicle platforms.			
Title: Platform Electrification Technologies	-	14.377	11.015
Description: This effort matures and integrates components and sub-systems in order to demonstrate a modular electrification architecture that scales across light to heavy weight classes of combat vehicles.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH6 / <i>Platform Electrification and Mobility Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p><i>FY 2021 Plans:</i> Develop scaleable, modular combat vehicle electrification architecture. Develop electric sprocket drive motors, diesel-electric power system and thermal management system for electrification architecture. Develop combat vehicle electrification software architecture. Develop electric fan and demonstrate cooling architecture. Demonstrate combat vehicle electrification software architecture. Demonstrate architecture and components for a modular high voltage, high energy storage system. Demonstrate architecture for a tactical battlefield recharge capability.</p> <p><i>FY 2022 Plans:</i> Will mature the electric sprocket drive system and develop integration software. Will mature thermal management system for a modular high voltage energy storage system. Will mature the diesel-electric power system and thermal management system and develop integration software. Will develop high power electrical components to enable the tactical battlefield recharging capability.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding decrease is a result of funding realignments to two new efforts in this Project, namely "Scalable Electrification & Control Architecture Technology" for electrification architecture and "Robotic Combat Vehicle (RCV) Silent Watch and Mobility Range Extension Advanced Technology" for silent watch/range extension; also slightly reduced work required to mature components developed in FY21.</p>				
<p><i>Title:</i> Advanced Mobility Technologies</p> <p><i>Description:</i> This effort matures and demonstrates a reduced weight composite running gear system for medium combat vehicle applications which increases operational effectiveness and reduces fuel consumption.</p> <p><i>FY 2021 Plans:</i> Demonstrate and validate performance of solid composite track and external suspension systems.</p> <p><i>FY 2022 Plans:</i> Will exploit composite materials and component designs to significantly reduce running gear system weights. Will reduce integration and supportability concerns with external suspension systems.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase reflects planned lifecycle of this effort attributable to the cost of lightweight materials in the suspension component and track designs.</p>		-	3.744	5.819
<p><i>Title:</i> Advanced Vehicle Power Technology Alliance (AVPTA) - Electrification Technology</p> <p><i>Description:</i> This effort develops and matures advanced energy storage technologies to improve power and energy performance and safety for vehicles. Higher energy stored with less space and weight increases vehicle efficiency and range. Ensures</p>		-	2.841	2.068

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH6 / <i>Platform Electrification and Mobility Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>electrified ground vehicles have enough power for mobility, silent watch, and enables capabilities such as advanced protection, lethality and network capabilities. This effort is a partnership with the Department of Energy.</p> <p>FY 2021 Plans: Demonstrate commercial battery chemistry and packaging technologies applicable to military hybrid and all-electric drive combat and tactical platforms.</p> <p>FY 2022 Plans: Will mature and optimize commercial based energy storage systems to meet military environmental conditions at a module level.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort with redirected focus on military hardening of commercial energy storage systems</p>				
<p>Title: System/Vehicle Integration and Test</p> <p>Description: This effort integrates advanced mobility, platform electrification components and electrification architecture technologies into surrogate platforms to demonstrate the performance, scalability and modularity of the system approach which will provide the capabilities of silent mobility, improved mobility performance, improved operational duration without re-supply, and provides power to enable integration of advanced protection, lethality and network capabilities.</p> <p>FY 2021 Plans: Integrate the sub-system models of the modular electrification architecture and components into surrogate hull models to maximize available volume.</p> <p>FY 2022 Plans: Will demonstrate sub-system packaging into the surrogate hulls for significantly improved under-armor power density while maximizing system integration for ease of assembly, maintenance, and supportability.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease reflects slightly lower level of effort required to realize and demonstrate the packaging approaches modeled in FY21.</p>		-	3.044	2.597
<p>Title: Scalable Electrification & Control Architecture Technology</p> <p>Description: This effort validates component-level performance and integrates the power distribution and control components to implement a common, scalable, electrified vehicle power architecture to enable analyze layered survivability technologies, high voltage batteries, fast vehicle charging from the grid, and silent mobility on combat platforms from 15 to 50 tons.</p>		-	-	1.930

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH6 / <i>Platform Electrification and Mobility Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p><i>FY 2022 Plans:</i> Will demonstrate component-level performance of the high voltage power converter and import/export power converter. Will integrate those components into the power subsystem to validate subsystem-level performance.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding for this effort was realigned from "Platform Electrification Technologies" effort in this Project to perform component demonstration and subsystem integration of required high voltage power conversion devices.</p>			
<p><i>Title:</i> RCV Silent Watch and Mobility Range Extension Advanced Technology</p> <p><i>Description:</i> This effort matures and integrates JP8 reformer components and sub-systems in order to demonstrate extended silent watch and mobility as part of a modular electrification architecture supporting robotic combat vehicles. The Army's robotic combat vehicles are expected to have increased silent watch and silent mobility requirements that are not met by current technologies.</p> <p><i>FY 2022 Plans:</i> Will optimize the lightweight anode supported solid oxide fuel cell integration with JP8 reformer and mature from test stand to stand alone operation on a light robotic combat vehicle to increase silent watch and mobility.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding for this effort was realigned from "Platform Electrification Technologies" effort in this Project to mature fuel cell for vehicle integration.</p>	-	-	1.462
Accomplishments/Planned Programs Subtotals	4.775	24.006	24.891

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BH8 / <i>Enhanced VETRONICS Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BH8: <i>Enhanced VETRONICS Advanced Technology</i>	-	12.398	12.009	14.989	-	14.989	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates vehicle electronics hardware such as computers, sensors, communications systems, displays, and vehicle command/control/driving mechanisms as well as vehicle software to enhance crew performance, increase vehicle fuel efficiency, reduced Size, Weight, and Power (SWaP) burdens and reduce vehicle maintenance costs. This Project also advances open system architectures (power and data) for military ground vehicles to enable common interfaces, standards and hardware implementations. The overall vehicle system architecture approach provides an open architecture such as the Vehicle Integration for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance / Electronic Warfare (C4ISR/EW) Interoperability (VICTORY), to allow platforms to accept future technologies without the need for significant re-design as new technologies are developed and integrated. Additionally this Project matures infrastructure that enables the ease of integration of autonomous subsystem technologies into future and existing tactical and combat vehicle architectures. Technical challenges include: software and algorithm development for increased levels of automation for both manned and unmanned systems, secure vehicle data networks, interoperability of intra-vehicle and inter-vehicle systems, and implementation of advanced user interfaces. Overcoming these technical challenges enables improved and increased span of collaborative vehicle operations, efficient workload management, commander's decision aids, embedded simulation for battlefield visualization and fully integrated virtual test/evaluation.

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

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

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

Work is also coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Enhanced - Vehicle Electronics (E-Vetronics)	12.398	12.009	14.989
Description: This effort addresses technical and integration challenges in the areas of vehicle architecture and systems integration. Specifically, this effort focuses on maturing and demonstrating a common ground vehicle open architecture with distributed display processing architecture, computing hardware capable of being re-configured to adapt to changes in Input / Output (I/O) needs, advanced network video distribution, advancements in slip ring technology, tactical situational awareness (SA), cooperative engagement and mission package integration through open architecture components and software. These			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BH8 / <i>Enhanced VETRONICS Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>efforts will enable future vehicle capabilities, reduce dependencies on proprietary solutions, and support increased market competition through open architecture components and software. This project will create the electronics architecture for future ground combat vehicles to enable software and hardware commonality and reduce system integration timing and cost.</p> <p>FY 2021 Plans: Begin development of a shared processor to support addition of new functionality without requiring additional processing hardware to the vehicle. Conduct first bench level demonstration of advanced slip ring technology, flexible computing I/O, and advancements in open systems architecture and tactical SA.</p> <p>FY 2022 Plans: Will continue development of architecture, tactical situational awareness, digital containerization, flexible computing I/O and advanced slip ring. Will conduct final demonstration of advanced slip ring and flexible computing I/O technologies, as well as a second bench level demonstration of all available components in an open system architecture. Will develop scalable, modular hybrid electric system architecture for tactical vehicles as well as interfaces to high voltage energy storage modules, power management systems to improve fuel efficiency for military vehicles.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Adjustment to economic assumptions because all long lead hardware procured as well as increase investment in Climate change initiative to reduce vehicle platform carbon emissions and increase fuel efficiency.</p>				
Accomplishments/Planned Programs Subtotals		12.398	12.009	14.989
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) B11 / Protection for Autonomous Systems Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
B11: Protection for Autonomous Systems Adv Tech	-	3.931	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates protection and survivability components such as novel ballistic and sensor protection to address both current and emerging advanced threats to autonomous ground vehicles. This Project integrates complimentary survivability technologies to enable advanced protection suites, providing greater survivability and protection against emerging threats. This Project develops a holistic set of protection technologies that specifically target the autonomous subsystems integrated on a robotic platform.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

In FY 2020 this Project will develop efforts that were successfully funded in PE 0602601A (Combat Vehicle and Automotive Technology) / Project C05 (Armor Applied Research) during FY 2019.

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

Work is performed by the U.S. Army Futures Command.

Work in this Project complements PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Protection for Autonomous Systems	2.724	-	-
Description: This effort focuses on maturing and demonstrating novel ballistic protection and sensor protection concepts to ensure autonomous ground vehicles can continue their mission in contested environments.			
Title: Vehicle Anti-Personnel Protection Armament System	1.207	-	-
Description: This effort matures and demonstrates capabilities to provide protection of manned and unmanned platforms against threats, non-combatants, civilian belligerents, and other potentially hostile actors.			
Accomplishments/Planned Programs Subtotals	3.931	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) B11 / <i>Protection for Autonomous Systems Adv 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BI3 / Sensor Protection Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BI3: Sensor Protection Advanced Technology	-	1.438	1.752	1.645	-	1.645	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates novel sensor protection capabilities which dramatically reduce the susceptibility of our thermal electro-optic/infrared (EO/IR) sensors to ever increasing threats on the battlefield. This effort enables continuation of the mission despite potential threat laser engagements. Low cost modular solutions will be demonstrated that can be applied across current and planned EO/IR targeting, surveillance, and situational awareness sensor systems against existing and emerging threats in support of combined arms maneuver.

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 Modernization Priorities Next Generation Combat Vehicle, Soldier Lethality, and Future Vertical Lift.

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), 0602143A (Soldier Lethality Technology), 0603465A (Future Vertical Lift Advanced Technology) and 0603118A (Soldier Lethality Advanced Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Sensor Protection Advanced Technology	1.438	1.752	1.645
Description: This effort will mature and demonstrate sensor protection and signature reduction capabilities which better ensure sensors are difficult to detect, dazzle, and damage by current and future laser threats.			
FY 2021 Plans: Mature and demonstrate technologies to protect emerging high sensitivity uncooled longwave infrared sensors.			
FY 2022 Plans: Will mature super window optical coating or material solution with environmental hardening. Will validate protected uncooled microbolometer camera in a relevant environment.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BI3 / <i>Sensor Protection Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.438	1.752	1.645

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) B15 / Materials Application and Integration Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BI5: <i>Materials Application and Integration Adv Tech</i>	-	3.476	5.286	4.947	-	4.947	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates lightweight novel materials, and new manufacturing processes and methodologies. These materials and technologies will enable the Army to address critical areas within survivability, mobility, and transportability.

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 the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy.

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

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

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

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

	FY 2020	FY 2021	FY 2022
Title: System Design Optimization for Lightweighting	3.476	4.588	4.252
Description: This effort matures technologies, tools, and advanced manufacturing techniques in support of the Army's mission to increase mobility, protection, and transportability while reducing weight. This effort focuses on maturing and demonstrating technologies to decrease ground vehicle weight while optimizing performances and enabling the Army trade space for enhanced capabilities. The technologies being demonstrated are in the fields of material maturation, design optimization, operational metrics, joining technologies, and additive manufacturing. This effort is coordinated with PE 0602145A (NGCV Technology).			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) B15 / <i>Materials Application and Integration Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Mature and demonstrate advanced/lightweight material technologies for design/weight optimization and advanced manufacturing, to include additive manufacturing. Validate and demonstrate integration of solid-state joining and hybrid joint design of dissimilar materials to improve performance while reducing weight and increasing system robustness. Validate material and component manufacturability, blast/ballistic performance, machinability, weldability, corrosion resistance, and stiffness characteristics.</p> <p>FY 2022 Plans: Will mature and demonstrate advanced/lightweight materials technologies including materials for armor applications, and novel materials for high temperature and high wear surfaces. Will apply integrated computational materials engineering (ICME) tools for improved Modeling & Simulation for virtual prototyping. Will mature and demonstrate advanced manufacturing technologies such as additive manufacturing for design optimization to improve component and sub-system performance, reduce part complexity, and reduce weight. Will validate and demonstrate integration of solid-state materials joining to include joint designs for advanced armor materials.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort for reduced research on solid state joining and hybrid joint design of dissimilar materials.</p>				
<p>Title: Advanced Vehicle Power Technology Alliance ? Materials</p> <p>Description: This effort develops and matures 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. Lighter materials/constructions and advances in joining technologies such as multi-material and dissimilar material joining will lead to lightweight military vehicle structures.</p> <p>FY 2021 Plans: Mature and demonstrate advanced/lightweight materials for ground vehicle weight optimization, energy storage/transfer, and protection such as FeMnAl (Iron, Manganese and Aluminum alloy), CuTa (Copper Tantalum), Magnesium, and/or other high strength aluminum alloys through optimization and validation of advanced manufacturing, machining, blast/ballistic performance, dissimilar material joining/weldability, and corrosion.</p> <p>FY 2022 Plans: Will mature and demonstrate advanced/lightweight materials for weight optimization, energy storage/transfer, and protection such as FeMnAl (Iron, Manganese and Aluminum alloy) for high hard armor applications, high strength alloy for structural applications, and conductive materials for energy transfer; validate manufacturing, machining, blast/ballistic, dissimilar materials joining/</p>		-	0.698	0.695

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) B15 / <i>Materials Application and Integration Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
weldability and corrosion performance for these materials. Will mature and demonstrate wire arc additive manufacturing for design optimization of large ground system components. FY 2021 to FY 2022 Increase/Decrease Statement: NA.				
Accomplishments/Planned Programs Subtotals		3.476	5.286	4.947
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BJ1 / Vehicle System Security Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BJ1: Vehicle System Security Advanced Technology	-	1.199	1.444	2.455	-	2.455	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates 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 mature cybersecurity technologies at the platform level to defeat cybersecurity threats and maintain assured vehicle functionality and freedom of maneuver in the cyber warfighting domain.

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 Modernization Priority Next Generation Combat Vehicle.

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

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Vehicle System Security Advanced Technology	1.199	1.444	2.455
Description: This effort matures and demonstrates technologies required to maintain operating tempo and overmatch capability during offensive digital attacks to military ground vehicle systems. Additionally, the effort will maintain critical vehicle functionality in peer and near-peer cyber-contested environments. The effort will also mature and demonstrate technologies to mitigate risk of future and emerging cyber vulnerabilities by designing highly assured systems with cybersecurity designed from the beginning.			
FY 2021 Plans: Develop a secure systems integration and assessment capability integrating hardware-in-the-loop and vehicular cybersecurity vulnerability models and exploits to assess cyber resiliency approaches. Mature and demonstrate vehicle data bus protection using embedded advanced sensing and analytics to provide real-time protection against malicious near-peer cyber attacks for both present and future tactical and combat military vehicles.			
FY 2022 Plans: Mature and demonstrate vehicle cybersecurity technologies which verify and validate the functionality of the hardware, software or firmware operation of vehicular microelectronics by identification, logging and notification of any instances of compromised			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BJ1 / <i>Vehicle System Security Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
hardware, software or firmware and the corresponding threat mitigation strategies without degrading the vehicle's designed functionality. FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort to focus on demonstration of cybersecurity hardware in relevant environments.				
Accomplishments/Planned Programs Subtotals		1.199	1.444	2.455
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BJ6 / Hydrogen Based Combat System Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BJ6: Hydrogen Based Combat System Advanced Technology	-	0.519	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, integrates and demonstrates the technologies required to enable combat systems to be powered by fuel cells to enable increased operational endurance, silent operations and improved mobility. This effort demonstrates the integration of multiple fuel cell stacks to achieve necessary power levels for tracked combat systems. The efforts in this Project analyze hydrogen generation and distribution approaches to validate operational relevance of hydrogen on the battlefield. This effort also develops and demonstrates in a relevant environment the required hydrogen generation technologies in order to quantify reliability, durability and efficiency.

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 Modernization Priority Next Generation Combat Vehicle.

Work is performed by the U.S. Army Futures Command (AFC).

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Hydrogen Based Combat System Advanced Technology	0.519	-	-
Description: This effort matures, integrates and demonstrates the technologies required to enable combat systems to be powered by fuel cells.			
Accomplishments/Planned Programs Subtotals	0.519	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BJ8 / <i>Detection of Explosive Hazards Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>BJ8: Detection of Explosive Hazards Advanced Technology</i>	-	4.919	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures, optimizes and demonstrates leap ahead capabilities for manned and unmanned detection and neutralization of peer, near peer and other threat mines, minefields and improvised explosive devices 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 Army Modernization Priorities Next Generation Combat Vehicle, and Soldier Lethality modernization priorities.

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

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Detection of Explosive Hazards Advanced Technology	4.919	-	-
Description: This effort matures and demonstrates an integrated, standoff, modular sensor processing capability that will enable remote, rapid autonomous detection of mines, other Explosive Hazards (EH) and indicators of emplacement from manned and unmanned ground vehicles and Unmanned Aerial Systems (UAS). This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), 0602143A (Soldier Lethality Technology), and 0603118A (Soldier Lethality Advanced Technology).			
Accomplishments/Planned Programs Subtotals	4.919	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BK1 / <i>Autonomous Mobility Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BK1: <i>Autonomous Mobility Adv Tech</i>	-	9.308	8.470	6.244	-	6.244	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates 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 will involve both simulation and live collection. Simulation will provide a baseline to correctly collect, clean, and analyze data that meets the need for improving algorithms for both formation control and unmanned aerial vehicle map input for unmanned ground vehicle mobility. Live data will start with Surrogate platforms in local areas. This will allow proper collection techniques, tools, and data to maximize embedded autonomy using Machine Learning and other Artificial Intelligent methods before utilizing live data collection. The Project will use AI/ML techniques to mature and demonstrate intelligent formation control to be used on maintained roads and in complex terrain without the need for GPS. Data will be collected from mounted platforms utilizing special internal and external sensors to improve algorithms for exact positioning, undistributed formation control, and increased speeds of unmanned platforms. Also, the Project will use AI/ML techniques to optimize intelligent autonomous ground platform planning through the use of Unmanned Aerial Systems (UAS) mapped areas. Data collected from air vehicle will be converted to maneuverable information for unmanned 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 .

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

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

This Project is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Machine Learning Data Collection	2.777	5.195	3.475
Description: This effort matures and demonstrates techniques and technologies for mass data collection to be used towards Army research in mobility with AI/ML efforts.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BK1 / <i>Autonomous Mobility Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Optimize data collection system created in FY20. Design the data pipeline and infrastructure to support a large number of sensor platforms, petabytes (quadrillion bytes) of data, and many concurrent users. Mature and demonstrate overall data collection approach with surrogate and actual vehicles using training and simulated operational events.</p> <p>FY 2022 Plans: Will optimize the data infrastructure for storage of large amounts of robotic ground vehicle data (petabytes) and access by many concurrent users. Will demonstrate the ground robotic data collection process with sensor kits installed on Army ground vehicles. Will mature and expand the AI/ML data for robotic ground data vehicles to include new environments and new types of robotic ground vehicle data</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY22 funding decrease reflects planned reduction to align to the data infrastructure maturation (optimizing from the previous years? work) and the data collection demonstration.</p>				
<p>Title: Formation Control</p> <p>Description: This effort uses AI/ML techniques to develop intelligent formation control to be used on maintained roads and in complex terrain without the need for GPS. 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.</p>		4.038	-	-
<p>Title: UAS Mapping</p> <p>Description: This effort uses AI/ML techniques to develop intelligent autonomous ground platform planning through the use of UAS mapped areas. Data collected from air vehicle will be converted to maneuverable information for unmanned ground platform with the identification of enemy positions, go/no-go areas, terrain classification, and optimal suggested paths.</p> <p>FY 2021 Plans: Improve the ability to use data collected from UAS to inform Unmanned Ground Vehicles (UGV) maneuver including in Global Positioning System (GPS)-denied and other degraded environments. Optimize the UAS's ability to identify enemies and terrain to be used for future UAS/UGV coordination.</p> <p>FY 2022 Plans: Will mature the ability to map the terrain, identify obstacles, and characterize the soil from a UAS and share that information with an unmanned ground vehicle (UGV) to better inform its planned maneuver(s). Will demonstrate these capabilities with Army platforms at a relevant Army test site.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		-	3.275	2.769

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BK1 / <i>Autonomous Mobility Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
In FY 2022, funding decrease reflects planned lifecycle progression of effort to focus on the UAS/UGV information-sharing demonstration at an Engineering Evaluation Test (EET).			
Title: Data Collection for Automated Target Recognition Advanced Research	2.493	-	-
Description: This effort synchronizes and fuses disparate data elements (images, videos, visual compilations, and figures) for machine learning algorithm training to inform automated target recognition.			
Accomplishments/Planned Programs Subtotals	9.308	8.470	6.244

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology				Project (Number/Name) BK4 / Next Gen Intelligent Fire Control(NG-IFC) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BK4: Next Gen Intelligent Fire Control(NG-IFC) Adv Tech	-	0.432	8.903	1.727	-	1.727	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project will mature and deliver armament specific hardware, algorithms and architectures to support the Next Generation Combat Vehicle 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.

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

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

Work in this Project is related to and fully integrated with the efforts funded in PE 0602145A (Next Generation Combat Vehicle Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Next Generation Intelligent Fire Control	0.432	8.903	1.727
Description: This effort will deliver armament specific hardware, algorithms and architectures to support the Next Generation Combat Vehicle with the necessary fire control on future manned and unmanned platforms.			
FY 2021 Plans: Demonstrate sensor interoperability in a fire control System Integration Lab (SIL) environment. Optimize and integrate hardware and software for beyond line of sight targeting with a forward sensor platform/system. Integrate fire control system, decision-aided algorithms, and targeting hardware in a relevant environment to demonstrate decreased sensor to shooter engagement time for combat vehicle platforms.			
FY 2022 Plans: Will demonstrate reduction of engagement timeline by leveraging advances of fire control technologies for extended range engagements through an improved user interface. Will mature hardware to demonstrate a tailored modular architecture framework.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BK4 / <i>Next Gen Intelligent Fire Control(NG-IFC) Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funding decrease in accordance with project lifecycle plans for reduced demonstrations of next generation fire control integrated technologies.				
Accomplishments/Planned Programs Subtotals		0.432	8.903	1.727
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BK6 / Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BK6: Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech	-	0.489	3.026	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies for large caliber direct fire light-weight armament systems that will exceed the current capability of 120 millimeter (mm) direct fire cannons and be optimized for future operational environment with cross-domain engagement capability. Specifically this effort integrates and demonstrates technologies for rapid fire on-the-move at all elevations (direct & indirect), compact ammunition design with advanced ignition, advanced recoil mitigation to reduce impulse and allow integration onto lighter platforms, automated ammunition handling and reloading. This Project supports open architecture to enable supervised autonomy and remote operation and integrates intelligent fire control to address multi-domain targets from 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.

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

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

Work in this Project is related to and fully integrated with the efforts funded in Program Element (PE) 0602145A (Next Generation Combat Vehicle Technology) and PE 0604115A (Technology Maturation Initiative).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Direct In-Direct Armament System (ADIDAS)	0.489	-	-
Description: This effort matures and demonstrates technologies for large caliber direct fire light-weight armament systems that will exceed the current capability of 120mm direct fire cannons and be optimized for future operational environment with cross-domain engagement capability.			
Title: Large Caliber Armament System (LCAS)	-	3.026	-
Description: This effort develops a next generation, automated, lightweight 120-mm armament system design for Next Generation Combat Vehicle, providing tank-like lethality for light medium-weight optionally manned platforms.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BK6 / <i>Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Optimize the weapon mount for increased gun elevations, an automated ammunition handling system, and integration on lighter weight, optionally manned combat vehicles; and mature and demonstrate an improved 120-mm reduced recoil weapon mount with increased lethality for future combat vehicles.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY22 funding was realigned to PE 0602181 All Domain Convergence Applied Research / Project CM7 Collaborative Convergence Applied Research. The "Large Caliber Armament System" effort completed in FY 2021; the "Advanced Lethality Armament System - Large Caliber" effort planned to start in FY 2022 is delayed to FY 2023 to allow technology to mature in PE 0602145A (Next Generation Combat Vehicle Technology), Project BK5 (Advanced Direct InDirect Armament System technology).</p>				
Accomplishments/Planned Programs Subtotals		0.489	3.026	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BP6 / Ground Vehicle Advanced Technology(CA)
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BP6: Ground Vehicle Advanced Technology(CA)	-	100.500	108.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Congressional Interest Item funding provided for Ground Vehicle Advanced Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Ground 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.

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

	FY 2020	FY 2021
<p>Congressional Add: Additive Manufacturing for Jointless Hull</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Additive Manufacturing for Jointless Hull.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Additive Manufacturing for Jointless Hull.</p> <p>Work executed by Army Futures Command.</p>	20.000	10.000
<p>Congressional Add: Carbon Fiber and Graphite Foam Technology</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Carbon Fiber and Graphite Foam Technology.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Carbon Fiber and Graphite Foam Technology.</p> <p>Work executed by Army Futures Command.</p>	10.000	10.000
<p>Congressional Add: Hydrogen Fuel Cells</p>	10.000	10.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2020 Accomplishments: Program Increase to support advanced research on Hydrogen Fuel Cells.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Hydrogen Fuel Cells.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: ATE5.2 Engine Development</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on ATE5.2 Engine Development.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in ATE5.2 Engine Development.</p> <p>Work executed by Army Futures Command.</p>	5.000	10.000
<p>Congressional Add: Additive Manufacturing of Critical Components</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Additive Manufacturing of Critical Components.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Additive Manufacturing of Critical Components.</p> <p>Work executed by Army Futures Command.</p>	5.000	5.000
<p>Congressional Add: Advanced Water Harvesting Technology</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Advanced Water Harvesting Technology.</p> <p>Work executed under the direction of the Army Futures Command.</p>	5.000	-
<p>Congressional Add: Advanced High Strength and Lightweight Steels</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Advanced High Strength and Lightweight Steels.</p>	3.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed under the direction of the Army Futures Command.		
Congressional Add: Combat Vehicle Weight Reduction Initiative FY 2020 Accomplishments: Program Increase to support advanced research on Combat Vehicle Weight Reduction Initiative.	8.000	10.000
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Conduct advanced research in Combat Vehicle Weight Reduction Initiative.		
Work executed by Army Futures Command.		
Congressional Add: Virtual and Physical Prototyping FY 2020 Accomplishments: Program Increase to support advanced research on Virtual and Physical Prototyping.	8.000	10.000
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Conduct advanced research in Virtual and Physical Prototyping.		
Work executed by Army Futures Command.		
Congressional Add: HMMWV Augmented Reality System FY 2020 Accomplishments: Program Increase to support advanced research on HMMWV Augmented Reality System.	5.000	-
Work executed under the direction of the Army Futures Command.		
Congressional Add: Health Usage Monitoring for HMMWV FY 2020 Accomplishments: Program Increase to support advanced research on Health Usage Monitoring for HMMWV.	3.000	-
Work executed under the direction of the Army Futures Command.		
Congressional Add: HMMWV Autonomy	5.000	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2020 Accomplishments: Program Increase to support advanced research on HMMWV Autonomy.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in HMMWV Autonomy.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: HMMWV Torque Monitoring</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on HMMWV Torque Monitoring.</p> <p>Work executed under the direction of the Army Futures Command.</p>	2.000	-
<p>Congressional Add: HMMWV Automotive Enhancements</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on HMMWV Automotive Enhancements.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in HMMWV Automotive Enhancements.</p> <p>Work executed by Army Futures Command.</p>	7.500	5.000
<p>Congressional Add: Additive Manufacturing</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Additive Manufacturing.</p> <p>Work executed under the direction of the Army Futures Command.</p>	4.000	-
<p>Congressional Add: Program increase - combat vehicle blast testing</p> <p>FY 2021 Plans: Conduct advanced research in Combat Vehicle Blast Testing.</p> <p>Work executed by Army Futures Command.</p>	-	6.000
<p>Congressional Add: Program increase - advanced adhesives</p> <p>FY 2021 Plans: Conduct advanced research in Advanced Adhesives.</p>	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BP6 / <i>Ground Vehicle Advanced Technology(CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - combat vehicle lithium 6T battery development FY 2021 Plans: Conduct advanced research in Combat Vehicle Lithium 6T Battery Development.	-	5.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - vehicle technology readiness levels FY 2021 Plans: Conduct advanced research in Vehicle Technology Readiness Levels.	-	2.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - 10X technology demonstration FY 2021 Plans: Conduct advanced research in 10x Technology Demonstration.	-	8.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - HMMWV augmented reality HUD FY 2021 Plans: Conduct advanced research in HMMWV Augmented Reality HUD.	-	5.000
Work executed by Army Futures Command.		
Congressional Add: Program increase - Operator-in-the-loop virtual and physical prototyping FY 2021 Plans: Conduct advanced research in Operator-in-the-Loop Virtual and Physical Prototyping.	-	4.000
Work executed by Army Futures Command.		
Congressional Adds Subtotals	100.500	108.000
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BZ9 / <i>Smart Targeting Environment for Lower Level Assets</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BZ9: <i>Smart Targeting Environment for Lower Level Assets</i>	-	-	3.823	3.954	-	3.954	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates mission targeting support software and algorithms leveraged from the Defense Advanced Research Project Agency (DARPA) System-of-System Enhanced Small Unit (SESU) concepts and technology to enable small units to continuously build and share targeting data and access strike assets in multi-domain 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 Modernization Priority Next Generation Combat Vehicle.

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

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

	FY 2020	FY 2021	FY 2022
Title: Small Targeting Environment for Lower Level Assets (STELLA)	-	3.823	3.954
<p>Description: This effort integrates search, fusion, data dissemination and interoperability algorithms to speed the overall targeting process by: utilizing automated target search algorithms based on mission parameters for processing time , detecting concealed targets and target priority; fusing local data processing of navigation and payload data to increase accuracy for engagement of targets; optimizing data dissemination algorithms based on local network conditions; streamlining interfaces for small units to access joint strike assets.</p> <p>FY 2021 Plans: Analyze reports and laboratory models to improve performance of technologies that will be integrated into small unit common operating picture (COP) to identify enemy location and access strike assets; mature tactical automated search algorithms with attribute trade-offs such as speed or detection thresholds.</p> <p>FY 2022 Plans: Will incorporate development of improved alignment of non-kinetic strike assets and plan for integration into the COP. Will implement tactical procedure software into Mounted Computing Environment/Mounted Mission Command software baselines. Will continue maturing small unit common operating picture procedural software for strike asset planning and tasking alignment</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BZ9 / <i>Smart Targeting Environment for Lower Level Assets</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
both prior to and during missions. Will conduct Soldier touch points and lab/field based demonstrations to assure project is meeting threshold metrics. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Increase reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		-	3.823	3.954
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity					R-1 Program Element (Number/Name)							
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)					PE 0603463A / Network C3I Advanced Technology							
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	138.937	216.520	155.867	-	155.867	-	-	-	-	-	-
AM7: Modular RF Communications Advanced Technology	-	14.744	12.057	9.288	-	9.288	-	-	-	-	-	-
AM9: Protected SATCOM Advanced Technology	-	-	16.032	25.552	-	25.552	-	-	-	-	-	-
AN2: Narrowband SATCOM Advanced Technology	-	-	4.813	11.630	-	11.630	-	-	-	-	-	-
AN4: Non Traditional Waveforms Advanced Technology	-	5.126	7.508	9.300	-	9.300	-	-	-	-	-	-
AN6: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	-	1.864	1.925	-	-	-	-	-	-	-	-	-
AN8: COE - Every Receiver is a Sensor Advanced Tech	-	5.571	2.934	2.887	-	2.887	-	-	-	-	-	-
AO1: UNT - Every Receiver is a Sensor Advanced Tech	-	6.044	2.888	2.944	-	2.944	-	-	-	-	-	-
AO3: Stand-In Advanced RF Effects (STARE) Adv Tech	-	1.864	2.888	-	-	-	-	-	-	-	-	-
AO6: Tag Track and Locate Small Satellites Adv Tech	-	13.034	16.051	-	-	-	-	-	-	-	-	-
AO7: EW for Maneuver Operations (EMO) Adv Tech	-	3.974	2.810	5.803	-	5.803	-	-	-	-	-	-
AP6: C4ISR Integrated Demonstrations Advanced Tech	-	4.233	3.603	-	-	-	-	-	-	-	-	-
AP8: Comms/Horiz Int for Army Mod Priorities Adv Tech	-	0.633	7.781	-	-	-	-	-	-	-	-	-
AP9: Next Generation HF Advanced Technology	-	5.592	6.739	7.835	-	7.835	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army										Date: May 2021			
Appropriation/Budget Activity					R-1 Program Element (Number/Name)								
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)					PE 0603463A / Network C3I Advanced Technology								
AQ1: Spectrum Obfuscation Advanced Technology	-	5.592	3.744	-	-	-	-	-	-	-	-	-	-
AQ5: Sensor CE-Integrated Sensor Architecture Adv Tech	-	1.406	1.971	1.645	-	1.645	-	-	-	-	-	-	-
AQ8: High Tempo Data Driven Decision Tools Adv Tech	-	-	2.911	3.121	-	3.121	-	-	-	-	-	-	-
AR2: Energy Informed Operations Advanced Technology	-	1.864	-	-	-	-	-	-	-	-	-	-	-
AR4: Intelligent Env Battlefield Awareness Adv Tech	-	0.641	3.138	4.075	-	4.075	-	-	-	-	-	-	-
AR6: Understanding the Environment as a Threat Adv Tech	-	2.155	2.706	2.524	-	2.524	-	-	-	-	-	-	-
AR8: Sensing in Contested Environments Adv Tech	-	-	0.948	1.611	-	1.611	-	-	-	-	-	-	-
AS9: Persistent Geophysical Sensing-Infrasound Adv Tech	-	2.257	4.600	2.448	-	2.448	-	-	-	-	-	-	-
AT3: Subterranean Detection and Monitoring Adv Tech	-	1.016	3.360	2.217	-	2.217	-	-	-	-	-	-	-
AT8: Network-Enabled GeoSpatial-GEOINT Services AdvTech	-	3.521	2.888	3.059	-	3.059	-	-	-	-	-	-	-
AU1: Tactical GeoSpatial Information Capabilities ATech	-	1.929	3.603	4.207	-	4.207	-	-	-	-	-	-	-
AU2: Optimization of Geospatial Data for Visualization	-	-	2.022	2.171	-	2.171	-	-	-	-	-	-	-
AU4: Geospatially Enabled Operational Design Adv Tech	-	4.610	7.905	7.956	-	7.956	-	-	-	-	-	-	-
AU6: Automated Analytics for Operational Environment AT	-	1.593	-	-	-	-	-	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	PE 0603463A / Network C3I Advanced Technology											
AV1: GEOInt/Ops Logistics Integration-Planning Adv Tech	-	-	3.771	3.867	-	3.867	-	-	-	-	-	-
AV2: LEO Advanced Technology	-	1.891	1.949	-	-	-	-	-	-	-	-	-
AV4: Foundational S&T for Network C3I Advanced Tech	-	-	2.068	7.751	-	7.751	-	-	-	-	-	-
AV8: Navigation Warfare (NAVWAR) Advanced Technology	-	5.707	2.535	1.927	-	1.927	-	-	-	-	-	-
AW2: Autonomous Navigation Advanced Technology	-	0.280	-	-	-	-	-	-	-	-	-	-
AW4: DoD PNT M&S Collaborative Initiative (CI) Adv Tech	-	2.796	2.888	-	-	-	-	-	-	-	-	-
AW6: Modular GPS Independent Sensors Advanced Tech	-	-	10.684	6.813	-	6.813	-	-	-	-	-	-
BP4: ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)	-	39.000	64.800	-	-	-	-	-	-	-	-	-
CF9: Automated IPB Adv Tech	-	-	-	0.989	-	0.989	-	-	-	-	-	-
C17: Mobile & Survivable Command Post (MASCP) Adv Tech	-	-	-	7.809	-	7.809	-	-	-	-	-	-
CJ8: Assured PNT Communications Advanced Tech	-	-	-	16.438	-	16.438	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Program Element (PE) matures and demonstrates technologies to provide an Army tactical network and enabling infrastructure that support operations in any environment, to include where the electromagnetic spectrum is denied or degraded. This is accomplished through the exploitation and optimization of components and systems for robust, low signature communications and data networks; assured positioning, navigation, and timing in contested environments; converged and coordinated cyber and electronic warfare activities; resilient mission command on the move; and the collection, processing, and dissemination of information for intelligence, surveillance, and reconnaissance.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>
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Work in this PE complements PE 0602146A (Network C3I Technology), 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 0602213A (C3I Applied Cyber), 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), and PE 0603466A (Air and Missile 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 is performed by the U.S. Army Futures Command (AFC), the U.S. Army Space and Missile Defense Command (SMDC) and U.S. Army Engineer Research and Development Center (ERDC).

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	142.899	158.608	163.892	-	163.892
Current President's Budget	138.937	216.520	155.867	-	155.867
Total Adjustments	-3.962	57.912	-8.025	-	-8.025
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-1.750			
• Congressional Rescissions	-	-			
• Congressional Adds	-	64.800			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.962	-5.138			
• Adjustments to Budget Years	-	-	-8.025	-	-8.025

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

Project: BP4: *ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)*

Congressional Add: *Unmanned Aerial Systems and Aerostat Operations*

Congressional Add: *Sensor Advanced Technology*

Congressional Add: *Assured Position, Navigation, and Timing Technology*

Congressional Add: *Payload and Ground Segment Research and Development for Small Satellite Science and Security Applications*

Congressional Add: *Urban Subterranean Mapping Technology*

Congressional Add: *Anticipating Threats to Natural Systems*

	FY 2020	FY 2021
	4.000	-
	10.000	-
	9.000	6.300
	5.000	-
	3.000	-
	6.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2020	FY 2021
Congressional Add: <i>Army Visual and Tactical Arctic Reconnaissance</i>	2.000	2.000
Congressional Add: <i>Program increase - anticipating threats to natural systems</i>	-	6.000
Congressional Add: <i>Program increase - S?UAS cyber threat management</i>	-	7.500
Congressional Add: <i>Program increase - sub?surface infrastructure in arctic environments</i>	-	1.000
Congressional Add: <i>Program increase - mesh network-enabled small satellites</i>	-	10.000
Congressional Add: <i>Program increase - geospatial artificial intelligence analytic tools</i>	-	4.000
Congressional Add: <i>Program increase - advanced materials and technologies for command post modernization</i>	-	10.000
Congressional Add: <i>Program increase - advanced materials for resilient sensors</i>	-	8.000
Congressional Add: <i>Program increase - tactical geospatial information capabilities</i>	-	10.000
Congressional Add Subtotals for Project: BP4	39.000	64.800
Congressional Add Totals for all Projects	39.000	64.800

Change Summary Explanation

\$5.250 million of FY222 will be realigned to APE 633463AV4 from APE GA0750000, Abrams Upgrade Program.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity					R-1 Program Element (Number/Name)				Project (Number/Name)			
2040 / 3					PE 0603463A / Network C3I Advanced Technology				AM7 / Modular RF Communications Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AM7: Modular RF Communications Advanced Technology	-	14.744	12.057	9.288	-	9.288	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned from:
PE 0603463A (Network C3I Advanced Technology) Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech)

A. Mission Description and Budget Item Justification

This Project optimizes autonomous networking protocols to automate the Primary, Alternate, Contingency, and Emergency (PACE) communication plan to initialize, adapt, and continue operations under changing environments and threats.

Work in this Project complements PE 06022146A (Network C3I Technology) Project AM6 (Modular RF Communications Technology) and PE 0602213A (C3I Applied Cyber), Project CY1 (Information Assurance and Network Resiliency 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Modular Radio Frequency (RF) Communications Advanced Technology	14.744	12.057	9.288
Description: This effort optimizes autonomous networking protocols to automate the Primary, Alternate, Contingency, and Emergency (PACE) communication plan to initialize, adapt, and continue operations under changing environments and threats.			
FY 2021 Plans:			
Mature the design to perform over disparate transport networks across multiple security classifications enabling a unified network operations across the Army Brigade network; refine and mature the algorithms to enable distributed decision making by coordinating and cooperating among decision engines distributed across the network; demonstrate the auto Primary, Alternate, Contingency, and Emergency (PACE) capability to initialize, detect, and adapt the network to the changing conditions and threats in a relevant field based experiment; refine the architecture for modularity, develop interfaces with external systems to exchange			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AM7 / Modular RF Communications Advanced Technology

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
information, and mature interface standards; and develop specifications for the next phase of capability to incorporate Artificial Intelligence/Machine Learning (AI/ML) techniques. FY 2022 Plans: Will optimize the network protocols design for disparate transport networks across multiple security classifications enabling a unified network operations across the Army Brigade network; optimize the algorithms of the decision engine to process data received from external systems; integrate the automated PACE (A-PACE) solution with Program of Record products (e.g. Mounted Mission Command Software, AFAATDS, and PF-D) and other S&T products; will use opportunities such as, Network Modernization Experiment (NetMod X), Joint Capabilities Technology Demonstration (JCTD), and Dynamic Front to optimize the design. FY 2021 to FY 2022 Increase/Decrease Statement: Overall funding decrease in FY22 reflects planned lifecycle level of effort.			
Accomplishments/Planned Programs Subtotals	14.744	12.057	9.288

C. Other Program Funding Summary (\$ in Millions) N/A Remarks D. Acquisition Strategy N/A
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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AM9 / Protected SATCOM Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AM9: Protected SATCOM Advanced Technology	-	-	16.032	25.552	-	25.552	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 funding is realigned from:
 PE 0602146A (Network C3I Technology) Project AP7 (Comms/Horiz Int for Army Mod Priorities Tech)
 PE 0603463A (Network C3I Advanced Technology) Project AP6 (C4ISR Integrated Demonstration Advanced Tech)

A. Mission Description and Budget Item Justification

This project matures and demonstrates technologies and components to increase resiliency of Wideband Satellite Communications (SATCOM) in contested and congested electromagnetic environments. This effort improves resiliency through science & technology investigation. Will compliment technologies that provide obfuscation of radio frequency (RF) spectrum signature in order to counter enemy electronic surveillance capabilities.

Work in this Project complements PE 0602146A (Network C3I Technology) Projects AM8 (Protected SATCOM Technology) and BZ8 (Aerial Tier Networking).

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

Work in this Project is performed by the U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Protected SATCOM Advanced Technology and Resilient Tactial Networking and Comms	-	12.223	25.351
Description: This project matures and demonstrates technologies and components to increase resiliency of Wideband SATCOM in contested and congested electromagnetic environments. This effort improves resiliency through science & technology investigation. Will compliment technologies that provide obfuscation of radio frequency (RF) spectrum signature in order to counter enemy electronic surveillance capabilities.			
FY 2021 Plans: Optimize and select those SATCOM technologies that will automatically adapt to constantly changing, congested, and contested environments; conduct demonstrations to establish a baseline for future research of intelligent satellite communications (i.e., systems that automatically adapt and mitigate network problems); mature and optimize components that support the control of the Army satellite network in a contested environment; mature and optimize Army capabilities through the exploitation of emerging commercial Low Earth Orbit (LEO) technologies and conduct demonstrations using these same technologies in a			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AM9 / Protected SATCOM Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>contested environment; and provide tactical SATCOM advantage to the US Army by demonstrating commercial LEO technologies that will validate improvements to Tactical SATCOM Network Resiliency and inform future Next Generation Tactical Terminal Development.</p> <p>FY 2022 Plans: Will mature and demonstrate components that support the control of the Army satellite networks in a contested environment, enabling automated tactical communications resiliency technologies; mature and optimize select SATCOM technologies for basic SATCOM waveforms that will automatically adapt to changing contested environments, leading to protection which improves throughput in tactical and enterprise environments; mature On-the-Move (OTM) satellite ground terminal technology that supports operation over multiple satellite constellations with low available size, weight, and power (SWAP), leading to Army communications resiliency through diversity for tactical vehicles; and mature At-the-Halt (ATH) satellite ground terminal technology that supports operation over multiple satellite constellations simultaneously, leading to Army communications resiliency through diversity for Army Tactical Operations Centers (TOC).</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 will support increased technology maturity and optimization of OTM and ATH satellite ground terminal technology leading to resiliency through diversity for Army TOCs. Funds realigned from PE 0602146A Project AP7 (Comms/Horiz Int for Army Mod Priorities Tech) and PE 0603463A Project AP6 (C4ISR Integrated Demonstration Advanced Tech).</p>				
<p>Title: High Altitude: Wideband Global Satellite Communications (SATCOM) (WGS) Ka Band Surrogate Payload / Aerial Tier Networking</p> <p>Description: Demonstrate a WGS surrogate payload for usage on a High Altitude Platform (HAP) with seamless transition to existing ground terminals by modifying existing solutions to support Capability Sets (CS), beginning with CS 23: Capacity & Resiliency.</p> <p>FY 2021 Plans: Mature and demonstrate WGS Ka Band Surrogate Payload which includes low power RF components and antenna optimized for the HAP field of view; improve performance of SATCOM terminal and modem so that they can acquire and track the HAP and be able to hand over to a second HAP; and integrate the WGS Surrogate Payload into the platform utilizing leased or purchased HAP enabling the anticipated performance improvement.</p> <p>FY 2022 Plans: Will validate the potential use of the WGS Surrogate's receive signals to identify and geo-locate adversary electronic warfare threats.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>		-	3.809	0.201

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AM9 / <i>Protected SATCOM Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
FY 22 funding decrease is aligned to lifecycle glide path to the post demonstration and transition to POR activities at the end of FY22.			
Accomplishments/Planned Programs Subtotals	-	16.032	25.552

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AN2 / Narrowband SATCOM Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AN2: <i>Narrowband SATCOM Advanced Technology</i>	-	-	4.813	11.630	-	11.630	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned from:
PE 0603463A (Network C3I Advanced Technology) Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech)

A. Mission Description and Budget Item Justification

This Project validates and demonstrates technologies to enable gateway communications across disparate Narrowband Satellite Communications (SATCOM) networks, enabling resiliency in contested environments. The Narrowband SATCOM network is the largest tactical network operated by the Army to provide situational understanding across all echelons. This project optimizes technologies and protocols to enable risk mitigation solution sets and awareness through adaptive learning capabilities.

Work in this Project complements PE 0602146A (Network C3I Technology) Project BZ6 (Narrowband SATCOM Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Narrowband SATCOM Advanced Technology	-	4.813	11.630
Description: This effort validates and demonstrates technologies to enable gateway communications across disparate Narrowband Satellite Communications (SATCOM) networks, enabling resiliency in contested environments.			
FY 2021 Plans: Optimize Narrowband SATCOM products based on schedule requirements, performance requirements, and integration needs for laboratory demonstrations in support of the Network, Long Range Precision Fires, Air & Missile Defense and Next Generation Combat Vehicle use case scenarios; demonstrate in a congested and contested environment to determine system design performance and assess human in-the-middle activities; demonstrate augmented artificial intelligence/machine learning operations in a congested and contested environment; and mature and demonstrate Narrowband SATCOM hardware and software.			
FY 2022 Plans: Will optimize the Narrowband SATCOM gateway network transport management system to incorporate capabilities such as artificial intelligence, machine learning and cognitive computing; validate system design performance and resiliency in maintaining an acceptable level of communication services; perform integrated demonstrations using multiple use-case scenarios of the			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AN2 / Narrowband SATCOM Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Networks, Long Range Precision Fires, Air & Missile Defense and Next Generation Combat Vehicle; and mature system to Technology Readiness Level of 5. FY 2021 to FY 2022 Increase/Decrease Statement: Increase supports integrated demonstrations for multiple use-case scenarios of the Networks, Long Range Precision Fires, Air & Missile Defense and Next Generation Combat Vehicle. Funding in this effort was realigned from PE 0603463A Project AP8 (Comms/Horiz Int for Army Mod Priorities Adv Tech).				
Accomplishments/Planned Programs Subtotals		-	4.813	11.630
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AN4 / Non Traditional Waveforms Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AN4: <i>Non Traditional Waveforms Advanced Technology</i>	-	5.126	7.508	9.300	-	9.300	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned from:
PE 0603463A (Network C3I Advanced Technology) Project AP6 (C4ISR Integrated Demonstrations Advanced Tech)

A. Mission Description and Budget Item Justification

This Project demonstrates non-traditional waveforms and technologies for resilient communications in contested environments providing anti-jam, low probability of intercept, and low probability of detection for the dismounted and vehicular user. This Project optimizes technologies not typically applied to the tactical environment, such as millimeter wave communications and directional networking with coherent combining of radio frequency signals, to maintain networked communications in and under contested and congested electromagnetic spectrum environments.

Work in this Project complements PE 0602146A (Network C3I Technology)/Project AN3 (Non Traditional Waveforms Technology) and AO4 (Energy Efficient Devices 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Non Traditional Waveforms Advanced Technology	5.126	7.508	9.300
Description: This effort demonstrates non-traditional waveforms and technologies for resilient communications in contested environments providing anti-jam, low probability of intercept, and low probability of detection for the dismounted and vehicular user. This effort optimizes technologies not typically applied to the tactical environment, such as millimeter wave communications and directional networking with coherent combining of radio frequency signals, to maintain networked communications in and under contested and congested electromagnetic spectrum environments.			
FY 2021 Plans: Will enhance low probability of intercept, low probability of detection as well as anti-jam technology while supporting dismounted and mounted systems to operate in relative contested and congested environments, using technologies such as distributed cooperative beamforming in conjunction with dismounted communication devices and highly directional millimeter wave systems			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AN4 / <i>Non Traditional Waveforms Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>using techniques such as amplitude control and advanced signal processing techniques; mature adaptive power control techniques and dismantled networking; and mature the millimeter wave demonstration system for at least a three node system with enhanced discovery and tracking speeds as well as advanced networking protocol enhancements for a highly directional network Mobile Ad hoc Network (MANET) for mounted operations at operational distances and throughputs.</p> <p><i>FY 2022 Plans:</i> Will mature anti-jam and low probability of intercept, low probability of detection communications capabilities for protected communications to be better suited for operationally relevant, contested environments; enable directional millimeter wave communications to support additional users in complex scenarios (e.g. on-the-move high speed directional ad-hoc network at operational distances); exploit and mature government owned millimeter wave antenna aperture to reduce the unit cost of mmW communications systems; apply techniques developed in previous years, (cooperative beamforming for voice and data communications) and enable upgrade of a legacy waveform(s) via software/firmware update only; and enhance waveform protection in contested environments using methods, such as combining cooperative beamforming with additional anti-jam low probability of intercept, low probability of detection techniques.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase in FY22 will support enhancement of millimeter wave communications technology to add resiliency for complex scenarios and improve waveform capabilities. Funding in this effort was realigned from PE 0603463A Project AP6 (C4ISR Integrated Demonstrations Advanced Tech).</p>			
Accomplishments/Planned Programs Subtotals	5.126	7.508	9.300

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AN6 / Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AN6: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	-	1.864	1.925	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This effort is an elimination in Fiscal Year (FY) 2022.

A. Mission Description and Budget Item Justification

This Project matures technologies providing increased resiliency for Wideband Satellite Communications (SATCOM) from contested and congested electromagnetics through the use of technologies including adaptive interference mitigation and diversity through multiple paths. Wideband SATCOM is the primary high-bandwidth Beyond Line of Sight (BLOS) communications used by the tactical Army and this project demonstrates protection of this valuable communication link.

Work in this Project complements PE 06022146A (Network C3I Technology) Project AN5 (Protected SATCOM-WB Global SATCOM Inter Canc 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	1.864	1.925	-
Description: This effort matures technologies providing increased resiliency for Wideband SATCOM from contested and congested electromagnetics through the use of technologies including adaptive interference mitigation and diversity through multiple paths. Wideband SATCOM is the primary high-bandwidth BLOS Communications used by the tactical Army and this project demonstrates protection of this valuable communication link.			
FY 2021 Plans: Mature and demonstrate Ka-band interference cancelling technology and planning tool in field based demonstrations and support transition of the Ka-band interference cancelling technologies into a Program of Record.			
FY 2021 to FY 2022 Increase/Decrease Statement: This effort completes in FY21.			
Accomplishments/Planned Programs Subtotals	1.864	1.925	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AN6 / Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AN8 / COE - Every Receiver is a Sensor Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AN8: COE - Every Receiver is a Sensor Advanced Tech	-	5.571	2.934	2.887	-	2.887	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project optimizes automated exploitation and fusion analysis tools, applications, and software services that harvest, correlate and fuse tactical receiver sources with new and emerging data sources to improve understanding of the threat picture and more efficiently support near-real time Situational Understanding of the battlefield.

Work in this Project complements 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 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Data Analytics for Situational Awareness	5.571	2.934	2.887
Description: This effort improves software technologies for intelligence/mission command (MC) mission collaboration to provide faster and higher quality decision-making support for the commander and his key staff. Specific efforts focus on integrating intelligence, surveillance and reconnaissance (ISR) planning and execution at the Task Force/Battalion through troop-level, as well as efforts that provide the capability to identify, fuse, and trace/track specific targets in an asymmetric environment.			
FY 2021 Plans: Mature the data platform with emphasis on intelligence and operations convergence through the application of advanced analytic capabilities; conduct a capability demonstration with a user jury to help establish baseline performance enhancements to situational awareness, and decreased time to action; and integrate additional data stores to capture estimates of future costs to extend the data platform further into relevant data stores.			
FY 2022 Plans: Will add and demonstrate enhanced attribute and cell level security capabilities within the converged intelligence and operations platform to show functionality across different classification boundaries; Will integrate machine learning frameworks to demonstrate machine learning capabilities within the converged platform; Will demonstrate tactical distributed PED workflows and			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AN8 / COE - Every Receiver is a Sensor Advanced Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
efficient data synchronization at lower echelons by developing and demonstrating Tactical Edge data synchronization to support the Disconnected, Intermittent, and Limited (DIL) environment.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		5.571	2.934	2.887
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AO1 / UNT - Every Receiver is a Sensor Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AO1: UNT - Every Receiver is a Sensor Advanced Tech	-	6.044	2.888	2.944	-	2.944	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates high fidelity Cyber-Electromagnetic Activity (CEMA) situational understanding by exploiting tactical receivers with sufficient capabilities as sensors. This Project optimizes real-time radio frequency mapping of the tactical environment in support of network operation and decision making.

Work in this Project complements PE 0602146A (Network C3I Technology) Projects AN9 (UNT - Every Receiver is a Sensor Technology) and AN7 (COE - Every Receiver is a Sensor Technology); and PE 0603463A (Network C3I Advanced Technology) Project AN8 (COE Every Receiver is a Sensor Advanced Tech).

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

Work in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Unified Network Transport (UNT) - Every Receiver is a Sensor Advanced Tech	1.821	-	-
Description: This effort demonstrates high fidelity Cyber-Electromagnetic Activity (CEMA) situational understanding by exploiting tactical receivers with sufficient capabilities as sensors. This effort optimizes real-time radio frequency mapping of the tactical environment in support of network operation and decision-making.			
Title: Multi Intelligence Modernization supporting Multifunction Operations	2.655	2.888	2.944
Description: This effort will optimize Intelligence Community investments in software frameworks and exploits against threat signals of interest (SOI) to mature a library of open, modular, and scalable software solutions that address identified capability gaps and to provide the commander with electronic situational awareness while at the same time protecting his assets from enemy deception and jamming. Work accomplished under PE 0602146A Project AN7 (COE - Every Receiver is a Sensor Advanced Tech) complements this effort.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AO1 / UNT - Every Receiver is a Sensor Advanced Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Optimize high altitude long stand-off RF payloads designed to operate above contested environments; demonstrate techniques and technologies developed to protect Electronic Support assets from adversaries? deception and jamming; and mature and demonstrate software frameworks that facilitate rapid fielding of new capabilities. FY 2022 Plans: Demonstrate Electronic Warfare payloads designed to operate from high altitude, long endurance platforms; mature and demonstrate small, form factor hardware standards to facilitate the use of modular hardware on small Size, Weight and Power (SWAP) platforms such as high altitude, long endurance platforms and small, unmanned aerial vehicles. FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: Highly Distributable UGS Description: This effort will mature a small, low cost sensor capability that can be distributed in mass quantity and tailored to specific electro-magnetic signals or other modalities (i.e. seismic) to allow the tactical commander to obtain relevant situational awareness data within a signal dense and contested operational environment.	1.568	-	-
Accomplishments/Planned Programs Subtotals	6.044	2.888	2.944

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AO3 / Stand-In Advanced RF Effects (STARE) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AO3: Stand-In Advanced RF Effects (STARE) Adv Tech	-	1.864	2.888	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 funding is realigned to:
PE 0603463A (Network C3I Advanced Technology) Project AO7 (EW for Maneuver Operations (EMO) Adv Tech)

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies and capabilities to provide a robust and reliable communications capabilities by leveraging commercial technologies and enhancing their operation to maintain network connectivity in contested and congested environments.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AO2 Stand-In Advanced RF Effects (STARE)). 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
<p>Title: Robust Grey C3I Advanced Technology</p> <p>Description: This effort matures and demonstrates technologies and capabilities to provide a robust and reliable communications capabilities by leveraging commercial technologies and enhancing their operation to maintain network connectivity in contested and congested environments.</p>	1.864	-	-
<p>Title: Stand-In Advanced RF Effects Advanced Technology</p> <p>Description: This effort harvests investments from 6.2 component level maturation and hardware synchronization research, to mature hardware for demonstration of capabilities for distributed Electronic Warfare.</p> <p>FY 2021 Plans: Harvest investments from 6.2 component level maturation, and hardware synchronization research and development, to mature hardware demonstration capabilities for distributed Electronic Warfare; validate initial countermeasures on distributed systems for evaluating performance metrics; evaluate performance metrics against one category of threats.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>	-	2.888	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AO3 / <i>Stand-In Advanced RF Effects (STARE) Adv Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding in this effort is realigned to PE 0603463A Project AO7 (EW for Maneuver Operations (EMO) Adv Tech) continuing the technical effort under a consolidated project.			
Accomplishments/Planned Programs Subtotals	1.864	2.888	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AO6 / Tag Track and Locate Small Satellites Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AO6: Tag Track and Locate Small Satellites Adv Tech	-	13.034	16.051	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In FY 2022, funding is realigned to:
Program Element (PE) 0603463A (Network C3I Advanced Technology Project CJ8 (Assured PNT Communications Advanced Tech)

A. Mission Description and Budget Item Justification

Tag, Track, and Locate (TT&L) Small Satellites Advanced Technology matures and demonstrates payloads, sensors, and data down link systems for tactically responsive Space and High Altitude platforms supporting Army ground forces. TT&L matures, demonstrates, and integrates lightweight materials, hardware components with reduced power consumption, and advanced data collection, processing, and dissemination capabilities. Also improves algorithms that process space and near space sensor data in real and near real time for integration into battlefield operating systems.

TT&L efforts will include:

- Technical demonstration of a sensor designed to provide space-based situational awareness to the tactical Warfighter;
- Development and demonstration of small satellite capabilities, which include classified payloads, to provide Assured Positioning, Navigation, and Timing services to the tactical ground component Warfighters;
- Constellation of space-based sensors that provide Reconnaissance, Surveillance, and Target Acquisition (RSTA) and Situational Awareness (SA) to the ground force commander to support Multi-Domain Operations (MDO);
- Applied research in quantum sciences based communications, sensing, and data teleportation to mature current technologies for small spacecraft applications.

These efforts support the Army's ability to control and exploit space assets that contribute to current and future military operations as defined in the national, Department of Defense (DOD), and Army future space strategies.

Work supports the Army Modernization Priorities.

Work in this Project complements PE 0602146A (Network C3I Technology) \ Project AO5 (UNT - Tag Track and Locate Small Satellites Tech).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Work in this Project is performed by the United States Army Space and Missile Defense Command (USASMDC) Technical Center (TC).

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

	FY 2020	FY 2021	FY 2022
Title: Tag, Track, and Locate Small Satellites	13.034	16.051	-
Description: This effort matures and demonstrates technologies required for smaller, warfighter-responsive sensor and communication Low Earth Orbit (LEO) small satellite constellations. Work will augment, improve, exploit and optimize existing commercial and DoD technologies and networks.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AO6 / <i>Tag Track and Locate Small Satellites Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>This effort validates software, hardware, and algorithms used to enable space-based capabilities in support of the Army's Modernization Priorities. This effort will exploit commercial advances and opportunities in small satellite constellation and payload management toward future Army concepts.</p> <p>FY 2021 Plans: Will mature and demonstrate technologies and validate software/algorithms for tracking and locating objects of interest to improve performance of space-based signal detection/processing/dissemination protocols, processes, and procedures; exploit existing commercial technologies to improve warfighter capabilities to overcome Anti Access/Area Denial (A2/AD).</p> <p>Perform on-orbit checkout testing of SVs including developmental testing prior to executing demonstrations; conduct JMUA and multiple tech demonstrations; participate in joint exercises; perform evaluations of spacecraft performance; participate in exercises to assess military utility; and demonstrate LEO based communications experiment aligned with tactical terminal and waveform development.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned to PE 0603463A Project CJ8 (Assured PNT Communications Advanced Tech) in FY2022.</p>				
Accomplishments/Planned Programs Subtotals		13.034	16.051	-
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AO7 / EW for Maneuver Operations (EMO) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AO7: EW for Maneuver Operations (EMO) Adv Tech	-	3.974	2.810	5.803	-	5.803	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies that understand contested spectrum points, sense, locate, and cue fires missions to create windows of opportunity in Anti-Access/ Area Denial (A2/AD) environments, restore network capabilities, and enable maneuver and fires.

Work in this Project complements PE 0602146A (Network C3I Technology) Projects AO2 (Stand-In Advanced RF Effects (STARE)) and AP5 (Electronic Warfare (EW) 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: EW for Maneuver Ops	2.863	1.601	1.746
Description: This effort matures and demonstrates hardware and software to conduct electronic warfare (EW) for intelligence, surveillance, and reconnaissance (ISR) in support of Army tactical operations. This effort complements PE 0602146A (Network C3I Technology) Project AO2 (Stand-In Advanced RF Effects (STARE)).			
FY 2021 Plans: Mature Electronic Warfare capabilities, for use against sensor systems, that will optimize and demonstrate low Size Weight and Power-Cost (SWaP-C) hardware; validate distribution and coordination capabilities for novel geolocation capabilities in simulated environments; and demonstrate these critical technologies for Electronic Warfare (EW) at the Brigade and Below tactical engagement.			
FY 2022 Plans: Will mature (i.e., technology readiness level 6) and demonstrate EW capabilities for use against sensor systems in representative environments, threats, and hardware; and flight-demonstrate distributed and coordinated capabilities for novel geolocation.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AO7 / EW for Maneuver Operations (EMO) Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.				
<p>Title: Simultaneous Countermeasure for Active Reconnaissance and Surveillance (SCARS)</p> <p>Description: This effort matures and demonstrates EW capabilities leveraging hardware-in-the-loop and modeling and simulation (M&S) of threat ISR systems to validate coordinated and collaborative non-kinetic effects.</p> <p>FY 2021 Plans: Demonstrate simultaneous Electronic Warfare (EW) techniques against layered adversary ISR capabilities; and perform evaluation of metrics within high fidelity laboratory environment to validate EW techniques capabilities to alter the kinetic engagement.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle conclusion of this effort.</p>		1.111	1.209	-
<p>Title: Stand-in Advanced RF Effects (STARE) Advanced Technology</p> <p>Description: This effort matures and demonstrates highly advanced hardware and software to improve power-on-target for EW systems against certain threat systems. This effort complements PE 0602146A Projects AP5 (Electronic Warfare Technology) and AO2 (Stand-In Advanced RF Effects (STARE)).</p> <p>FY 2022 Plans: Will mature and optimized synchronization hardware, advanced signal processing, and EW system designs for distributed EW. Field demonstrate hardware system improvements to validate the effectiveness of distributed EW against certain classes of threat systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle initiation of this effort. In FY22 funding was realigned from PE 0603463A Project AO3 (Stand-In Advanced RF Effects (STARE) Adv Tech).</p>		-	-	2.817
<p>Title: Tactical Force Signature Effects (TForSE) Advanced Technology ? Counter ISR Techniques</p> <p>Description: This effort matures and demonstrates Electronic Warfare capabilities against adversary counter-fire sensors and Intelligence, Surveillance, and Reconnaissance (ISR) systems leveraging high fidelity hardware-in-the-loop, modeling and simulation (M&S), and representative systems.</p> <p>FY 2022 Plans:</p>		-	-	1.240

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AO7 / EW for Maneuver Operations (EMO) Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will mature initial EW capabilities against adversary systems that provide battlefield situational understanding and localization; and validate EW effectiveness in laboratory or representative environments to mask and deceive blue locations.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle initiation of this effort.				
Accomplishments/Planned Programs Subtotals		3.974	2.810	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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AP6 / C4ISR Integrated Demonstrations Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AP6: C4ISR Integrated Demonstrations Advanced Tech	-	4.233	3.603	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned to:
 PE 0603463A (Network C3I Advanced Technology) Projects AN4 (Non Traditional Waveforms Advanced Technology), AM9 (Protected SATCOM Advanced Technology), AP9 (Next Generation HF Advanced Technology)

A. Mission Description and Budget Item Justification

Provides System of Systems (SoS) engineering rigor on Science & Technology (S&T) projects by providing field-based risk reduction processes, quantifiable technology performance in a SoS context, data-driven programmatic decision support, and field-based performance data to supplement Technology Readiness Level (TRL) assessments.

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: C4ISR Integrated Demonstrations Advanced Tech	4.233	3.603	-
Description: This effort provides appropriate System of Systems (SoS) engineering rigor for multiple Science & Technology (S&T) projects by providing field-based risk reduction processes, quantifiable technology performance in a SoS context, data-driven programmatic decision support, and field-based performance data to supplement Technology Readiness Level Assessments. This project provides network automation, resiliency, and situational understanding through S&T advancements.			
FY 2021 Plans: Demonstrate maturing and emerging commercial and government off-the-shelf research and development advanced technologies in threat-based field experimentation to inform the Army's Modernization Priorities, including Network/C3I, Future Vertical Lift, Next Generation Combat Vehicle, and Soldier Lethality; assess science & technology efforts in a field-relevant environment to demonstrate technology maturation; optimize virtualization to increase venue capabilities by incrementally building a more			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AP6 / <i>C4ISR Integrated Demonstrations Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
scalable tactical network; and mature and demonstrate advancement of spectrum collection, injection, and management capabilities. FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned to these individual projects performing the Field Based Risk Reduction (FBRR) experiments for integration alignment to the individual projects? plans. Program Element (PE) 0603463A Projects AN4 (Non Traditional Waveforms Advanced Technology), AM9 (Protected SATCOM Advanced Technology), and AP9 (Next Generation HF Advanced Technology)				
Accomplishments/Planned Programs Subtotals		4.233	3.603	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AP8 / Comms/Horiz Int for Army Mod Priorities Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AP8: Comms/Horiz Int for Army Mod Priorities Adv Tech	-	0.633	7.781	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, funding is realigned to:
 PE 0603041A (Project Convergence) Projects CL9 (Collaborative Battlefield Networked Lethality System Adv Technologies), CM2 (Collaborative Convergence Adv Tech), and CM8 (Convergence Battlefield Integration)
 PE 0603463A (Network C3I Advanced Technology) Project AN2 (Narrowband SATCOM Advanced Technology)

A. Mission Description and Budget Item Justification

This Project provides unified communications for the Army's modernization priorities through operationally-relevant, end-to-end network demonstrations which leverage Science & Technology (S&T) and commercial technology adapted to mitigate performance gaps in the presence of electronic warfare (EW) systems and reduce network complexity.

Work in this Project complements PE 06022146A (Network C3I Technology) Project AP7 (Comms Support to CSA / Horizontal Integ Fields 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Communications Support to Army Modernization Priorities/Horizontal Integration Fields Advance Technology	0.633	7.781	-
Description: This effort provides unified communications for the Army's modernization priorities through operationally-relevant, end-to-end network demonstrations which leverage S&T and commercial technology adapted to mitigate performance gaps in the presence of EW systems and reduce network complexity.			
FY 2021 Plans: Conducts demonstrations at NetModX 21 Field experiment, which is NGCV themed to align with NGCV Robotic Combat Vehicle(RCV) Phase 2 demonstration. Provides support to Next Generation Combat Vehicle (NGCV) Robotic Combat Vehicle phase 2 demonstration.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AP8 / Comms/Horiz Int for Army Mod Priorities Adv Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Effort terminated. Funding and work realigned to Program Element (PE) 0603041A Projects CL9 (Collaborative Battlefield Networked Lethality System Adv Technologies), CM2 (Collaborative Convergence Adv Tech), and CM8 (Convergence Battlefield Integration); and Program Element (PE) 0603463A Project AN2 (Narrowband SATCOM Advanced Technology).			
Accomplishments/Planned Programs Subtotals	0.633	7.781	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AP9 / Next Generation HF Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AP9: Next Generation HF Advanced Technology	-	5.592	6.739	7.835	-	7.835	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 funding is realigned from:
PE 0603463A (Network C3I Advanced Technology) Project AP6 (C4ISR Integrated Demonstration Advanced Tech)

A. Mission Description and Budget Item Justification

This Project improves performance of technologies to provide assured and resilient reach-back communications in satellite denied or degraded environments. This Project optimizes performance of new high frequency (HF) technology to provide low probability of detection and anti-jam capabilities to overcome emerging electronic warfare threats.

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

Work in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Next Generation HF Advanced Technology	5.592	6.739	7.835
Description: This effort improves performance of technologies to provide assured and resilient reach-back communications in satellite denied or degraded environments. This project optimizes performance of HF technology to provide low probability of detection and anti-jam capabilities to overcome emerging electronic warfare threats.			
FY 2021 Plans: Mature the High Frequency (HF) Communications Hub proof-of-concept to provide an assured, resilient, alternate beyond line-of-sight communications link for tactical and strategic Army assets in satellite denied, area denied environments and increased resiliency to enemy detection and interception; demonstrate HF Communications Hub proof-of-concept operating with legacy HF radios in beyond line-of-sight operationally relevant environments to validate desired capabilities, performance, and interoperability; quantify anti-jam, low probability of intercept, and low probability of detection metrics to inform the Army's HF requirements for resiliency in contested and congested environments; and validate performance metrics through modeling and simulation and demonstrations.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AP9 / <i>Next Generation HF Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Will enhance the High Frequency (HF) Communications Hub and mature the edge terminal HF radio hardware and software to provide an assured, resilient, alternate beyond line-of-sight communications link for tactical and strategic Army assets; conduct technology readiness level 6 demonstration in a beyond line-of-sight operationally relevant environment of the HF Communications Hub proof-of-concept operating with legacy HF radios, other edge radio terminals, and the Regional Hub Node integrated into the larger tactical network executing mission threads; provide final assessment of performance from technology demonstration and provide recommendations to transition organizations; assess the performance against pacing threats in satellite denied and area denied environments to determine the increased resiliency to enemy detection and interception.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding in this project increased to support maturation of the HF Communications Hub. Funding increase was realigned from PE 0603463A (Network C3I Advanced Technology) AP6 (C4ISR Integrated Demonstrations Advanced Tech).</p>			
Accomplishments/Planned Programs Subtotals	5.592	6.739	7.835

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AQ1 / Spectrum Obfuscation Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AQ1: <i>Spectrum Obfuscation Advanced Technology</i>	-	5.592	3.744	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned to:
PE 0603463A (Network C3I Advanced Technology) Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).

A. Mission Description and Budget Item Justification

This project validates and demonstrates technologies that provide obfuscation of radio frequency (RF) spectrum signature in order to counter enemy electronic surveillance capabilities. This Project optimizes, matures and demonstrates novel materials, technologies, techniques and applications that increase camouflage and concealment capabilities against known and emerging sensor threats, provide effective deception capabilities, increase survivability, mature analytical processes for modeling performance of signature management technologies during multi-domain operations as well as developing combinations of physical and electronic signature decoy components. These technologies will produce proof of concept system demonstrators that decrease the probability of detection and targeting by peer and near-peer adversaries, enabling freedom of movement of semi-independent and dispersed formations

Work in this Project complements PE 0603463A (Network C3I Advanced Technology) Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech) and 0603118A (Soldier Signature Management Advanced Technology; Project AZ6 (Soldier Signature Management).

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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Spectrum Obfuscation Advanced Technology	5.592	-	-
Description: This effort validates and demonstrates technologies that provide obfuscation of RF spectrum signature in order to counter enemy electronic surveillance capabilities.			
Title: Camouflage, Concealment and Deception	-	3.744	-
Description: This effort demonstrates innovative camouflage, concealment and deception technologies for expeditionary assets (i.e. mission command platforms, battle management centers and supporting equipment) to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats, and to reduce the probability of detection			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AQ1 / <i>Spectrum Obfuscation Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>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 2021 Plans: Mature technologies with the goal of improving the performance of materials and component technologies in support of camouflage and deception efforts for use with high value assets (i.e. mission command platforms, battle management centers and supporting equipment); mature and demonstrate integrated signature management technologies for high-valued assets to improve effectiveness and survivability against hyperspectral sensors to enable expeditionary maneuver and mission command during multi-domain operations.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, the work performed in this effort is realigned to PE 0603463A Project CI7 (Mobile and Survivable Command Post (MASCP) Adv Tech).</p>				
Accomplishments/Planned Programs Subtotals		5.592	3.744	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AQ5 / Sensor CE-Integrated Sensor Architecture Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AQ5: Sensor CE-Integrated Sensor Architecture Adv Tech	-	1.406	1.971	1.645	-	1.645	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a sensor interoperability architecture consisting of standards, interfaces, and services. The application managers will have adaptive functionality that allows for improved collaboration, survivability and recoverability, security, and adaptability to a dynamic network. Work in this Project supports the Army Science and Technology Network, Next Generation Combat Vehicle, Soldier Lethality, Air and Missile Defense, Long Range Precision Fires and Future Vertical Lift modernization priorities.

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

Work in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Sensor CE - Integrated Sensor Architecture	1.406	1.971	1.645
<p>Description: This effort matures and demonstrates an agile and adaptive interoperability sensor architecture that allows a system to dynamically discover and leverage other systems on a network without any specific or prior knowledge across limited, heterogeneous resources and against a peer adversary. The goal of this effort is to develop standards, models, and protocols that provide a common language for sensor systems to connect, publish their capabilities and needs, and interact with other systems, even on disadvantaged networks. The benefits of this effort are increased sensor collaboration, reduced decision timelines, reduced soldier load, and reduced integration costs.</p> <p>FY 2021 Plans: Demonstrate an improvement on bandwidth utilization by performing smart data summary and aggregation; show intelligent high level tasking of multiple disparate sensors to reduce the need for details on each sensor's unique characteristics; and continue to mature smart subscription services to ensure sensor data goes where it is needed.</p> <p>FY 2022 Plans: Will optimize network awareness technologies to improve bandwidth utilization for sensor interoperability; will demonstrate dynamic allocation of resources to show the correct sensor data assisting in providing targeting information to effectors.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AQ5 / <i>Sensor CE-Integrated Sensor Architecture Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.406	1.971	1.645

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AQ8 / High Tempo Data Driven Decision Tools Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AQ8: High Tempo Data Driven Decision Tools Adv Tech	-	-	2.911	3.121	-	3.121	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned to:
Program Element 060346A (Network C3I Advanced Technology) Project C17 (Mobile and Survivable Command Post (MASCP) Adv Tech)

A. Mission Description and Budget Item Justification

This Project matures and demonstrates data driven decision tools that help develop cyber situational understanding (SU) for Commanders. It enhances decision-making and accurately assesses and integrates cyber impacts with all of the domains in Multi-Domain Operations (MDO) and thereby enhances mission effectiveness by improving decision cycles.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AQ7 (High Tempo Data Driven Decision Tools). 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 2020	FY 2021	FY 2022
Title: High Tempo Data Driven Decision Tools Advanced Technology	-	2.911	3.121
<p>Description: This effort matures and demonstrates data driven decision tools tailored to reflect specific mission / information needs of the commander and individual staff members comprised of the following: software that facilitates the exchange of cyber data and mission information between the cyber electromagnetic activities (CEMA) cell, the S-6 and other staff officers (e.g., S-3, S-2, Fire Support Officer (FSO)), helping to assess higher-level impacts of lower-level events, and capturing the information as part of models for possible re-use; and software that dynamically populates the Common Operating Picture (COP) with visualizations designed for exploration and understanding of the impact of the cyber domain on the current mission.</p> <p>FY 2021 Plans: Using vignettes, demonstrate S-6 / S-3 / Commander perspectives and collaboration that show improved cyber situational understanding (SU); and demonstrate that the model/cyber impact tool dynamically updates the Common Operating Picture.</p> <p>FY 2022 Plans: Update COP Visualizations based on soldier/stakeholder feedback; develop cyber visualization guides to inform COP Visualization development; incorporate additional commander's cyber needs into COP Visualizations; demonstrate improved cyber SU in S-6 / S-3 / Commander perspectives and collaboration in field environment and dynamically connect to canned data;</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AQ8 / High Tempo Data Driven Decision Tools Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
demonstrate that the Collaborative Cyber Understanding software dynamically updates the COP Visualizations and cyber decision models; conduct a soldier evaluation of cyber decision model (cyber workflow/decision making process).				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		-	2.911	3.121
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AR2 / Energy Informed Operations Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AR2: Energy Informed Operations Advanced Technology</i>	-	1.864	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates software, algorithms, communication and control methodologies that allow more expedient, efficient, and informed use of energy resources across the battlefield. It provides Commanders at all echelons with situational awareness (SA) that allows them to understand and control their power and energy resources to ensure continuous operations of mission equipment and maintain overmatch of adversaries.

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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Expeditionary Energy Informed Operations	1.864	-	-
Description: This effort matures and demonstrates advanced power and thermal management and distribution technologies for command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) applications as well as validates and integrates designs in power generation, hybrid energy storage, and assessments.			
Accomplishments/Planned Programs Subtotals	1.864	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AR4 / Intelligent Env Battlefield Awareness Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AR4: Intelligent Env Battlefield Awareness Adv Tech	-	0.641	3.138	4.075	-	4.075	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates and optimizes technologies to allow Soldiers to maneuver faster around or through existing environmental (urban/industrial) conditions and physical landscape constraints. This effort matures and demonstrates web modules/software tools delivering crucial geo-chemical resources and advanced knowledge of geo-environmental infrastructure to mission planners.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AR3 Intelligent Env Battlefield Awareness 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 U.S. Army Engineer Research and Development Center.

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

	FY 2020	FY 2021	FY 2022
Title: Geo-Forensics for Reconnaissance Exploitation	0.641	1.503	1.185
Description: This effort provides unique terrestrial patterns to describe and predict the geological, biological, and overall ecological information associated with A2/AD sites from CONUS analogs.			
FY 2021 Plans: Demonstrate a software tool to predict soil behavior and its impact to Army maneuver and mobility that will be represented on a geospatial map to be used for mission planning; and mature prediction algorithms of ice structure, permafrost, and freeze/thaw events for sub-Arctic and Arctic terrain across seasons.			
FY 2022 Plans: Will mature search algorithms to match global analogs, ?smart? interpolation function, and expand search criteria by desired geochemical characteristics.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.			
Title: Arctic Threat Demonstrations	-	1.635	1.284

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AR4 / Intelligent Env Battlefield Awareness Adv Tech

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort matures and demonstrates visualization tools which enable geospatial decisions based on anticipated physical threats, hazards and dependencies posed by terrain and weather extremes in cold regions.</p> <p>FY 2021 Plans: Integrate sophisticated weather models into high resolution remotely sensed terrain for a platform of terrain state changes such as freeze/thaw, snowmelt, and ice vulnerability to aid in preventing risks to operational effectiveness and efficiency in cold regions.</p> <p>FY 2022 Plans: Will demonstrate environmental prediction algorithms to accurately assess ice structure, permafrost and freeze thaw events for operational movement.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.</p>			
<p>Title: Predictive Geographic Information System (GIS) Mapping (physical) Demonstration</p> <p>Description: This effort reduces the impact of unknown and changing terrain conditions by automating the integration of disparate datasets and overlays of terrain obstacles producing a high-fidelity map that integrates soil composition, vegetation, hydrology, and permafrost/ice data.</p> <p>FY 2022 Plans: Will demonstrate a comprehensive database of input and output variables used across terrain (soil, hydrologic, and arctic) models and identify compatible integration points.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort Starting in FY 2022.</p>	-	-	1.606
Accomplishments/Planned Programs Subtotals	0.641	3.138	4.075

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

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AR6 / Understanding the Environment as a Threat Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AR6: <i>Understanding the Environment as a Threat Adv Tech</i>	-	2.155	2.706	2.524	-	2.524	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates tools that provide capability to inform the Soldier of different routes through a complex urban landscape. Optimizes tools that balance exposure to environmental threats with mission constraints to provide a risk versus reward capability of operating in different areas of the urban theater. This Project matures and demonstrates predictive software accurately integrating the risks of physical, chemical, and biological threats in an urban environment into route planning tools.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AR5 (Understanding the Environment as a Threat 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 Engineer Research and Development Center.

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

	FY 2020	FY 2021	FY 2022
Title: Environmental Threat Technology Demonstrations for route planning	2.155	1.357	1.340
Description: This effort matures and demonstrates a software tool informing and balancing the risk of exposure to environmental threats with maneuver constraints along potential routes. The software integrates the risks associated with different environmental matrices in complex urban environments and includes the capability for routing in off-road scenarios.			
FY 2021 Plans: Demonstrate threat overlays to synergize battlefield intelligence modules with visualized threats and course forecasting; and provide an interactive simulation environment to evaluate tool performance in urban theaters.			
FY 2022 Plans: Will mature and validate a risk-course forecasting algorithms that account for dynamics and persistence of toxic industrial chemicals and materials (TIC/Ms) in air, water, and soil in denied urban terrain.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AR6 / Understanding the Environment as a Threat Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funding change reflects the planned lifecycle of this effort.				
Title: Hazard Prediction Demonstration		-	1.349	1.084
Description: This effort matures and demonstrates a mission planning platform that provides Soldiers with a predictive visualization technology to identify, track and plan for industrial or commercial chemical/environmental threats in operational environments.				
FY 2021 Plans: Mature predictive software algorithms that integrate air and/or spill releases with water, soil, infrastructures, and sub-terrain domains for immediate and persistent risk assessments; and demonstrate threat overlays to synergize battlefield intelligence and visualize threats across multiple domains (i.e., air, water, soil).				
FY 2022 Plans: Will mature and demonstrate developed algorithms that integrate contaminant mobility based on hydrology and soils and the sorption/degradation products.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.				
Title: Subsurface Forensics Demonstration		-	-	0.100
Description: This effort demonstrates sensing technologies for toxic industrial chemicals and materials (TIC/Ms) that are indicative of illicit activities in increasingly complex matrices where testing terminates with authentic wastewater treatment influent.				
FY 2022 Plans: Will mature data transmission capabilities from sensor through sewer systems and determine interoperability with commercial off the shelf robotic platforms.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort starting in FY 2022.				
Accomplishments/Planned Programs Subtotals		2.155	2.706	2.524
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AR6 / <i>Understanding the Environment as a Threat Adv Tech</i>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AR8 / Sensing in Contested Environments Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AR8: Sensing in Contested Environments Adv Tech	-	-	0.948	1.611	-	1.611	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced sensor technologies that characterize hazards posed to warfighters by non-weaponized biological hazards in subterranean environments. Demonstrations of adaptive commercial off the shelf sensor technologies on existing UGV platforms to gather end-user feedback.

Work complements PE 0602146A (Network C3I Technology) Project AR7 (Sensing in Contested Environments 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 U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Non-Traditional Threat Detection Advance Technology	-	0.948	1.611
Description: This effort matures and demonstrates combined commercial off the shelf capabilities from multiple sources as an integrated robotic-operable expeditionary kit for accurate detection of biological hazards for early warning in subterranean environments from point of ingress/egress prior to exposure.			
FY 2021 Plans: Validate candidate sensor technologies for maturity and effectiveness and demonstrate scenarios to detect and characterize of chemical hazards including water quality, heavy metals in soils, air quality, and non-weaponized radiological hazards.			
FY 2022 Plans: Will demonstrate an integrated optical sensor platform capable of identification of relevant environmental threats.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	0.948	1.611

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Tec hnology	Project (Number/Name) AR8 / Sensing in Contested Environments Adv 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AS9 / Persistent Geophysical Sensing-Infrasound Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AS9: Persistent Geophysical Sensing-Infrasound Adv Tech	-	2.257	4.600	2.448	-	2.448	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates kitted hardware and software solutions that 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 matures and demonstrates methodologies to assign maneuver relevant engineering attributes to geospatial feature data such as bridge load classification, road condition, and bathymetry.

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

Work in this Project complements PE 0602146A (Network C3I Technology) / Project AR9 (Persistent Geophysical Sensing-Infrasound Tech).

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

	FY 2020	FY 2021	FY 2022
Title: Remote Assessment of Infrastructure for Ensured Maneuver (RAFTER) Demonstrations	2.257	4.600	-
Description: This effort matures and demonstrates a light-weight, low-power, persistent monitoring system that is capable of integration with mission command platforms with associated software for processing geophysical data in near-real-time (with no SME in the loop) to provide actionable intelligence concerning critical transportation assets.			
FY 2021 Plans: Mature and demonstrate autonomous geophysical data processing and alerts for decision making using the persistent monitoring system and software in the battlespace; and mature and demonstrate the next generation sensors as part of the autonomous geophysical data processing and alerts for decision making.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in FY22 reflects planned lifecycle of this effort, completing in FY21.			
Title: Battlefield Intelligence by Geophysical Sensing (BIGS) Demonstration	-	-	2.448
Description: This effort matures and demonstrates geophysical and geo-sensing technologies to persistently assess battlefield elements to include infrastructure (algorithm refinements) and additional sources of interest, such as explosive and fires events			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AS9 / <i>Persistent Geophysical Sensing-Infrasound Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
and various threats. Optimization of the array sensors and geometry to improve array performance for new sources of interest while reducing logistics will also be matured and demonstrated. New detection and classification signal processing algorithms will be validated throughout the life of the task in a phased demonstration schedule.			
<i>FY 2022 Plans:</i> Will mature and validate non-HPC meteorological and terrain/topography overlays for detection thresholds through internal demonstrations before integrating with existing software and will provide configuration updates to Integrated Sensor Architecture (ISA) messaging within the existing software to be compatible with Command Post Computing Environment (CPCE).			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase in FY22 reflects planned lifecycle of this effort, beginning in FY22.			
Accomplishments/Planned Programs Subtotals	2.257	4.600	2.448

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AT3 / Subterranean Detection and Monitoring Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AT3: Subterranean Detection and Monitoring Adv Tech	-	1.016	3.360	2.217	-	2.217	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project validates and demonstrates advanced subterranean monitoring and vulnerability assessment technologies providing mobile and man-portable solutions to enhance survivability and threat awareness during urban operations and negate enemy subterranean operation advantage. This Project also optimizes and demonstrates enhanced technologies to detect tunnels and tunneling activity in complex and varied environments.

This effort complements PE 0602146A (Network C3I Technology) / Project AT2 (Subterranean Detection and Monitoring 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 conducted at U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Subterranean Threat Assessment by Real-time Sensing Demonstrations	1.016	3.360	2.217
Description: This effort validates and demonstrates integrated suite of tunnel detection and persistent surveillance technologies, mobile and man-portable solutions to detect underground municipal infrastructure, voids, and other subterranean vulnerabilities in urban and complex domains.			
FY 2021 Plans: Validate passive sensor algorithms and sensor installation methods in variable geo-materials; and demonstrate the EMI electromagnetic induction (EMI) transmitter at a live experiment in an appropriate operational environment.			
FY 2022 Plans: Will demonstrate an integrated suite of tunnel detection and persistent surveillance technologies to detect subterranean avenues of approach in an operationally relevant urban environment.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in FY22 reflects planned lifecycle of this effort, ending in FY22. Multiple demonstration events and technology maturation occurred in FY21. FY22 will culminate in a single demonstration of multiple technologies (suite of detection technologies).			
Accomplishments/Planned Programs Subtotals	1.016	3.360	2.217

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Tec hnology	Project (Number/Name) AT3 / Subterranean Detection and Monitoring Adv Tech

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AT8 / Network-Enabled GeoSpatial-GEOINT Services AdvTech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AT8: Network-Enabled GeoSpatial-GEOINT Services AdvTech	-	3.521	2.888	3.059	-	3.059	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project integrates and demonstrates the geo-registration, feature extraction, change detection, data visualization and transmission capabilities developed in the applied research portion of this effort. Tools developed for the exploitation of 3D datasets will be integrated into a streamlined workflow requiring low levels of expertise, putting advanced processing capabilities in the hands of the Soldier. This effort includes demonstrations of tactical enhancements and the integrated ability to rapidly share mission critical 3D information in support of planning and execution.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AT7 (Network-Enabled GeoSpatial and GEOINT Services 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 U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: 3D Terrain Automated Geospatial Co-Registration and Change Detection (Previously: Integration & Demonstration of 3D Data Model Feature Extraction, Geo-registration, Analytical Tool Development & Vis)	3.521	2.888	3.059
Description: This effort matures, integrates and demonstrates the design and formulation of new urban terrain data models, frameworks and processes to automate the transformation of tactical unit generated source data (e.g. LiDAR, imagery, and full motion video derived data) to new model constructs for rapid and accurate geo-registration of features (manmade infrastructure).			
FY 2021 Plans: Demonstrate in a high fidelity laboratory environment successful co-registration of disparate sources of field generated 3D geospatial data for incorporating into the tactical foundation layer terrain dataset.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AT8 / <i>Network-Enabled GeoSpatial-GEOINT Services AdvTech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature, integrate and test digital elevation model co-registration and change detection algorithms providing tactical units rapid access to newly collected 3D terrain data. Will demonstrate the optimization of algorithms for near real time processing, advanced analytics, and 3D data dissemination in a laboratory environment utilizing the Army Geospatial Enterprise Node.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects the planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	3.521	2.888	3.059

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AU1 / Tactical GeoSpatial Information Capabilities ATech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AU1: <i>Tactical GeoSpatial Information Capabilities ATech</i>	-	1.929	3.603	4.207	-	4.207	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates next generation geospatial analytical tools for 3D complex environments applicable to low echelon and tactical edge exploitation. These new capabilities will allow deployed units to enhance/update provisioned (baseline) standard, sharable, geospatial foundation (SSGF) data through automated analytics on multi-sourced spatial data resulting in streamlined, high fidelity terrain analysis products. Reducing data gaps and processing timelines will greatly increase Soldier situational awareness and support faster decision making in complex terrain.

Work in this Project complements PE 0602146A Network C3I Technology Project AT9 (Tactical GeoSpatial Information Capabilities 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 U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: 3D Terrain Analysis	1.255	3.064	2.230
Description: This effort integrates and demonstrates 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 2021 Plans: Develop and demonstrate enhanced terrain processing for generating a high resolution foundation feature layers providing enhanced situational awareness through new tactical terrain products supporting the Distributed Common Ground Station - Army.			
FY 2022 Plans: Will demonstrate advanced terrain data processing capabilities, followed by toolkit testing and delivery, targeted for the Distributed Common Ground System (DCGS-A). Will test automated feature extraction and faster processing times for higher-resolution data sources. Will demonstrate enhanced terrain processing tools providing highly accurate, tactical scale decision aids supporting situational awareness, actionable maneuver and force protection in complex terrain through an enhanced geospatial feature layer of combined dense terrain and external image sources.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AU1 / Tactical GeoSpatial Information Capabilities ATech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Funding change reflects the planned lifecycle of this effort.				
Title: Previously Advanced Airborne LiDAR		0.674	0.539	1.977
Description: This effort integrates and demonstrates enhanced Geiger-mode LiDAR hardware/software, for advanced testing of protocols, equipment, and products for enhanced high-altitude/wide area terrain data collection, to support tactical operations.				
FY 2021 Plans: Demonstrate (through analysis of FY2020 flight campaign results) a performance assessment of various hardware components (laser, scanner, and detector) being matured to reduce risk for airborne LIDAR prototypes.				
FY 2022 Plans: Will mature new airborne LIDAR sensors signal processing algorithms to increase collection speed and enhance terrain feature collection accuracy providing evolutionary improvements to airborne collection of enhanced 3D urban data with expanded area coverage and decreased workflow timelines.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in Fiscal Year 2022 will support maturation efforts in advance of demonstrations and transitions in Fiscal Year 2023.				
Accomplishments/Planned Programs Subtotals		1.929	3.603	4.207
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AU2 / Optimization of Geospatial Data for Visualization			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AU2: Optimization of Geospatial Data for Visualization	-	-	2.022	2.171	-	2.171	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project develops and demonstrates new open source software defined data models, and establishes an architecture to provide correct (mission context) geospatial content to the end-user consistent with device, tactical assessment/need, available bandwidth, and user movement. Advanced software and processes will reduce file size and network requirements, enabling near real-time updates to Soldiers. Resulting 3D foundation data and associated accuracy information will enable position and navigation determination, through analysis with a variety of Soldier and vehicle borne sensors.

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

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

	FY 2020	FY 2021	FY 2022
Title: Optimization of Geospatial Data for Tactical Visualization-Demonstration	-	2.022	2.171
Description: This effort matures and demonstrates 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.			
FY 2021 Plans: Mature and demonstrate full motion video (FMV) to 3D data processing algorithm achieving geometric accuracy of terrain and infrastructure for integration into the tactical unit's geospatial foundation layer.			
FY 2022 Plans: Will demonstrate push of tactically relevant GEOINT to mobile devices, with consideration paid to factors determining level of detail and new 3D data representation selected to minimize bandwidth.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	2.022	2.171

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU2 / <i>Optimization of Geospatial Data for Visualization</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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AU4 / Geospatially Enabled Operational Design Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AU4: Geospatially Enabled Operational Design Adv Tech	-	4.610	7.905	7.956	-	7.956	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates, integrates and transitions to the Army Command Post Computing Environment, 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 budget planning and operational assessment processes, enhancing the collaborative interaction between commanders, staffs, and unified action partners.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AU3 (Geospatially Enabled Operational Design 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 U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Geospatially Operational Design (GEOD) - Demonstration (Previously Virtual Collaborative Operational Design Demonstrations)	2.233	7.905	7.956
Description: This effort integrates and demonstrates 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.			
FY 2021 Plans: Mature and demonstrate analytics and tools for framing an operational environment (OE), facilitating models that represent the current conditions of the OE (current state) and models that represent what the OE should resemble (represent) at the conclusion of an operation (desired end state); and demonstrate a suite of automated data aggregation, analysis and visualization algorithms that perform operational assessments to compare planning criteria against current estimates enabling continuous updates of planning staff running estimates.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AU4 / Geospatially Enabled Operational Design Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will demonstrate tools to support Army Design Methodology (ADM) to frame the problem and visualize the desired end state in a geospatial context. Will evaluate a suite of data visualization capabilities that allow commanders and staffs to bridge conceptual planning to deliberate planning at echelons down to battalion.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.				
Title: Tactical Data Analysis and Visualization Demonstration		2.377	-	-
Description: This effort integrates and demonstrates a suite of automated data aggregation analysis and visualization capabilities allowing commanders and staffs the capability to bridge conceptual planning (ADM) to deliberate planning at echelons down to battalion.				
Accomplishments/Planned Programs Subtotals		4.610	7.905	7.956
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AU6 / Automated Analytics for Operational Environment AT			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AU6: Automated Analytics for Operational Environment AT	-	1.593	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates advanced technologies to understand and visualize threat patterns and operational environment changes and support mission planning by contextualizing results based on battlefield conditions and on hidden patterns discovered and merged from textual reporting. Work supports the Common Operating Environment LOE.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AU5 (Automated Analytics for Operational 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 is performed by the U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Simultaneous Multi-Domain Data Representation	0.593	-	-
Description: This effort demonstrates advanced capabilities to provide commanders and staffs with the ability to understand and operate in multiple domains simultaneously, utilizing data representations and algorithms to seamlessly track the enemy, determine patterns of behavior or actions, identify operational environment changes, and support mission planning by contextualizing results from textual data analysis based upon battlefield conditions.			
Title: Automated Analysis of Multi-Domain Data	1.000	-	-
Description: This effort demonstrates data models to support automated sense making and analysis and advanced relevancy ranking approaches to identify and prioritize knowledge gaps and contextualized results.			
Accomplishments/Planned Programs Subtotals	1.593	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU6 / <i>Automated Analytics for Operational Environment AT</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AV1 / GEOInt/Ops Logistics Integration-Planning Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AV1: GEOInt/Ops Logistics Integration-Planning Adv Tech	-	-	3.771	3.867	-	3.867	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a suite of analytical and visualization tools designed to facilitate analysis of courses of action (COAs) through modeling and simulation (M&S) and wargames to support development of alternate COAs and approval of the operational plan (OPLAN). This Project will integrate existing M&S and wargaming applications (One Semi-Automated Forces; Infantry Warrior Simulation ; Logistics Composite Model), to assess multiple courses of action to be analyzed in a multi-domain 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 is performed by the U.S. Army Engineer Research and Development Center and coordinated with U.S. Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Integration of intel and logistics Multi Echelon Planning	-	3.771	3.867
Description: This effort demonstrates a suite of analytical and visualization tools designed to facilitate analysis of multiple courses of action through M&S and wargames to support development of alternate COAs and approval of the operational plan.			
FY 2021 Plans: Optimize application programming interfaces (APIs) that allow automated ingestion of data into M&S and war-game applications and then back into mission planning software.			
FY 2022 Plans: Will demonstrate automated analysis and synchronization of multiple courses of action with modeling and simulation (M&S) and war-games, streamlining the course of action (COA) comparison and approval processes, and ultimately the operational plan approval.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	3.771	3.867

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AV1 / <i>GEOInt/Ops Logistics Integration-Planning Adv Tech</i>
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AV2 / LEO Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AV2: LEO Advanced Technology	-	1.891	1.949	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, funding is realigned to:
PE 0603463A (Network C3I Advanced Technology) CJ8 (Assured PNT Communications Advanced Tech)

A. Mission Description and Budget Item Justification

This Project matures Low Earth Orbit (LEO) constellation management for space order-of-battle architectures and protocols. The advanced technology development will involve using two spacecraft and will leverage commercial LEO mega-constellation investments to develop capabilities, which support direct sensor-to-shooter data links while under control by a maneuver battalion commander. Technology will be optimized to enable communications and deep strikes in contested environments. This Project supports the Army's efforts to proliferate and control space assets to support the tactical ground commander. It includes exploration efforts to augment missile warning, Global Positioning System (GPS), and global communications.

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

Work in this Project is performed by the US Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) Technical Center in Huntsville, AL and the Defense Advanced Research Projects Agency (DARPA), Arlington, VA.

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

	FY 2020	FY 2021	FY 2022
Title: Payload Technology Development	1.891	1.949	-
Description: Mature the technology for Low Earth Orbit satellites. Payload integration will be validated as well as the architecture and design of two LEO satellites for support to an Army tactical commander.			
FY 2021 Plans: Will mature LEO constellation management technologies.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funds realigned to PE 0603463A (Network C3I Advanced Technology) CJ8 (Assured PNT Communications Advanced Tech) in FY2022.			
Accomplishments/Planned Programs Subtotals	1.891	1.949	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AV2 / LEO Advanced 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AV4 / Foundational S&T for Network C3I Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AV4: Foundational S&T for Network C3I Advanced Tech	-	-	2.068	7.751	-	7.751	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates 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 and demonstrates 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 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 Army Futures Command (AFC).

This work is done in coordination with PE 0602146A (Network C3I Technology), Project AV3 (Foundational S&T for Network C3I Technology).

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

	FY 2020	FY 2021	FY 2022
Title: Demonstration of emerging technologies for holistic network integration	-	2.068	-
Description: This effort matures and demonstrates underlying technologies applicable to next generation networks and integration of the same.			
FY 2021 Plans: Will mature and demonstrate emerging technologies from the sister 6.2 effort focusing on Autonomy, Artificial intelligence/Machine Learning as applicable to, but not limited to, holistic network integration; and investigate Autonomy-related machine learning technologies, advanced teaming, and navigation/routing necessary for the Ground and Air platforms in support of the Army Modernization Priorities.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding from the effort was realigned to planned Enabling University Advanced Development (Air Platform, NC3I, and Soldier) effort executed by AFC University Technology Development Division under PE 0603042A (C3I Advanced Technology) Project CN3 (Network Enabling University Adv Development), PE 0603043A (Network C3I Advanced Technology) Project CL4 (Air			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AV4 / Foundational S&T for Network C3I Advanced Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Platform Enabling University Adv Development), and PE 0603044A (Soldier Advanced Technology) Project CN8 (Soldier Enabled University Advanced Development).				
<p>Title: Demonstration of Disruptive, Innovative Research for Emerging (DIRE) Advanced Network Capabilities</p> <p>Description: This effort demonstrates innovative network capabilities using a rapid and agile methodology to evaluate the feasibility of incorporation into Army network problem sets.</p> <p>FY 2022 Plans: Will demonstrate and evaluate 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 an MDO enabled environment.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding for this effort increases to support the rapidly changing need for innovative network solutions to an all domain battlefield. Funding was realigned from Abrams Recapitalization, APE GA0750000, Abrams Upgrade Program.</p>		-	-	7.751
Accomplishments/Planned Programs Subtotals		-	2.068	7.751
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AV8 / Navigation Warfare (NAVWAR) Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AV8: Navigation Warfare (NAVWAR) Advanced Technology	-	5.707	2.535	1.927	-	1.927	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project matures and demonstrates capabilities allowing the Army to monitor, understand, and control the Navigation Warfare (NAVWAR) environment. This requires an integrated approach to Electronic Protection (EP), Electronic Support (ES), and Electronic Attack (EA) to rapidly characterize the NAVWAR environment, deny Positioning, Navigation, and Timing (PNT) based capabilities to our adversaries, and maintain Army capabilities.

Work accomplished under Program Element (PE) 0602146A Project AW1 (Autonomous Navigation Technology) complements this effort.

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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
<p>Title: NAVWAR for Ground Soldiers</p> <p>Description: This effort matures and demonstrates capabilities allowing the Army to monitor, understand, and control the NAVWAR environment. This requires an integrated approach to Electronic Protection (EP), Electronic Support (ES), and Electronic Attack (EA) to rapidly characterize the NAVWAR environment, deny PNT based capabilities to our adversaries, and maintain Army capabilities.</p>	5.707	-	-
<p>Title: PNT Situational Awareness (SA) Advanced Technology</p> <p>Description: This effort demonstrates real time PNT Situational Awareness for a Common Operating Picture (COP) on selected Computing Environment (CE); improves fusion algorithms for at least two types of PNT SA sensors (terrestrial, air, space); generates an Interface Control Document (ICD) for PNT SA messages; allow open integration and reference implementation for PNT SA stored data for distribution on various platforms.</p> <p>FY 2021 Plans:</p>	-	2.535	1.927

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) AV8 / Navigation Warfare (NAVWAR) Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Select and demonstrate simulated aggregation of multi-domain sensor data into Computing Environment; improve current emitter characterization techniques/algorithms, and optimize data fusion software.</p> <p>FY 2022 Plans: Will incorporate high altitude sensor data to take advantage of the unique performance characteristics of existing sensors in different domains. Improve existing PNT Situational Awareness (SA) Initial Capabilities Document (ICD) to make use of multidimensional data fields.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort</p>				
Accomplishments/Planned Programs Subtotals		5.707	2.535	1.927
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AW2 / Autonomous Navigation Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AW2: Autonomous Navigation Advanced Technology	-	0.280	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project will leverage Assured Positioning, Navigation, and Timing (PNT) efforts. It improves localization and decision making of Robotic/Autonomous Systems by optimizing use of sensors on the platform and taking advantage of all available navigation signals.

Work in this Project complements PE 0602146A Project AW1 Autonomous Navigation 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Autonomous Navigation	0.280	-	-
Description: This effort leverages Assured PNT efforts and improves localization and decision making of Robotic/Autonomous Systems by optimizing use of sensors on the platform and taking advantage of all available navigation signals.			
Accomplishments/Planned Programs Subtotals	0.280	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AW4 / DoD PNT M&S Collaborative Initiative (CI) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AW4: DoD PNT M&S Collaborative Initiative (CI) Adv Tech	-	2.796	2.888	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Effort concluded in Fiscal Year (FY) 2021. No funding request for FY 2022.

A. Mission Description and Budget Item Justification

This Project matures, demonstrates and performs modeling and simulation (M&S) of Positioning, Navigation, and Timing (PNT) technologies to provide access to trusted PNT information in global positioning system (GPS) denied or degraded environments.

Work in this Project complements PE 0602146A (Network C3I Technology) Project AW3 (DoD PNT M&S Collaborative Initiative 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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: DoD PNT M&S Collaborative Initiative (CI)	2.796	2.888	-
Description: This effort matures, demonstrates and performs modeling and simulation (M&S) of PNT technologies to provide access to trusted PNT information in global positioning system (GPS) denied or degraded environments.			
FY 2021 Plans: Conduct a final demonstration of the matured system to Tri-Service Stakeholders of a PNT M&S capability performing force effectiveness analysis of candidate PNT technologies. This demonstration documents how the candidate PNT Technologies impacted operational mission effectiveness in a specific scenario.			
FY 2021 to FY 2022 Increase/Decrease Statement: Effort concludes as planned in FY21.			
Accomplishments/Planned Programs Subtotals	2.796	2.888	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AW4 / <i>DoD PNT M&S Collaborative Initiative (CI) Adv 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) AW6 / Modular GPS Independent Sensors Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AW6: Modular GPS Independent Sensors Advanced Tech	-	-	10.684	6.813	-	6.813	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, funding is realigned to:
Program Element (PE) 0603002A (Medical Advanced Technology) Project MM9 (Tech Base/Enabling Rsrch for Infect Dis Adv Tech).

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a resilient, soldier-integrated precision navigation and timing solution, providing precision geolocation, geospatial survey information, global positioning system (GPS) spoofing awareness and countermeasures to dismounted warfighters in GPS-denied/degraded environments.

Work accomplished under Program Element (PE) 0602146A (Network C3I Technology) Project AW5 (Modular GPS Independent Sensors Technology) complements this effort.

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Soldier-Integrated PNT	-	10.684	6.813
Description: This effort implements a standards-based, open Positioning, Navigation, and Timing (PNT) architecture solution for rapid commercial of the shelf (COTS) and emerging technology integration; incorporates artificial intelligence approaches to aggregate multiple organic and networked sensor inputs for improved PNT accuracy and reliability; demonstrates Simultaneous Localization and Mapping (SLAM) based-algorithms incorporating alternative PNT inputs; and demonstrates alternative PNT sensors and approaches, including radio frequency time differencing, signals of opportunity, inertial, gravimetric, and imagery.			
FY 2021 Plans: Validate initial Soldier-Integrated PNT technologies based on an open architecture that incorporates multiple sensors and algorithmic approaches; validate and optimize multiple types of alternative PNT sensors sourced through a technology discovery process; optimize a modular, open PNT sensor fusion architecture and algorithm optimization for dismounted soldiers; and			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AW6 / <i>Modular GPS Independent Sensors Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>integrate and demonstrate modular Soldier-Integrated-PNT technologies and initial interfacing with a soldier form factor display device.</p> <p>FY 2022 Plans: Will continue to validate, and integrate, initial Soldier-Integrated PNT technologies through technology discovery with Army Applications Lab and maturation of commercial systems. Will mature PNT interfaces and messaging necessary to distribute accurate position and timing across wirelessly-connected soldier-borne component. Will improve the performance of vision aided navigation utilizing artificial intelligence techniques and assess existing spoof-detection algorithms for integration. Will optimize size, weight, and power (SWAP) of anti-jam antennas for dismounted users. Will integrate and demonstrate interoperability of modular, alternative PNT sensors with existing Army dismounted PNT systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding was realigned to Program Element (PE) 0603002A (Medical Advanced Technology) Project MM9 (Tech Base/Enabling Rsrch for Infect Dis Adv Tech). Mature techniques to improve position in GPS-denied/degraded environments utilizing radio frequency time differencing will not be accomplished due to the realignment.</p>				
Accomplishments/Planned Programs Subtotals		-	10.684	6.813
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) BP4 / ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BP4: ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)	-	39.000	64.800	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
Congressional Interest Item funding provided for Electronic Warfare Advanced Technologies.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Electronic Warfare Advanced Technologies.

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 2020	FY 2021
Congressional Add: Unmanned Aerial Systems and Aerostat Operations FY 2020 Accomplishments: Congressional Interest Item.	4.000	-
Congressional Add: Sensor Advanced Technology FY 2020 Accomplishments: Congressional Interest Item.	10.000	-
Congressional Add: Assured Position, Navigation, and Timing Technology FY 2020 Accomplishments: Congressional Interest Item. FY 2021 Plans: Conduct advanced research in Assured Position, Navigation, and Timing Technology. Work executed by Army Futures Command.	9.000	6.300
Congressional Add: Payload and Ground Segment Research and Development for Small Satellite Science and Security Applications FY 2020 Accomplishments: Congressional Interest Item.	5.000	-
Congressional Add: Urban Subterranean Mapping Technology	3.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) BP4 / ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
FY 2020 Accomplishments: Congressional Interest Item. Program Increase to support advanced research on Urban Subterranean Mapping Technology.		
Congressional Add: Anticipating Threats to Natural Systems	6.000	-
FY 2020 Accomplishments: Congressional Interest Item. Program Increase to support advanced research on Anticipating Threats to Natural Systems.		
Congressional Add: Army Visual and Tactical Arctic Reconnaissance	2.000	2.000
FY 2020 Accomplishments: Congressional Interest Item. Program Increase to support advanced research on Army Visual and Tactical Arctic Reconnaissance.		
FY 2021 Plans: Conduct advanced research in Army Visual and Tactical Arctic Reconnaissance. Work executed by Army Futures Command.		
Congressional Add: Program increase - anticipating threats to natural systems	-	6.000
FY 2021 Plans: Conduct advanced research in Anticipating Threats to Natural Systems. Work executed by Army Futures Command.		
Congressional Add: Program increase - S?UAS cyber threat management	-	7.500
FY 2021 Plans: Conduct advanced research in S-UAS Cyber Threat Management. Work executed by Army Futures Command.		
Congressional Add: Program increase - sub?surface infrastructure in arctic environments	-	1.000
FY 2021 Plans: Conduct advanced research in Sub-Surface Infrastructure in Arctic Environments. Work executed by Army Futures Command.		
Congressional Add: Program increase - mesh network-enabled small satellites	-	10.000
FY 2021 Plans: Conduct advanced research in Mesh Network-Enabled Small Satellites. Work executed by Army Futures Command.		
Congressional Add: Program increase - geospatial artificial intelligence analytic tools	-	4.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) BP4 / ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2021 Plans: Conduct advanced research in Geospatial Artificial Intelligence Analytical Tools.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: Program increase - advanced materials and technologies for command post modernization</p> <p>FY 2021 Plans: Conduct advanced research in Advanced Materials and Technologies for Command Post Modernization.</p> <p>Work executed by Army Futures Command.</p>	-	10.000
<p>Congressional Add: Program increase - advanced materials for resilient sensors</p> <p>FY 2021 Plans: Conduct advanced research in Advanced Materials for Resilient Sensors.</p> <p>Work executed by Army Futures Command.</p>	-	8.000
<p>Congressional Add: Program increase - tactical geospatial information capabilities</p> <p>FY 2021 Plans: Conduct advanced research in Tactical Geospatial Information Capabilities.</p> <p>Work executed by Army Futures Command.</p>	-	10.000
Congressional Adds Subtotals	39.000	64.800

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) CF9 / Automated IPB Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CF9: Automated IPB Adv Tech	-	-	-	0.989	-	0.989	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 this Project was realigned from Program Element (PE) 0603463A (Network C3I Advanced Technology) Project AU6 (Automated Analytics for Operational Environment AT).

A. Mission Description and Budget Item Justification

This Project will mature and demonstrate advanced algorithms for multi-domain visualization of explicit and implicit relationships between the populace and the theater environment. Capabilities resulting from this effort will directly and substantially support Army and Joint Global Integration Planning requirements, provide a globally accessible web based digital intelligence preparation of the battlefield (IPB) platform supporting collaborative product development, and help facilitate a shared understanding of the operational environment. Automated IPB provides an integrated Intelligence Community planning data platform for Joint Global Integration Planning requirements.

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

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

	FY 2020	FY 2021	FY 2022
Title: Automated IPB Demonstrations	-	-	0.989
Description: This effort develops and demonstrates a collaborative, adaptive planning capability that allows planners to employ resources leveraging geospatial, terrain, environmental effects, and authoritative data from distributed information databases in order to collaborate in the development and assessment of courses of action, visualize potential outcomes, make decisions and develop and disseminate plans and orders.			
FY 2022 Plans: Will design and demonstrate algorithms for advanced, multi-domain visualization of explicit and implicit relationships between the populace and the theater environment.			
FY 2021 to FY 2022 Increase/Decrease Statement: In Fiscal Year (FY) 2022, funding for this effort is realigned from PE 0603463A Project AU6 (Automated Analytics for Operational Environment AT).			
Accomplishments/Planned Programs Subtotals	-	-	0.989

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) CF9 / <i>Automated IPB Adv 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) C17 / Mobile & Survivable Command Post (MASCP) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
C17: Mobile & Survivable Command Post (MASCP) Adv Tech	-	-	-	7.809	-	7.809	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 funding is realigned from:
 PE 0603463A (Network C3I Advanced Technology) Projects AQ1 (Spectrum Obfuscation Advanced Technology), AQ5 (Sensor CE-Integrated Sensor Architecture Adv Tech), AQ8 (High Tempo Data Driven Decision Tools Adv Tech), AM9 (Protected SATCOM Advanced Technology)
 PE 0602213A (C3 Applied Cyber) Project CY8 (Cyber Security App Research and Exper Partner Tech)
 PE 0602146A (Network C3I Technology) Project AV6 (Airborne Engineering Support Technology)

A. Mission Description and Budget Item Justification

The Project matures and demonstrates technologies to support scalable, survivable, mobile Command Posts (CP). Technologies addressed will use the Brigade CP as a baseline while providing the opportunity for solutions to scale up or down to Army tactical echelons. Work in this project includes integrating anti-jam (AJ) and low probability of intercept (LPI)/low probability of detection (LPD) communications focused on enabling the CP to disperse, form & reform, and employ technologies for signal remoting; optimizing power generation and storage for distributed CP operations; reducing computing infrastructure footprint, SWAP, manpower, and complexity; maturing technologies to reduce CP emissions and have situational awareness of those signatures to improve CP node employment; maturing electro-magnetic spectrum (EMS) emulation technologies to improve survivability options; and optimizing emerging electronic-textiles and composite materials for CP structures.

Work in this Project complements PE 0602146A (Network C3I Technology), Project C13 (Mobile and Survivable Command Post (MASCP) Tech). The cited work is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology focus areas and the Army Modernization Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: CP Modularity and Dispersion Advanced Technology	-	-	3.477
Description: Increases the ability for Commanders to move and disperse the CP through improved intra-CP communications, modular CP hardware to include distributed power systems, and network solutions leveraging open systems architectures to support information flow in distributed, intermittent, and latent (DIL) environments. This effort will eliminate centralized points of failure and critical nodes that constrain CP mobility and survivability. Areas of technology development include be distributed			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology	Project (Number/Name) C17 / Mobile & Survivable Command Post (MASCP) Adv Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
tactical cloud architecture, mesh network security architecture, high performance computing, integrated power, and distributed collaborative technologies.				
<p>FY 2022 Plans: Will optimize subsystems of a wireless antenna remoting capability based on the Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Electronic Warfare (EW) Open Suite of Standards (CMOSS); improve the performance of highly directional transport using wireless antenna remoting with AJ and LPD to send and receive information between a command node and the remote site; optimize component design of small power generation, storage technology, and onboard vehicle power technologies to enable distributed command post operations; validate and optimize hardware and software components to support distributed CP computing.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22 funding is realigned from PE 0603463A Projects AQ5 (Sensor CE-Integrated Sensor Architecture Adv Tech), AQ8 (High Tempo Data Driven Decision Tools Adv Tech); PE 0602213A (C3I Applied Cyber) Project CY8 (Cyber Security App Research and Exper Partner Tech); and PE 0602146A (Network C3I Technology) Project AV6 (Airborne Engineering Support Technology).</p>				
<p>Title: Signature Management and Reduction Advanced Technology</p> <p>Description: Provides advanced technologies to reduce and manage electromagnetic spectrum signatures of CP platforms and command post components.</p> <p>FY 2022 Plans: Will mature a sensor-based radio frequency (RF) awareness tool that will allow friendly Commanders to see and understand their emission posture; validate the performance of sensors to detect RF emissions; optimize and demonstrate a software application providing situational awareness of CP emission status.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: FY22 funding is realigned from PE 0603463A AM9 (Protected SATCOM Advanced Technology).</p>		-	-	0.407
<p>Title: Advanced Technology Supporting Camouflage, Concealment, and Deception</p> <p>Description: This effort demonstrates innovative camouflage, concealment and deception technologies, for expeditionary assets (i.e. mission command platforms, battle management centers and supporting equipment), in order to defeat advanced 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.</p> <p>FY 2022 Plans:</p>		-	-	3.925

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) C17 / <i>Mobile & Survivable Command Post (MASCP) Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will demonstrate the ability to provide electromagnetic shielding for complexed shelters, while maintaining radio frequency shielding performance, large format advanced camouflage solutions, and demonstrator physical asset with signatures; mature inflatable technologies and protection material solutions and demonstrate these capabilities in support of rapidly deployable CPs; mature and integrate mobile camouflage capabilities to mitigate CP vulnerability; mature and demonstrate use of EMS emulations on autonomous systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22 funding is realigned from PE 0603463A Project AQ1 (Spectrum Obfuscation Advanced Technology).</p>				
Accomplishments/Planned Programs Subtotals		-	-	7.809
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / Network C3I Advanced Technology				Project (Number/Name) CJ8 / Assured PNT Communications Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CJ8: Assured PNT Communications Advanced Tech	-	-	-	16.438	-	16.438	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In FY 2022, funding is realigned to this Project from Program Element (PE) 0603463A (Network C3I Advanced Technology Project AO6 (Tag, Track and Locate Small Satellites Adv Tech)).

A. Mission Description and Budget Item Justification

Tactical Land Component Forces require access to Space and High Altitude (HA) capabilities to enable force protection and maneuver during Multi-Domain Operations (MDO). 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.

APNT Communications Advanced Technology PE will provide prototyping, development, and experimentation of HA sensors and Tactical Space Layer (TSL) sensors (electro-optical, synthetic aperture radar (SAR), and radio frequency) which are designed to provide wide-area, responsive deep area sensing required for beyond line of sight (BLOS) targeting and force maneuver, significantly reducing Sensor to Shooter (S2S) timelines. APNT Advanced Technology PE matures, demonstrates, and integrates lightweight materials, hardware components with reduced power consumption, and advanced data collection, processing, and dissemination capabilities. Also improves algorithms that process space and near space sensor data in real and near real time for integration into battlefield operating systems.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. Work in this Project is performed by the United States Army Space and Missile Defense Command (USASMDC) Technical Center (TC).

Work in this Project complements PE 0602146A (Network C3I Technology) Projects CK1 (Assured PNT Enabling Technologies) and CG3 (Assured PNT Communications Applied Research).

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

	FY 2020	FY 2021	FY 2022
Title: Assured Positioning Navigation and Timing (APNT) Communications Advanced Technology	-	-	16.438
Description: This effort matures and demonstrates technologies required for smaller, more responsive and direct access to space and HA deep-sensing sensors and tactical communication capabilities for soldiers at the tactical edge. Work will augment, improve, exploit, and optimize existing commercial and DoD technologies and networks. Work supports Army Modernization Priorities."			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) CJ8 / <i>Assured PNT Communications Advanced Tech</i>

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

	FY 2020	FY 2021	FY 2022
<p>This effort will validate software, hardware, and algorithms used to enable Space-Based and HA platform based capabilities in support of the Army's Modernization Priorities. This effort will exploit commercial advances and opportunities in integrating Space/HA sensors or Deep Sensing capabilities and payload management toward future Army concepts. Develop/demonstrate critical technical elements for a LEO-based global high-speed network backbone enabling highly networked, resilient, and persistent DoD payloads to provide over the horizon sensing, signals, and communication, with continuous surveillance of ground, surface, and air domains.</p> <p><i>FY 2022 Plans:</i> Will demonstrate systems during joint exercises; demonstrate a sensor designed to provide space-based situational awareness to the tactical Warfighter; develop and demonstrate small satellite capabilities, which include classified payloads, to provide APNT services to the tactical ground component Warfighters; exploit a constellation of space-based sensors that provide Tactical ISR (Intelligence, Surveillance, and Reconnaissance) and Situational Awareness (SA) to the ground force commander to support MDO; develop and demonstrate optical communications for Quantum Entanglement (QE);develop and demonstrate QE including site-to-site communications from a small satellite in Space or High Altitude platform; and mature the QE technology and demonstrate optical and quantum signals passed between small spacecraft, HA platforms, and/or Space (or HA) to ground. Will complete assembly, integration, testing, and conduct a technology demonstration event; and participate in joint exercises, culminating with TRL 5 payload technology demonstration in an operational environment.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funds transitioned from PE 0603463A A06 (Tag, Track and Locate Small Satellites) in FY2022. New start in FY2022.</p>			
Accomplishments/Planned Programs Subtotals	-	-	16.438

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 2022 Army **Date: May 2021**

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	196.393	177.142	93.909	-	93.909	-	-	-	-	-	-
AE6: Strategic Long Range Cannon Advanced Technology	-	73.832	-	-	-	-	-	-	-	-	-	-
AE8: Land-Based Anti-Ship Missile (LBASM) Advanced Tech	-	20.664	9.690	15.698	-	15.698	-	-	-	-	-	-
AE9: Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech	-	13.567	9.710	-	-	-	-	-	-	-	-	-
AF4: Missile Simulation Advanced Technology	-	0.262	-	-	-	-	-	-	-	-	-	-
AG3: Extended Range Cannon Artillery (ERCA) Adv Tech	-	19.170	17.760	3.117	-	3.117	-	-	-	-	-	-
AG5: Extended Range Artillery Munition Suite Adv Tech	-	34.135	48.822	33.828	-	33.828	-	-	-	-	-	-
AG7: Energetic Materials and Adv Processing Adv Tech	-	1.956	2.061	2.096	-	2.096	-	-	-	-	-	-
AH3: Single Multi-mission Attack Missile Adv Tech	-	5.449	-	-	-	-	-	-	-	-	-	-
BO8: Long Range Precision Fires Advanced Tech (CA)	-	15.000	60.000	-	-	-	-	-	-	-	-	-
BS3: Strategic Missile Advanced Technology	-	12.358	-	-	-	-	-	-	-	-	-	-
BY2: Advanced Hypersonic Technology	-	-	29.099	39.170	-	39.170	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE matures and demonstrates Long Range Precision Fires (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 Lines of Effort. LRPF Missiles Advanced Development matures and demonstrates a broad range of Missile technologies to enhance Army integrated LRPF capabilities at extended range. Cannon Artillery Advanced Development matures and demonstrates critical technologies to increase range, precision, and both point and area effects for cannon artillery. Supporting LRPF Technologies Advanced

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>
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Development matures and demonstrates a broad range of component technologies to address weapon cost drivers and enhance performance of future LRPF munitions and systems.

Work in this PE complements PE 0602147A Long Range Precision Fires 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 (AFC).

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	189.386	121.060	86.534	-	86.534
Current President's Budget	196.393	177.142	93.909	-	93.909
Total Adjustments	7.007	56.082	7.375	-	7.375
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	15.000	60.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.819	-			
• SBIR/STTR Transfer	-7.174	-3.918			
• Adjustments to Budget Years	-	-	7.375	-	7.375

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

Project: BO8: *Long Range Precision Fires Advanced Tech (CA)*

Congressional Add: *High Energy Laser Development*

Congressional Add: *Missile Rapid Demonstration Capability*

Congressional Add: *Program increase - composite cannon tubes*

Congressional Add: *Program increase - hypervelocity projectile extended range*

Congressional Add: *Program increase: Tactical intercepting vehicle for access*

Congressional Add Subtotals for Project: BO8

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	5.000	-
	10.000	25.000
	-	5.000
	-	20.000
	-	10.000
Congressional Add Subtotals for Project: BO8	15.000	60.000
Congressional Add Totals for all Projects	15.000	60.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) AE6 / Strategic Long Range Cannon Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AE6: Strategic Long Range Cannon Advanced Technology	-	73.832	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by maturing and demonstrating technologies for a long range cannon capability to deliver lethal effects at strategic ranges while providing lethality overmatch.

Work in this Project complements PE 0604115A Technology Maturation Initiatives / Project AY6 Strategic Long Range Cannon.

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).

Project AE6 is being eliminated in FY 2021.

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

	FY 2020	FY 2021	FY 2022
Title: Strategic Long Range Cannon Advanced Technology	73.832	-	-
Description: This effort will mature and demonstrate subsystem technologies to further enhance range, lethality, and precision enablers for extended range cannon and munition systems.			
Accomplishments/Planned Programs Subtotals	73.832	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) AE8 / Land-Based Anti-Ship Missile (LBASM) Advanced Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AE8: Land-Based Anti-Ship Missile (LBASM) Advanced Tech	-	20.664	9.690	15.698	-	15.698	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by maturing and demonstrating critical technologies to detect, engage, and defeat moving land or maritime surface targets under all conditions.

Work in this Project complements PE 0602147A Long Range Precision Fires 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 2020	FY 2021	FY 2022
Title: Land Based Anti-Ship Missile (LBASM) Advanced Technology	20.664	9.690	15.698
Description: Matures and demonstrates 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.			
FY 2021 Plans: Mature and demonstrate multi-mode seeker technologies in a surrogate missile system to obtain real world effect on seeker performance; analyze and exploit the data obtained through flight testing to optimize tracking, identification and aim-point algorithms; conduct system level performance testing through hardware-in-the-loop and system captive carry to improve the performance and precision of the sensor suite.			
FY 2022 Plans: Will complete demonstrations of multi-mode seeker technologies in a surrogate missile system to obtain real world effect on seeker performance; complete analysis flight testing data and optimization of tracking, identification and aim-point algorithms; and begin maturation and integration of seeker technologies into the Precision Strike Missile.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY 2022 will support increased effort to perform additional demonstrations, flight testing and data analysis.			
Accomplishments/Planned Programs Subtotals	20.664	9.690	15.698

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AE8 / <i>Land-Based Anti-Ship Missile (LBASM) Advanced 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) AE9 / Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AE9: Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech	-	13.567	9.710	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

Effort completed in Fiscal Year (FY) 2021. No funding request for FY 2022.

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires (LRPF) Modernization Priority capabilities by maturing and demonstrating propulsion technologies that enables extended range target engagements and navigation component technologies that reduce dependence on Global Positioning System (GPS) for precision effects. Additionally, technology development will support LRPF capabilities by investigating and developing critical technologies for the delivery of dedicated organic intelligence, surveillance and reconnaissance (ISR) payloads and attack capabilities via long range missiles. These long range missile delivered payloads will provide ISR that will be able to provide targetable data for area and point targets, and attack platforms for targets of opportunity.

Work in this Project complements PE 0602147A Long Range Precision Fires 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 2020	FY 2021	FY 2022
Title: Low-Cost Tactical Extended Range Missile (LC-TERM) Advanced Technology	13.567	9.710	-
Description: Mature and demonstrate propulsion technologies that enables extended range target engagement and navigation component technologies that reduce dependence on GPS for precision.			
FY 2021 Plans: Complete demonstrations of integrated enhanced long range fires navigation technologies to verify reduced dependence on GPS for precision effects, which include improved inertial, anti-jam, and complementary navigation technologies; demonstrate with static motor testing high temperature fiber, resin, optimized case insulation, nozzle, and structures propulsion component technologies to verify increased mass fraction, energy output, and range in the same form factor.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AE9 / <i>Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Effort completes in FY 2021.			
Accomplishments/Planned Programs Subtotals	13.567	9.710	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) AF4 / Missile Simulation Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AF4: Missile Simulation Advanced Technology	-	0.262	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year 2021 this Project was realigned to:
 PE 0602147A (Long Range Precision Fires Technology)
 * Project AF8 (Affordable Extended Range Precision Technology)

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by maturing and demonstrating enhanced analysis and high fidelity modeling and simulation technologies for advanced missiles and interceptor design and analysis.

Work in this Project complements PE 0602147A Long Range Precision Fires 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 2020	FY 2021	FY 2022
Title: Missile Simulation Advanced Technology	0.262	-	-
Description: Mature and demonstrate enhanced analysis and high fidelity modeling and simulation technologies for advanced missiles and interceptor design and analysis.			
Accomplishments/Planned Programs Subtotals	0.262	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) AG3 / Extended Range Cannon Artillery (ERCA) Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AG3: <i>Extended Range Cannon Artillery (ERCA) Adv Tech</i>	-	19.170	17.760	3.117	-	3.117	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities. This effort matures and demonstrates artillery technologies including light weight cannon and mount structures, high efficiency recoil cylinders, common lower power fire control hardware, improved fire control software, and improved sensor to shooter communications which will increase range and accuracy without an increase in platform weight. This effort also develops a collaborative environment with analytic capabilities to support Fires and Intel Soldiers.

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 2020	FY 2021	FY 2022
Title: Extended Range Cannon Artillery Advanced Technology	19.170	14.754	-
Description: This effort matures and demonstrates extended range Armament technologies including Cannons and Gun Mounts, novel integration for automation, improved fire control, ammunition handling, and improved sensor to shooter communications which will maximize range increases and enable increase precision with next generation munition and target acquisition technology.			
FY 2021 Plans: Continue maturation of integrated automation technologies for the ammunition handling and weapon control components; optimize cannon, mount, and weapon system components to maximize weight reduction, optimize cannon/projectile interfaces, as well as ancillary components for automation; demonstrate automated ammunition handling at high rates of fire; demonstrate initial prototype of advanced precision technologies integrated in artillery fire control sensors and systems.			
FY 2021 to FY 2022 Increase/Decrease Statement: Completed of demonstration of initial prototype of automated ammo handling and fire control systems.			
Title: Synchronized High Op-Tempo (SHOT) Targeting for LRPF	-	3.006	3.117

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AG3 / <i>Extended Range Cannon Artillery (ERCA) Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Description: This effort develops a collaborative environment with analytic capabilities to support Fires and Intel Soldiers in organizing planning products, and analytics that automate data discovery and development of targets and streamlining workflows that support Course of Action development.</p> <p>FY 2021 Plans: Mature and demonstrate initial multiple intelligence (multi-INT) algorithms capable of facilitating timely creation of intelligence to support long range fires missions. Demonstrate system platforms capable of managing cross-domain, multi-INT, multi-platform data flows, and evaluate on the basis of speed, accuracy, and data integrity.</p> <p>FY 2022 Plans: Will continue maturation of multi-INT intelligence algorithms capable of facilitating timely creation of intelligence to support long range fires missions. Will integrate with Fires Systems and aggregation with Advanced Field Artillery Tactical Data System (AFATDS) minimum data for effects. Will align to Program of Record (POR) data fabric concepts to automate aggregation of all relevant data necessary to identify target and present actionable fires options.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort.</p>			
Accomplishments/Planned Programs Subtotals	19.170	17.760	3.117

<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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) AG5 / Extended Range Artillery Munition Suite Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AG5: <i>Extended Range Artillery Munition Suite Adv Tech</i>	-	34.135	48.822	33.828	-	33.828	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities. This effort matures and demonstrates extended range artillery technologies including advanced projectile propulsion and guidance technologies to increase range and accuracy.

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 2020	FY 2021	FY 2022
Title: Extended Range Artillery Munition Suite Advanced Technology	34.135	48.822	33.828
Description: Matures and optimizes long range unitary artillery projectile systems in the areas of range, precision, counter-measure, and payload technologies.			
FY 2021 Plans: Matured long range unitary artillery projectile systems to validate system modeling and simulation to optimize configurations of projectile technologies for increased performance; demonstrate integrated concepts of Extended Range Artillery Projectiles (e.g. XM1155) including improved algorithms, increased range, sensor optimization and integration; further optimize extended range cargo munitions for advanced area effects munition compatible with current and future artillery systems in the following areas: 1) dispensing techniques and sensor optimization for improved area effects; 2) formulations and characteristics for smoke and illumination payloads; and 3) survivability of cannon-launched terrain shaping munition. Perform demonstration to validate key enabling component technologies.			
FY 2022 Plans: Will mature and demonstrate long-range unitary artillery projectile systems to validate system M&S, architectures, and component capabilities. Will optimize configurations of projectile concepts to obtain increased performance; will continue to demonstrate integrated concepts for extended range artillery projectiles including: improved guidance algorithms, increased range, sensor optimization and integration. Will improve performance of extended range airframes designs for conventional and cargo munitions for advanced effects compatible with current and future artillery systems. Will continue to mature potential payload			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AG5 / <i>Extended Range Artillery Munition Suite Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
configurations for extended range airframe delivered effects that include: dispensing techniques, potential payloads and sub-munition survivability. Will validate post gun launch propulsion range extension technologies.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in accordance with project plan to demonstrate a unitary warhead Extended Range Artillery Projectile.				
Accomplishments/Planned Programs Subtotals		34.135	48.822	33.828
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) AG7 / Energetic Materials and Adv Processing Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AG7: Energetic Materials and Adv Processing Adv Tech	-	1.956	2.061	2.096	-	2.096	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities. This effort matures and demonstrates the performance of energetic materials ranging from medium caliber through large caliber 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 is performed by the United States Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Scale-up of Insensitive Energetic Materials	1.956	2.061	2.096
Description: This effort matures and demonstrates the performance and insensitivity of energetic materials ranging from 25mm medium caliber (direct fire) through 155mm large caliber (indirect fire) weapons.			
FY 2021 Plans: Continue to demonstrate and qualify energetic materials for complete material characterization; demonstrate developed high-energy explosive and propellant formulations in representative applications; mature and optimize advanced processing methods for increased scale and higher throughput of energetic ingredients and formulations.			
FY 2022 Plans: Will demonstrate advanced processing methods for increased scale and higher throughput of energetic ingredients and formulations; will demonstrate scale-up of energetic materials and advanced processing methods.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.956	2.061	2.096

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army Date: May 2021

Appropriation/Budget Activity	R-1 Program Element (Number/Name)	Project (Number/Name)
2040 / 3	PE 0603464A / Long Range Precision Fires Advanced Technology	AG7 / Energetic Materials and Adv Processing Adv 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) AH3 / Single Multi-mission Attack Missile Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AH3: Single Multi-mission Attack Missile Adv Tech	-	5.449	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology
 * Project 263 Future Msl Tech Integr

In Fiscal Year 2021 (FY21) this Project is realigned to
 PE 0603465A Future Vertical Lift Advanced Technology
 * Project AK5 Multi-Role Small Guided Missile Advanced Tech

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities. Matures and demonstrate technologies for an expeditionary short-to-medium range loitering missile with man-in-the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets.

Work in this Project complements PE 0602147A Long Range Precision Fires Technology and PE 0603465A Future Vertical Lift 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 2020	FY 2021	FY 2022
Title: Single Multi-mission Attack Missile (SMAM) Advanced Technology	5.449	-	-
Description: Matures and demonstrate technologies for an expeditionary short-to- medium range loitering missile with man-in-the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets.			
Accomplishments/Planned Programs Subtotals	5.449	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AH3 / <i>Single Multi-mission Attack Missile Adv Tech</i>

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) BO8 / Long Range Precision Fires Advanced Tech (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BO8: Long Range Precision Fires Advanced Tech (CA)	-	15.000	60.000	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Congressional Interest Item funding provided for Long Range Precision Advanced Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Long Range Precision 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.

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

	FY 2020	FY 2021
<p>Congressional Add: High Energy Laser Development</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on High Energy Laser Development.</p> <p>Work executed under the direction of the Army Futures Command.</p>	5.000	-
<p>Congressional Add: Missile Rapid Demonstration Capability</p> <p>FY 2020 Accomplishments: Program Increase supported advanced research on Missile Rapid Demonstration Capability.</p> <p>Work executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Missile Rapid Demonstration Capability.</p> <p>Work executed by Army Futures Command.</p>	10.000	25.000
<p>Congressional Add: Program increase - composite cannon tubes</p> <p>FY 2021 Plans: Conduct advanced research in Composite Cannon Tubes.</p>	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) BO8 / Long Range Precision Fires Advanced Tech (CA)
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - hypervelocity projectile extended range FY 2021 Plans: Conduct advanced research in Hypervelocity Projectile Extended Range.	-	20.000
Work executed by Army Futures Command.		
Congressional Add: Program increase: Tactical intercepting vehicle for access FY 2021 Plans: Conduct advanced research in Tactical Intercepting Vehicle for Access.	-	10.000
Work executed by Army Futures Command.		
Congressional Adds Subtotals	15.000	60.000

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) BS3 / Strategic Missile Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BS3: Strategic Missile Advanced Technology	-	12.358	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 this Project is realigned to:
 PE 0603464A (Long Range Precision Fires Advanced Technology)
 * Project BY2 (Advanced Hypersonic Technology)

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by developing and maturing critical technologies for ground-based strategic missiles. Technology development includes critical technologies to improve strategic missile components such as advanced structures and materials, thermal protection systems, guidance/seekers, navigation systems, electronic controls, improve/miniatuize avionics and automated fight termination systems.

Work in this Project complements PE 0602147 Long Range Precision Fires Technology.

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

Work in this Project is performed by the U.S. Army Futures Command (AFC) in coordination with the United States Army Rapid Capability and Critical Technologies Office (RCCTO).

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

	FY 2020	FY 2021	FY 2022
Title: Strategic Missile Advanced Technology	12.358	-	-
Description: This effort develops and matures critical technologies for ground-based strategic missiles.			
Accomplishments/Planned Programs Subtotals	12.358	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology	Project (Number/Name) BS3 / Strategic Missile Advanced Technology

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603464A / Long Range Precision Fires Advanced Technology				Project (Number/Name) BY2 / Advanced Hypersonic Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BY2: Advanced Hypersonic Technology	-	-	29.099	39.170	-	39.170	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In FY 2021 (FY21) this Project is realigned from:
PE 0603464A Long Range Precision Fires Advanced Technology:
* Project BS3 Strategic Missile Advanced Technology

A. Mission Description and Budget Item Justification

This Project directly supports Long Range Precision Fires Modernization Priority capabilities by developing and maturing critical technologies for ground-based strategic missiles. Technology development includes critical technologies to improve strategic missile components such as advanced structures and materials, thermal protection systems, navigation systems, modeling and simulation tools for hypersonic flight regimes, and kill chain architectures. Work in this Project complements PE 0602147 Long Range Precision Fires Technology. The cited work is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

Work in this Project is performed by the U.S. Army Futures Command (AFC) in coordination with the United States Army Rapid Capability and Critical Technologies Office (RCCTO).

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

	FY 2020	FY 2021	FY 2022
Title: Hypersonics Advanced Technology	-	29.099	39.170
Description: This Project matures and demonstrates new subsystems and components of a hypersonic weapon delivery system to defeat Anti Access/Area Denial (A2/AD) capabilities, suppress adversary Long Range Fires, and engage other high payoff/time critical targets. The effort includes modeling and simulating interfaces, data formats and networks to simulate integration into existing Army command and control systems for a separate, future prototype hypersonic weapon system effort.			
FY 2021 Plans: Will begin modeling, simulation and demonstrating of system components of Long Range Hypersonic Weapon. Will begin simulation of integration of subsystems and component technologies to optimize hypersonic weapon system performance.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) BY2 / <i>Advanced Hypersonic Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Will optimize candidate materials and material processing techniques to support critical material decisions for hypersonic weapons application; will mature simulation tools for optimization of vehicle flight performance; will mature guidance, navigation and control (GN&C) technology to dramatically reduce reliance on GPS for navigation accuracy; will mature data links and advanced communication technologies that will provide in-flight communication with the weapon system to hold multiple targets at risk; and will mature seeker / terminal sensor technologies that will allow engagement with moving or relocated targets.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> The funding increase is to expand the capability to mature in-flight communications / data link capabilities and terminal sensor / seeker capabilities for incorporation into the Common Hypersonic Glide Body (CHGB) in Army LRHW Batteries 2 in FY25 and 3 in FY27, respectively. This is a critical technology that will allow LRHW to hold multiple targets at risk and support attack of moving maritime and/or ground targets.</p>			
Accomplishments/Planned Programs Subtotals	-	29.099	39.170

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603465A / Future Vertical Lift Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	180.163	220.334	179.677	-	179.677	-	-	-	-	-	-
AI4: Joint Multi-Role (JMR) Demonstration Advanced Tech	-	18.239	-	-	-	-	-	-	-	-	-	-
AI6: Next Gen Tactical UAS TD Advanced Technology	-	9.589	-	-	-	-	-	-	-	-	-	-
AI8: Alternative Concept Engine Advanced Technology	-	2.808	2.507	3.828	-	3.828	-	-	-	-	-	-
AJ1: Future UAS Engine Advanced Technology	-	1.659	2.724	-	-	-	-	-	-	-	-	-
AJ3: Next Generation Rotorcraft Transmission Adv Tech	-	1.052	1.342	1.404	-	1.404	-	-	-	-	-	-
AJ5: Digital Vehicle Management & Control Advanced Tech	-	1.105	6.515	-	-	-	-	-	-	-	-	-
AJ7: Advanced Rotors Advanced Technology	-	2.397	2.407	2.477	-	2.477	-	-	-	-	-	-
AJ9: Integ Mission Equip for Vert Lift Systems Adv Tech	-	15.170	21.719	24.063	-	24.063	-	-	-	-	-	-
AK3: Aviation Survivability Advanced Technology	-	19.978	11.168	3.966	-	3.966	-	-	-	-	-	-
AK5: Multi-Role Small Guided Missile Advanced Tech	-	2.326	2.888	5.867	-	5.867	-	-	-	-	-	-
AK7: Adv Rotorcraft Armaments Protection Sys Adv Tech	-	3.010	6.177	10.541	-	10.541	-	-	-	-	-	-
AK8: Air Launched Effects Advanced Technology	-	3.083	28.542	28.905	-	28.905	-	-	-	-	-	-
AL1: Adv Teaming for Tactical Aviation Oper Adv Tech	-	20.102	40.157	39.953	-	39.953	-	-	-	-	-	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
<i>2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	<i>PE 0603465A / Future Vertical Lift Advanced Technology</i>											
<i>AL3: HPC for Rotorcraft Applications Adv Tech</i>	-	4.780	4.862	5.073	-	5.073	-	-	-	-	-	-
<i>AL6: Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>	-	30.302	-	-	-	-	-	-	-	-	-	-
<i>AL7: Full Spectrum Targeting Advanced Technology</i>	-	5.202	9.610	9.393	-	9.393	-	-	-	-	-	-
<i>AL9: Holistic Sit Awareness and Dec Making Adv Tech</i>	-	-	4.871	19.529	-	19.529	-	-	-	-	-	-
<i>AM3: Aircraft and Aircrew Protection Advanced Tech</i>	-	4.361	-	-	-	-	-	-	-	-	-	-
<i>AM5: Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>	-	-	1.925	-	-	-	-	-	-	-	-	-
<i>BP8: Future Vertical Lift Air Platform Adv Tech (CA)</i>	-	35.000	68.750	-	-	-	-	-	-	-	-	-
<i>CA8: Adv Rotocraft Armaments Protection Sys</i>	-	-	0.963	1.234	-	1.234	-	-	-	-	-	-
<i>CC4: FVL Radar Advanced Technologies</i>	-	-	3.207	4.000	-	4.000	-	-	-	-	-	-
<i>CG1: Holistic Team Survivability Adv Tech</i>	-	-	-	6.424	-	6.424	-	-	-	-	-	-
<i>CH6: Adapt & Resilnt Tact Autnmy Cont & Struct Adv Tech</i>	-	-	-	4.561	-	4.561	-	-	-	-	-	-
<i>CH7: Power & Thermal Management for FVL Adv Tech</i>	-	-	-	3.402	-	3.402	-	-	-	-	-	-
<i>CH8: UAS Survivability Adv Technology</i>	-	-	-	5.057	-	5.057	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This PE matures and demonstrates manned and unmanned air vehicle and mission system technologies as well as advanced teaming capabilities to enable Army Future Vertical Lift. Emphasis is on 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. Within this PE, aviation technologies are advanced and integrated into realistic and robust demonstrations.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>
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Work 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 Advanced Technology Development), PE 0602183A Air Platform Applied Research and PE 0603043A Air Platform Advanced Technology

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

Work 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 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	174.892	156.194	190.050	-	190.050
Current President's Budget	180.163	220.334	179.677	-	179.677
Total Adjustments	5.271	64.140	-10.373	-	-10.373
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-11.748	-			
• Congressional Rescissions	-	-			
• Congressional Adds	35.000	68.750			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-12.252	-			
• SBIR/STTR Transfer	-5.729	-4.610			
• Adjustments to Budget Years	-	-	-10.373	-	-10.373

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

Project: BP8: *Future Vertical Lift Air Platform Adv Tech (CA)*

Congressional Add: *Joint Tactical Aerial Resupply Vehicle*

Congressional Add: *Advanced Helicopter Seating System*

Congressional Add: *Adhesive Technology*

Congressional Add: *Helicopter Emergency Oil Systems*

Congressional Add: *UAV Fuel Systems Enhancements*

Congressional Add: *Surface Tolerant Advanced Adhesives*

Congressional Add: *Ferrium Steels for Improved Drive Systems*

Congressional Add: *Stretch Broken Composite Material Forms*

Congressional Add: *Program increase - UH-60 main rotor blade modernization*

Congressional Add: *Program increase - soldier information interface for aviation fleet management tool*

	FY 2020	FY 2021
	6.000	8.000
	5.000	15.000
	3.000	-
	2.000	2.000
	2.000	2.000
	5.000	5.000
	4.000	5.000
	8.000	-
	-	5.000
	-	2.250

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

Congressional Add: *Program increase - displays and safety in DVE*

Congressional Add: *Program increase - digital engineering demonstration*

Congressional Add: *Program increase - tethered UAS for all?terrain vehicles*

Congressional Add Subtotals for Project: BP8

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	-	4.000
	-	8.000
	-	12.500
Congressional Add Subtotals for Project: BP8	35.000	68.750
Congressional Add Totals for all Projects	35.000	68.750

Change Summary Explanation

FY2020 funding change due to \$35.000 M in Congressional adds, and -\$11.748M in Congressional Rescissions

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) A14 / <i>Joint Multi-Role (JMR) Demonstration Advanced Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>A14: Joint Multi-Role (JMR) Demonstration Advanced Tech</i>	-	18.239	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year 2021 (FY21), this Project terminates.

A. Mission Description and Budget Item Justification

This Project demonstrates transformational advanced rotary-wing configurations and open systems architectures to prepare the Department of Defense (DoD) for decisions regarding Future Vertical Lift (FVL).

Work in this Project is fully coordinated with PE 0602148A (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.

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

	FY 2020	FY 2021	FY 2022
Title: Joint Multi-Role (JMR) Technology Demonstration	18.239	-	-
Description: Provide demonstration of Future Vertical Lift (FVL) platform configurations that address multi domain battle capability needs. Determine optimum vehicle attributes that meet future force capability needs for increased system speed, range, payload, and reduced operating costs in order to inform and reduce future aviation materiel acquisitions. Flight demonstrate operational capabilities of technology demonstrators.			
Accomplishments/Planned Programs Subtotals	18.239	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) A16 / <i>Next Gen Tactical UAS TD Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>A16: Next Gen Tactical UAS TD Advanced Technology</i>	-	9.589	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 (FY21) this Project is realigned to:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
 * Project AK8 Air Launched Effects Advanced Technology

The FY20 funding requested in this Project was reduced in the FY20 Appropriation Conference Report.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates conceptual designs and enabling technologies to support the development of technically feasible and achievable requirements for the Future Unmanned Aircraft Systems (FUAS) Program of Record. The Project will also reduce the developmental risk of critical technologies for FUAS.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY 20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work in this effort is performed by the U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Next Gen Tactical UAS Technology Demonstration	9.589	-	-
Description: This Project will develop and demonstrate conceptual designs and enabling technologies to support the development of technically feasible and achievable requirements for the Future Unmanned Aircraft Systems (FUAS) Program of Record.			
Accomplishments/Planned Programs Subtotals	9.589	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / Future Vertical Lift Advanced Technology	Project (Number/Name) A16 / Next Gen Tactical UAS TD Advanced 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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) A18 / <i>Alternative Concept Engine Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>A18: Alternative Concept Engine Advanced Technology</i>	-	2.808	2.507	3.828	-	3.828	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project provides demonstration of adaptable, fuel efficient, and high power to weight engine technologies for potential application to Future Vertical Lift platforms. Efforts include development of alternative, adaptive and smart engine technologies to provide improved performance, readiness and affordability across the engine operating envelope for increased operational capability.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Alternative Concept Engine (ACE)	2.808	2.507	1.720
Description: This effort demonstrates alternative, adaptive, and intelligent engine technologies to provide improved / mission-optimized performance, readiness and affordability across an expanding engine envelope for increased operational capability for Future Vertical Lift (FVL) platforms. The alternative concept engine technology demonstrations planned for this effort are applicable to current and future platforms.			
FY 2021 Plans: Complete ACE fabrication. Will conduct engine performance demonstration and testing. Engine test metrics will include variable output speed, fuel efficiency, high power to weight ratio, and durability. Engine technologies will be demonstrated to Technology Readiness Level (TRL) 6 for Future Vertical Lift applications.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) A18 / <i>Alternative Concept Engine Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will complete engine sand ingestion and performance demonstration testing. Engine test metrics will include variable output speed, power turbine efficiency, high power to weight ratio, and durability. Engine technologies will be demonstrated to Technology Readiness Level (TRL) 6 for Future Vertical Lift applications.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle glide path of this effort with ramp down of testing efforts in FY22.</p>				
<p>Title: Improved Propulsion Technology Demonstration (IPTD)</p> <p>Description: Effort will develop and execute an advanced engine integration, maintenance, and capability improvement strategy to produce key technology advancements on Future Long Range Assault Aircraft (FLRAA) engine systems, including the ACE engine technologies as appropriate. Full engine validation testing will be completed to TRL 6 providing improved propulsion system performance, maintainability, and durability while reducing integration risk for FVL FLRAA Platform.</p> <p>FY 2022 Plans: Will perform trade-off analysis and design of advanced engine technologies in engine integration, maintainability, and technology to produce improved engine performance, maintainability, and durability to meet FLRAA capability needs.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, funding from PE 0603465A, Project AJ1 Future UAS Engine Advanced Technology, is realigned to this effort.</p>		-	-	2.108
Accomplishments/Planned Programs Subtotals		2.808	2.507	3.828
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AJ1 / <i>Future UAS Engine Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AJ1: <i>Future UAS Engine Advanced Technology</i>	-	1.659	2.724	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 this Project was realigned to:
Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / AI8 (Alternative Concept Engine Advanced Technology)

A. Mission Description and Budget Item Justification

This Project provides full system demonstration of a JP8-fueled, reliable, fuel-efficient and high power-to-weight engine concept for Future Unmanned Aircraft Systems (FUAS).

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Reliable Advanced Small Power Systems	1.659	2.724	-
Description: This effort demonstrates adaptive and intelligent engine technologies to provide improved / mission- optimized performance, readiness, and affordability across an expanding engine envelope for increased operational capability for group 3 and 4 FUAS platforms.			
FY 2021 Plans: Perform Reliable Advanced Small Power System engine design optimization. Complete fabrication and integration of engine components, hardware and assembly for engine test. Engine test metrics will include Horsepower to Weight ratio, Specific Fuel Consumption and Noise Signature.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AJ1 / <i>Future UAS Engine Advanced Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
In FY22 this effort is realigned to, PE 0603465A (Future Vertical Lift Advanced Technology) / AI8 (Alternative Concept Engine Advanced Technology).			
Accomplishments/Planned Programs Subtotals	1.659	2.724	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AJ3 / <i>Next Generation Rotorcraft Transmission Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AJ3: <i>Next Generation Rotorcraft Transmission Adv Tech</i>	-	1.052	1.342	1.404	-	1.404	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project develops and ground demonstrates variable-speed transmission technologies that can be matured and integrated into the development of Future Vertical Lift (FVL) platforms.

Work in this Project is fully coordinated with PE 0602148A (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 2020	FY 2021	FY 2022
<p>Title: Next Generation Rotorcraft Transmission</p> <p>Description: This effort demonstrates advanced rotorcraft drive technologies with the potential to increase the horsepower-to-weight ratio; reduce drive system noise; reduce production, operating and support costs; and provide automatic component impending-failure detection. The drive system demonstrators for this effort will be applicable to Future Vertical Lift (FVL) platforms.</p> <p>FY 2021 Plans: Variable speed transmission and controls will be integrated into an iron-bird ground test facility. The integrated system will go through endurance testing to demonstrate functionality and reliability consistent with project goals.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding is realigned in FY22 to the High Reduction-Ratio Transmission effort within this project.</p>	1.052	1.342	-
<p>Title: High Reduction-Ratio Transmission.</p> <p>Description: This effort will mature and demonstrate the technologies necessary for development, design, fabrication, and testing of a high reduction-ratio transmission in two stages or less (60:1 reduction ratio) with high efficiency and improved reliability against corrosion and seal leakage. Technology demonstrations from this effort will be applicable to Future Vertical Lift (FVL) platforms.</p>	-	-	1.404

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AJ3 / <i>Next Generation Rotorcraft Transmission Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p><i>FY 2022 Plans:</i> Begin design of a transmission that demonstrates 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. Design will include advanced gear materials and advanced seals for high reliability and reduced life-cycle costs.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding is realigned in FY22 from the Next Generation Rotorcraft Transmission effort within this project.</p>			
Accomplishments/Planned Programs Subtotals	1.052	1.342	1.404

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AJ5 / <i>Digital Vehicle Management & Control Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AJ5: <i>Digital Vehicle Management & Control Advanced Tech</i>	-	1.105	6.515	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 (FY22) this Project was administratively realigned to:
 Program Element (PE) 0603465A / Future Vertical Lift Advanced Technology
 * Project CH6 Adapt & Resilnt Tact Autnmy Cont & Struct Adv Tech.

A. Mission Description and Budget Item Justification

This Project designs, integrates, and demonstrates Future Vertical Lift (FVL) flight control and Vehicle Management Systems (VMS) technologies. Technologies demonstrated include: advanced flight control laws and autonomy; automatic reconfiguration for speed/damage; coupled cockpit symbology and haptic cueing; and handling qualities requirements for new platform concepts. Develops and demonstrates structures technologies and mission-adaptive autonomy and control algorithms that provide level 1 handling qualities, resilience to extreme and hostile environments, damage-mitigation by reconfiguration of redundant controls, increased agility and speed with minimal fatigue, increased payload and weight efficiency, optional pilotage and manned-unmanned teaming capabilities, cognitive off-loading, and reduction of structural maintenance burden.

Work in this Project is fully coordinated with Program Element (PE) 0602148A (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 2020	FY 2021	FY 2022
Title: Digital Vehicle Management and Control	1.105	-	-
Description: This effort demonstrates integrated Future Vertical Lift (FVL) capable flight controls and advanced sensors to satisfy future capability needs to fly in any visual environment, adapt to degradation and damage to complete the mission and support autonomous operations and manned-unmanned teaming (MUM-T). Technologies demonstrated include: advanced flight control laws and autonomy; automatic reconfiguration for speed/damage; coupled cockpit symbology and haptic cueing; and handling qualities requirements for new platform concepts.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AJ5 / <i>Digital Vehicle Management & Control Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Title: Adaptive and Resilient Tactical Autonomy, Controls, and Structures (ARTACS) Adv Tech</p> <p>Description: Develop, integrate, and demonstrate autonomy, controls, and advanced structures technologies to ensure mission success for manned/unmanned, multiple capability set FVL platforms in the contested environment of multi-domain operations.</p> <p>FY 2021 Plans: Develop, integrate, and demonstrate autonomy, structures, and controls technologies that enable multi-domain operations performance, efficiency, and versatility, and enhance extreme environment reliability and availability. Conduct trade studies to optimize the synergy of applicable technologies that will include weight-optimized, fatigue-tolerant, multifunctional, structural configurations, advanced modeling techniques for Future Vertical Lift platforms, advanced flight controls for configurations with redundant effectors at high speed, and state-of-the-art algorithms for autonomy, optional pilotage, and teaming. Complete the development of the Rotorcraft Aircrew Systems Concept Airborne Laboratory (RASCAL) Version 2.0 in-flight laboratory to enable demonstration of relevant technologies in load alleviation, component life extension, damage tolerance, advanced flight controls, autonomy, optional pilotage, manned/unmanned teaming, and air-launched effects.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: This effort is realigned in FY22 to 0603465A (Future Vertical Lift Advanced Technology) / CH6 (Adaptive & Resilient Tactical Autonomy, Controls, and Structures (ARTACS) Advanced Tech).</p>	-	6.515	-
Accomplishments/Planned Programs Subtotals	1.105	6.515	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AJ7 / <i>Advanced Rotors Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AJ7: Advanced Rotors Advanced Technology</i>	-	2.397	2.407	2.477	-	2.477	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates and integrates new technologies that enable global and highly efficient/reliable operations for Future Vertical Lift (FVL) aircraft and Future Unmanned Aircraft Systems (FUAS) throughout the flight envelope.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Rotors Technology	2.397	2.407	-
<p>Description: This effort demonstrates full scale, integrated rotor system technologies through the assessment of alternative designs aimed to satisfy future capability needs for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) increased system durability, efficiency, speed, range, and payload. Technologies include: integrated high speed, low drag rotor technologies for high speed configurations; interactional aero tailoring between rotor and body & auxiliary lift/ propulsors; light weight, low volume, efficient and high authority electro- mechanical actuators (EMAs); reliable and safety critical actuators/hubs/ controls for Independent Blade Control (IBC)/swash plateless rotors; damage compensation/load alleviation; active/passive flow control; and automated track and balance.</p> <p>FY 2021 Plans: Conduct detailed design of high speed, highly efficient rotor system for FUAS platforms. Complete component technology bench testing. Conduct planning for fabrication of demonstration hardware.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement:</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AJ7 / <i>Advanced Rotors Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
In FY22, this effort is realigned to the High Speed, Highly Efficient Rotors effort within this project.			
Title: High Speed, Highly Efficient Rotors	-	-	2.477
Description: This effort demonstrates full scale, integrated rotor system technologies through the assessment of alternative designs aimed to satisfy future capability needs for Future Vertical Lift (FVL) increased system durability, efficiency, speed, range, and payload. Technologies include: integrated high speed, low drag rotor technologies for high speed configurations; interactional aerodynamics tailoring between rotor and body & auxiliary lift/ propulsors; light weight, low volume, efficient and high authority electro-mechanical actuators (EMAs); reliable and robust actuators/hubs/controls for Independent Blade Control (IBC)/ swashplateless rotors; active/passive flow control; and automated track and balance.			
FY 2022 Plans: Will complete detailed design of high speed, highly efficient rotor system for FVL platforms. Will commence fabrication of demonstration hardware. Will commence structural test planning.			
FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, this effort is realigned from the Advanced Rotors Technology effort within this Project			
Accomplishments/Planned Programs Subtotals	2.397	2.407	2.477

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

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AJ9 / <i>Integ Mission Equip for Vert Lift Systems Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AJ9: <i>Integ Mission Equip for Vert Lift Systems Adv Tech</i>	-	15.170	21.719	24.063	-	24.063	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a mission systems architecture to support Future Vertical Lift (FVL) through utilization of a reconfigurable and flexible tiered architectural approach.

This Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Integrated Mission Equipment for Vertical Lift Systems	15.170	21.719	24.063
<p>Description: Develops and demonstrates a mission systems architecture to support Future Vertical Lift (FVL) through utilization of a reconfigurable and flexible tiered architectural approach. The approach will consist of the following: Maturing and implementing Model Based Engineering methods and Modular Open Systems Architecture strategies; instantiating an architecture verification environment and developing an agile and resilient digital backbone to support the rapidly changing threat environment including the digital battleground.</p> <p>FY 2021 Plans: Develop the initial verification process and conduct experiments for the Architecture Verification Environment (AVE). Complete mechanization of the AVE validation process to achieve TRL 5 and will use to validate FVL architecture for the Future Long Range Assault Aircraft (FLRAA) Mid-Tier Acquisition Request for Proposal and Contract Award. Begin laboratory testing of digital backbone candidate technologies, testing core software infrastructure in a laboratory, continuing safety accreditation process of infrastructure, and beginning acquisition of core mission capabilities. Complete Mission System Flying Testbed (FTB)</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AJ9 / <i>Integ Mission Equip for Vert Lift Systems Adv Tech</i>

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

	FY 2020	FY 2021	FY 2022
requirements and design, identifying initial demonstration mission systems, acquiring FTB components and beginning aircraft modifications.			
<p>FY 2022 Plans: Will complete purchasing, assembly, and checkout of the Architecture Verification Environment (AVE) facility to provide validation and verification of the FY21 National Defense Authorization Act (NDAA) Modular Open Systems Approach (MOSA) requirements. Will mature the verification process and conduct MOSA validation and verification on Future Vertical Lift (FVL), Enduring Fleet and S&T developed artifacts to identify and close gaps for FVL. Will develop MOSA engineering processes and training materials for wider adoption of MOSA. Will acquire candidate Digital Backbone technologies to evaluate in the AVE facility and update the Digital Backbone Objective Architecture. Will acquire core, reusable mission capabilities (e.g., route planning, digital map) to test Model Based System Engineering (MBSE), airworthiness and cyber qualification methods. Will expand the cloud-based Architecture Collaboration Environment (ACE) capabilities and maintain Authority to Operate (ATO) to develop MBSE specifications for the Digital Backbone, core software infrastructure capabilities, and Mission Systems Flying Testbed (MSFTB) to be integrated on UH-60M Black Hawk . Will acquire core software infrastructure capabilities, that are airworthy, and cyber security certifiable, for the MSFTB and conduct laboratory integration assessments. Will acquire and install the Digital Backbone A-Kit in a UH-60M aircraft. Will design and acquire the MSFTB ground and flight test equipment and begin component assembly in the ground lab environment. Will perform a model-based source selection of multiple MSFTB Mission System Integrators for future down-selection based on FY21 NDAA MOSA requirements</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 supports more testing and demonstrations for core software infrastructure and digital backbone on UH-60M.</p>			
Accomplishments/Planned Programs Subtotals	15.170	21.719	24.063

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AK3 / <i>Aviation Survivability Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AK3: <i>Aviation Survivability Advanced Technology</i>	-	19.978	11.168	3.966	-	3.966	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates increased Future Vertical Lift (FVL) survivability through the integration and demonstration of technologies that reduce platform signatures, improve threat warning and countermeasures against integrated networked air and ground threat systems. Also matures and demonstrates UAS survivability technologies to enable manned/unmanned team based approaches to enable operation in contested peer/near peer environments
Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Survivability Against Integrated Networked Threats	4.802	3.655	3.966
Description: This effort increases rotorcraft survivability by reducing platform signatures, providing the means to more efficiently counter enemy detection and tracking systems			
FY 2021 Plans: Continue the development and refinement of Aircraft Survivability Correlator algorithms. Develop and refine own-ship and team-based survivability behaviors. Integrate holistic technologies to enhance Future Vertical Lift survivability. Integrate components in preparation for System Integration Laboratory experimentations.			
FY 2022 Plans: Will mature Survivability Correlator software and supporting components, such as the interfaces to available sensors and effectors, for demonstration. Will integrate relevant sensors and effectors, verify functionality, and demonstrate own-ship Aircraft Survivability Correlator capabilities. Will continue development of team-based survivability technologies.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK3 / <i>Aviation Survivability Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
FY22 funding increase to reflect demonstrations of Aircraft Survivability capabilities.				
Title: Digital Dual Use Sensors (DDUS) Description: This effort will mature and demonstrate dual band infrared sensor technologies to enable future multi-function sensing concepts suitable for both manned and unmanned aviation platforms. Effort will combine recent advances in digital readout technologies and large (megapixel) infrared detector fabrication to develop a dual band infrared proof-of-principle demonstrator and assess the feasibility of the sensor to support both pilotage and aircraft survivability functions.		8.642	-	-
Title: Multispectral Threat Detection and Countermeasure Technologies Description: This effort matures and demonstrates countermeasure technologies that provide platform protection and integrated cueing against electro-optical (EO), infrared (IR) and radio frequency (RF) guided threats.		6.534	-	-
Title: Cognitive Countermeasures Maturation and Demonstration Description: This effort matures and demonstrates adaptive countermeasure technologies that provide platform protection against guided threats. It provides countermeasure electronics for adaptive decision making and countermeasure components that enable systems to counter the characteristics of agile threats. FY 2021 Plans: Mature electronic countermeasure module and measure initial performance; demonstrate countermeasure components to detect, identify, and locate threats; mature supporting RF electronics and components for electronic countermeasure demonstration. FY 2021 to FY 2022 Increase/Decrease Statement: This effort ends in FY21.		-	2.000	-
Title: EW Air Sensors / CM Description: This effort matures and demonstrates sensor and countermeasure technologies that provide platform protection and integrated cueing against advanced and emerging threats to aviation platforms. It provides advanced sensors and effectors capable of detecting and responding to threats with diverse signatures. FY 2021 Plans: Mature hardware and supporting components for demonstration; complete proof-of-concept hardware; perform data collection with hardware to verify functionality. FY 2021 to FY 2022 Increase/Decrease Statement:		-	4.483	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK3 / <i>Aviation Survivability Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
This effort is realigned in FY22 to PE 0603465A FVL Adv Tech, Project CG1 Holistic Team Survivability Adv Tech.			
Title: UAS Survivability Demonstration	-	1.030	-
Description: UAS Survivability Technology (UST) addresses the evolving threat environment to support the Maneuver Force within the Multi-Domain Battle concept. UST will develop and demonstrate increased UAS Survivability in a peer / near-peer environment with minimal impacts to aircraft performance. This work supports Future Vertical Lift and Advanced Unmanned Aircraft Systems.			
FY 2021 Plans: Develop UAS Survivability behaviors and mission profiles. Develop UAS susceptibility and electromagnetic vulnerability reduction technologies.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned in FY22 to PE 0603465A FVL Adv Tech, Project CH8 UAS Survivability Adv Technology.			
Accomplishments/Planned Programs Subtotals	19.978	11.168	3.966

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK5 / <i>Multi-Role Small Guided Missile Advanced Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AK5: Multi-Role Small Guided Missile Advanced Tech</i>	-	2.326	2.888	5.867	-	5.867	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2021, funds were realigned from:
 PE 0603464A (Long Range Precision Fires Advanced Technology) / AH3 (Single Multimission Attack Missile Adv Tech)
 PE 0603464A / AH1 (Multiple Simul Engagement Technologies Adv Tech).

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a holistic lethality solution for current Army Aviation and Future Vertical Lift (FVL) Modernization Priority. This effort matures and demonstrates critical technology and designs component for future affordable rockets and missiles to provide overwhelming defeat of conventional and asymmetrical threats in all environments. Matures and demonstrates component technologies to enable an expeditionary short-to-medium range loitering missile with man-in-the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 2020	FY 2021	FY 2022
Title: Modular Missile Advanced Technology	2.326	-	-
Description: This effort matures and demonstrates armament solutions adaptable to current aviation and Future Vertical Lift (FVL) applications in small caliber, medium caliber, counter measure technologies with a focus on light lethal aerodynamic systems.			
Title: Single Multi-Mission Attack Missile	-	2.888	-
Description: Matures and demonstrates component technologies for an expeditionary short-to- medium range loitering missile with man-in- the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets.			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK5 / <i>Multi-Role Small Guided Missile Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p><i>FY 2021 Plans:</i> Demonstrate component technologies in a surrogate flight testbed; will evaluate performance of datalink, navigation, fire control, and warhead hardware and software in representative flight environment.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> This effort completes in FY21 as planned.</p>				
<p><i>Title:</i> Multiple Simultaneous Engagement Technologies (MSET)</p> <p><i>Description:</i> Matures and demonstrates critical component technology and designs for future missiles that provide simultaneous multiple launch, control, and supervised autonomous terminal engagement of multiple missiles against stationary and moving hard/soft targets, image-based target discrimination/shared situation awareness/lock-on, and multi-missile control digital datalink with inter-missile cooperative networked communications. The end-state is a multi-missile Organic C2 solution that handles all aspects of sensor integration, fire control, and airspace management. This capability will support overwhelming lethal effects against anti-access/aerial denial (A2AD) / Integrated Air Defense Systems (IADS).</p> <p><i>FY 2022 Plans:</i> Will mature and demonstrate component technologies through system level simulation integration and initial Hardware In the Loop (HWIL) component integration. Will continue to mature and improve component technologies utilizing simulation and HWIL results with the objective to suppress, defeat and/or destroy near peer A2AD/IADS threats at maximum survivable ranges.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> This planned new effort continues maturation and demonstration of technologies being developed in PE 0602148A/AK4 Multi-Role Small Guided Missile Technology, PE 0602147A/AH2 SMAM Technologies and PE 0602147A/AG9 MSET Technologies necessary to equip the warfighter with the capability of simultaneous multiple launch, control, and supervised autonomous terminal engagement of loitering missiles.</p>		-	-	5.867
Accomplishments/Planned Programs Subtotals		2.326	2.888	5.867
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK7 / <i>Adv Rotorcraft Armaments Protection Sys Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AK7: Adv Rotorcraft Armaments Protection Sys Adv Tech</i>	-	3.010	6.177	10.541	-	10.541	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates and demonstrates a holistic lethality solution for Future Vertical Lift (FVL) offensive and defensive applications, focused on but not limited to Future Attack Reconnaissance Aircraft. Develop components for use in multi-role armament solutions for fire control, armament systems, munitions and integration of threat agnostic countermeasures.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 2020	FY 2021	FY 2022
Title: Aviation Armament System Technologies	3.010	-	-
Description: This effort matures and demonstrates armament solutions adaptable to current aviation and future vertical lift applications in small caliber, medium caliber, counter measure technologies with a focus on light lethal aerodynamic systems.			
Title: ARAPS-FARA	-	5.744	9.934
Description: This effort matures and demonstrates a holistic medium caliber lethality solution for Future Vertical Lift offensive applications. Develops components for use in multi-role armament solutions for fire control, software, armament systems, and munitions.			
FY 2021 Plans: Mature and demonstrate a 20mm medium caliber armament system for integration onto Future Vertical Lift. Demonstrate a novel 20mm multi-purpose munition with advanced capabilities versus current air launched munitions.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK7 / <i>Adv Rotorcraft Armaments Protection Sys Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature aviation specific fire control software and algorithms to support aviation requirements for turreted medium caliber weapon targeting solutions including Future Vertical Lift Future Attack Reconnaissance Aircraft?s. Will integrate and optimize a 20mm armament system onto a representative aviation platform. FY 2021 to FY 2022 Increase/Decrease Statement: FY22 increase is due to integrating and optimizing the 20mm armament system on a representative platform.			
Title: ARAPS-Dispenser Description: This effort matures and demonstrates a dispenser countermeasure, a component of the holistic survivability solution for Future Vertical Lift defensive applications. Develop components for use in multi-role countermeasure solutions for fire control, software and countermeasure systems. FY 2021 Plans: Mature a countermeasure dispenser solution that provides increased survivability for current and future aviation platforms. FY 2022 Plans: Will optimize design of countermeasure dispenser to further address survivability for current and future aviation platforms. Will demonstrate capabilities of an optimized counter measure dispenser. FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort in design optimization of dispenser.	-	0.433	0.607
Accomplishments/Planned Programs Subtotals	3.010	6.177	10.541

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AK8 / <i>Air Launched Effects Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AK8: <i>Air Launched Effects Advanced Technology</i>	-	3.083	28.542	28.905	-	28.905	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2021, funds were realigned from:
PE 0603465A (Future Vertical Lift Advanced Technology) / AI6 (Next Gen Tactical UAS TD Advanced Technology)

A. Mission Description and Budget Item Justification

This project develops and demonstrates the ability to launch an Unmanned Aircraft System (UAS) from a manned or unmanned Future Vertical Lift (FVL) aircraft at tactical altitudes and to control the UAS from the cockpit or a crew station; and assesses 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) PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Air Launched Effects	3.083	28.542	28.905
Description: Develop and demonstrate the ability to launch a Future Unmanned Aircraft Systems (FUAS) from FVL platform at tactical altitudes, and to control the UAS from the cockpit or a crew station. Assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios. These air-launched FUAS will employ a variety of non-lethal effects including: electronic attack, decoy, and communications relay.			
FY 2021 Plans: Integrate mission payloads and behaviors into an air launched UAS and demonstrate reconnaissance, surveillance, electronic warfare, and decoy multi-domain operational concepts; demonstrate and evaluate modular open system architecture approaches			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AK8 / <i>Air Launched Effects Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>for attainable air and ground launched unmanned air vehicles; assess mission effectiveness of individual and teamed organic UAS assets in support of the manned aircraft. Develop and integrate advanced autonomy algorithms to decrease operator workload.</p> <p><i>FY 2022 Plans:</i> Will integrate synthetic aperture radar payload, enhanced target acquisition software, and complimentary autonomous behaviors into air launched effects UAS, and evaluate increased capability to detect, identify, locate, and report threats through flight testing. Will integrate decoy payloads and associated individual UAS autonomous employment behaviors into air launched effects, and evaluate system performance through flight testing. Will integrate advanced communications payload into air launched effects UAS and evaluate effectiveness for Joint all-domain operations. Will mature and integrate a modular open systems approach (MOSA) based mission equipment package in accordance with approved hardware and software architectures to allow rapid technology insertion and payload integration on the future family of air launched effects air vehicles. Will mature and evaluate air launched UAS recovery system, enabling cost savings and improved mission capability through asset reuse. Will demonstrate improvements in mission effectiveness enabled through these air launched effects enhancements as a part of a multi-domain combined arms team through participation in Joint service all-domain experiments.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>				
Accomplishments/Planned Programs Subtotals		3.083	28.542	28.905
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AL1 / <i>Adv Teaming for Tactical Aviation Oper Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AL1: <i>Adv Teaming for Tactical Aviation Oper Adv Tech</i>	-	20.102	40.157	39.953	-	39.953	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates and drafts frameworks for autonomous teaming behaviors and autonomous decision making for Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platform formations in combined arms operations.

Work in this Project is fully coordinated with PE 0602148A (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 United States Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Teaming Demonstration	20.102	32.378	32.055
Description: Develop and demonstrate teaming behaviors and autonomous decision making for mixed FVL and FUAS platform formations in combined arms operations that are beyond current Manned-Unmanned Teaming (MUM-T) technologies. Focus areas include: resilient autonomous algorithms; self-organizing unmanned formations; distributed command and control; and navigation. This effort will also demonstrate multi-platform distributed apertures of multispectral sensors for threat detection and awareness and improved reliability through adaptation in autonomous systems.			
FY 2021 Plans: Mature and demonstrate advanced teaming technologies focused on collaborative lethal attack in GPS denied conditions; integrate attack teaming hardware and software into mission systems packages for test and evaluation; simulate autonomous team attack behaviors in foundational mission based vignettes; and test and evaluate modular open systems based frameworks for certifiable team autonomy.			
FY 2022 Plans: Will mature and integrate advanced teaming technologies into mission systems teaming architecture for mixed formations of manned and unmanned aircraft, and demonstrate through flight testing multi-Unmanned Aircraft System (UAS) collaborative reconnaissance, surveillance, target acquisition (RSTA), coordinated attack, and decoy in GPS denied and communications			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AL1 / <i>Adv Teaming for Tactical Aviation Oper Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>degraded conditions. Will simulate autonomous decoy and electronic attack synchronized UAS team behaviors in mission representative vignettes. Will verify modular open systems integration approaches for rapidly upgradable and transitionable team autonomy. Will integrate collaborative autonomous behaviors including team mission command, autonomous RSTA execution, electronic warfare mission planning to disrupt or jam, coordinated RF homing and sensing using multiple aircraft equipped with aided target recognition, decoy mission management to divulge threats, and team adaptations network disruptions, into teams of UAS, including air launched effects, and demonstrate advanced teaming concepts of operations and improvements in mission effectiveness as a part of a multi-domain combined arms team through participation in Joint service all-domain experiments.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: Sensors / Multi-Function Imagers for Future Aviation</p> <p>Description: Mature and demonstrate multi-function sensing system concepts to enable teaming behaviors and autonomous decision making for both manned and unmanned aviation platforms. This effort will enable tactical operations in complex environments (e.g. high threat, degraded visuals, and urban) through the use of sensing modules suitable for multiple tactical applications. The multifunction sensor approach will mitigate the need for additional dedicated sensor modules thus reducing the total cost and logistics burden for future aviation systems.</p> <p>FY 2021 Plans: Optimize tactical packaging design for universal multispectral sensor modules leveraging state-of-the-art digital readout dual band infrared sensor technologies developed within the Digital Dual Use Sensors effort for demonstration of multifunction sensing concepts. Demonstrate the suitability of the sensor module to support both pilotage and threat warning applications. Optimize sensor placement locations for both the Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) variants of FVL based on currently available designs</p> <p>FY 2022 Plans: Will mature digital readout dual band infrared sensor technologies for both pilotage and threat warning applications. Will mature digital readout integrated circuit based multispectral camera modules. Will demonstrate both laboratory and field test measurements to corroborate the higher sensitivity and fast frame rate performance of the novel multispectral cameras. Will integrate multispectral camera modules onto a manned airborne testbed platform.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	7.779	7.898
Accomplishments/Planned Programs Subtotals	20.102	40.157	39.953

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / Future Vertical Lift Advanced Technology	Project (Number/Name) AL1 / Adv Teaming for Tactical Aviation Oper Adv Tech

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AL3 / <i>HPC for Rotorcraft Applications Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AL3: HPC for Rotorcraft Applications Adv Tech</i>	-	4.780	4.862	5.073	-	5.073	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This effort develops and demonstrates the use of high-fidelity computational fluid dynamics for Future Vertical Lift platforms through the utilization of DoD High-Performance Computing (HPC) and software tools for cutting-edge modeling and simulation, as well as adding software capabilities for workflow automation and design space exploration. Efforts in this project are also applicable to the family of Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platforms.

Work in this Project is fully coordinated with Program Element (PE) PE 0602148A (Future Vertical Lift 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 is performed by the United States (US) Army Engineer Research and Development Center and coordinated with US Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Engineered Resilient Systems for Future Vertical Lift	4.780	-	-
Description: This effort matures and demonstrates capabilities (tools and methodologies) to rapidly create high-fidelity computational modeling to support the simulation of system performance for different Army missions in various geographic settings worldwide; provide input to and obtain output from combat simulations for different echelons pertaining to system performance; and conduct system trades that consider system performance in different operational environments and mission contexts. This effort focuses on Future Vertical Lift and next generation tactical unmanned aircraft system platforms.			
Title: Engineered Resilient Systems (ERS) for Army Aviation	-	4.862	3.102
Description: This effort supports Future Vertical Lift by exploiting advancements in physics-based software tools to provide rapid engineering analysis of proposed rotorcraft platforms, providing high-fidelity computational modeling of candidate Future Attack Reconnaissance Aircraft (FARA) platforms during the FARA down-selection, increasing the speed of simulations by automating simulation setup and execution on DoD HPC systems, and maturing and demonstrating the use of advanced machine learning techniques for aviation datasets to inform both the development of FVL systems and current operations.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advance d Technology</i>	Project (Number/Name) AL3 / <i>HPC for Rotorcraft Applications Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Optimize the execution of high-fidelity computational modeling of candidate Future Attack Reconnaissance Aircraft (FARA) platforms during the next phase of FARA down-selection. Improve the engineering analysis of FARA systems through the inclusion of mission effectiveness modeling and increased simulation fidelity. Demonstrate the use of physics-informed machine learning techniques to increase the accuracy of design software for future FVL lines of effort.</p> <p>FY 2022 Plans: Will improve the accuracy and continue to optimize the execution of low, medium, and high-fidelity computational modeling that supports ongoing analysis of the Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) platforms. Will improve the engineering analysis of the FARA and FLRAA systems through the inclusion of acoustic modeling and surrogate techniques. Will advance surrogate modeling techniques to increase the speed of analysis for FVL platforms.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects the planned lifecycle of this effort with the reduction of physics-informed machine learning techniques in FY22.</p>			
<p>Title: Engineered Resilient Systems (ERS) for Advanced Army Aviation Concepts</p> <p>Description: This effort supports Future Vertical Lift (FVL) by utilizing advanced machine-assisted design algorithms to explore design spaces and choose resilient platform variants. Advanced computational techniques will leverage automated design processes to expand computational testbeds in support of testing and evaluation. Increase high accuracy physics in modeling and simulation to optimize platforms for all operational environments and mission scenarios. Provide multi-fidelity computational models of candidate Future Attack Reconnaissance Aircraft (FARA), Future Long-Range Assault Platforms (FLRAA), and Future Tactical Unmanned Aircraft Systems (FTUAS) platforms to support acquisition decision-makers.</p> <p>FY 2022 Plans: Will optimize the execution of low, medium, and high-fidelity computational modeling that supports analysis of FVL Family of Systems, Air-Launched Effects, and candidate Future Tactical Unmanned Aircraft Systems (FTUAS) platforms. Will provide tools for evaluating Air-Launched Effects and UAS platform's ability to support mission objectives and platform effectiveness through the expansion of computational testbeds. Will demonstrate the use of advanced machine-assisted design techniques to increase the speed of analysis for FVL Family of Systems and UAS platforms. Will evaluate the expansion of computational modeling capability to secret and above secret high-performance computing.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase reflects the planned start of this effort in FY22 to focus on higher-fidelity physics models and advanced computational methods such as machine-assisted design algorithms.</p>	-	-	1.971
Accomplishments/Planned Programs Subtotals	4.780	4.862	5.073

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / Future Vertical Lift Advanced Technology	Project (Number/Name) AL3 / HPC for Rotorcraft Applications Advanced Tech

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AL6 / <i>Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AL6: Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>	-	30.302	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology:
 * Project 313 Adv Rotarywing Veh Tech
 PE 0603710A Night Vision Advanced Technology
 * Project K86 Night Vision, Abn Sys

In Fiscal Year 2021 (FY21) this Project is terminated.

A. Mission Description and Budget Item Justification

This Project develops, matures, and demonstrates advanced sensors, cueing, and flight controls to provide the ability to maintain terrain and obstacle situational awareness during all Degraded Visual Environment Mitigation (DVE-M) environments on current Army Aviation and Future Vertical Lift (FVL) platforms. The program provides an opportunity for DoD, North Atlantic Treaty Organization (NATO) nations, global industry, and academia to participate with their own assets in order to foster information exchange and collaboration.

Work in this Project is fully coordinated with PE 0602148A (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 U.S. Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Degraded Visual Environment Mitigation (DVE-M)	17.306	-	-
Description: Develop and mature advanced sensor cueing and flight controls to provide ability to maintain terrain and obstacle situational awareness during all DVEs both aircraft induced (brown-out & white-out) and environmentally induced (fog, rain, snow etc.). Flight testing on fleet aircraft is an integral component of the demonstration.			
Title: Sensors for DVE-M	12.996	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AL6 / <i>Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Description: This effort will mature and demonstrate combinations of sensors (radar and infrared) and sensor fusion technologies to assess their degree of effectiveness to improve safety of flight under degraded visual conditions. Effort includes development of 3 dimensional (3D) local area maps derived/refined by data from onboard sensors. 3D maps will be utilized to generate two dimensional (2D) views of the environment for presentation to pilots/crew and also support demonstration of autonomous behaviors including flight guidance and safe landing zone determination. Effort will result in an improved understanding of the complex sensor/fusion trade space to improve development of requirements and acquisition strategies for Future Vertical Lift (FVL) and the current fleet.			
Accomplishments/Planned Programs Subtotals	30.302	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AL7 / <i>Full Spectrum Targeting Advanced Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AL7: Full Spectrum Targeting Advanced Technology</i>	-	5.202	9.610	9.393	-	9.393	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project demonstrates next generation targeting concepts for Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platforms.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Full Spectrum Targeting	5.202	9.610	9.393
<p>Description: This effort will mature and demonstrate key targeting sensor system to enable the Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) modernization priorities. Effort will leverage advancements in laser, infrared imaging focal plane arrays, and multi/hyperspectral system technologies to develop a stabilized, turreted payload that can actively and/or passively image in multiple spectral bands simultaneously providing robust targeting and situational awareness capabilities for the prevailing battlefield conditions. Effort will demonstrate the ability of multi/hyperspectral sensing to autonomously identify tactical threats and reduce cognitive workloads through sensor fusion and automated spectral selection.</p> <p>FY 2021 Plans: Exploit broadband and multi/hyperspectral data from prior year collection to mature and demonstrate novel automated processing approaches for target detection, recognition, and identification. Validate performance of broadband and multi/hyperspectral automated processing algorithms. Complete initial data processing architecture design and demonstrate functionality and performance. Optimize and complete packaging of a high performance dual band megapixel infrared imaging sensor for the integrated targeting system demonstrator.</p> <p>FY 2022 Plans:</p>			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AL7 / <i>Full Spectrum Targeting Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature and integrate a novel dual-band infrared sensor along with advanced active / passive optical components and active / passive sensors into a steerable turret. Will mature approaches for spectral imaging for target detection using the steerable turret to conduct data collections with multiple spectral bands against military targets in relevant environments. Will mature approaches for detection of hidden, obscured, and decoy targets to improve sensor target recognition and identification performance. Will demonstrate automated processing techniques in multiple spectral bands suitable for detection, recognition and identification of FVL and FUAS relevant target sets. Will develop techniques for sensor fusion and automated selection of optimal spectral bands to reduce FVL and FUAS cognitive burden. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	5.202	9.610	9.393

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AL9 / <i>Holistic Sit Awareness and Decision Making Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
<i>AL9: Holistic Sit Awareness and Decision Making Adv Tech</i>	-	-	4.871	19.529	-	19.529	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This project matures technologies from 0601248A AL8 Holistic Situational Awareness and Decision Making Technology project for further maturation and demonstration.

In FY22, work and funds were integrated into this project from: PE 0603118: Soldier Lethality Advanced Technology, Project BC4: Soldier Decision-Making & Comms Performance Advanced Tech Task 14: Early Human Systems Integration (HSI) Demonstration.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a pilotage and decision aiding system that allows for care free operations in complex and hostile environments through: demonstration of a comprehensive human machine interface for all SA domains (terrain & obstacles, threat, weather, & environment); and demonstration of decision aiding technologies to reduce cognitive loading of air crews during operations in complex and hostile environments.

Work in this Project is fully coordinated with Program Element (PE) PE 0602148A (Future Vertical Lift 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 (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Holistic Situational Awareness and Decision Making	-	4.871	9.629
Description: This program directly contributes to Future Vertical Lift (FVL) to ensure Future Aircraft pilots have the necessary situational awareness, accurate understanding of the tactical mission, and ability to decide faster than our adversaries.			
FY 2021 Plans: Demonstrate the decision-aiding algorithms, next-generation crew stations, and architectures needed to operate in complex and high-threat environments. Demonstrate how these systems effectively enable pilots to understand, process, and decide on the various information sources such as: threat awareness, manned-unmanned teaming with Unmanned Aircraft Systems (UAS), management of aviation survivability equipment, weapons targeting/handover, pilotage and navigation, operation in			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advance d Technology</i>	Project (Number/Name) AL9 / <i>Holistic Sit Awareness and Dec Making Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>degraded visual environments, aircraft system management, GPS-denied operations, air-launched effects, blue force tracking, and communications.</p> <p>FY 2022 Plans: Will demonstrate FVL Air Mission Commander (AMC) increased effectiveness when equipped with the combined capabilities of a fused world model that includes both geo-referenced sensor output and abstract situational data, decision aiding tools, autonomous flight controls, and pilot cueing; Will participate in flight demonstration(s) to assess this capability?s impact on increasing mission effectiveness and reducing pilot cognitive workload</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase change due to increased flight demonstration activity, increased data collection of AMC effectiveness in a relevant environment and data management demands.</p>				
<p>Title: Multi-function RF for FVL Platforms</p> <p>Description: This effort matures and demonstrates multi-function radio-frequency (RF) sensor technologies to support the Future Vertical Lift (FVL) family of systems. It provides integrated software and hardware technologies that enable the use of common electronics and system components to support varied functions, such as enhanced situational awareness, threat-detection and localization, targeting, communications, and aircraft pilotage. This will result in improved performance for these critical functions and reduced requirements for size, weight, and power for mission equipment across FVL platforms.</p> <p>FY 2022 Plans: Will analyze the technical requirements of multiple functions and perform engineering analysis to determine technical specifications; will develop technical models of multi-function RF components and assess expected performance against mission requirements; will initiate development of multi-function RF components.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding realigned from Holistic Situational Awareness and Decision Making effort in this Project to this new effort in FY22.</p>		-	-	7.930
<p>Title: Early Human Systems Integration Demonstrations</p> <p>Description: Human Systems Integration (HSI) analysis assesses and matures technologies to optimize pilot situational awareness and workload management, crew task automation and decision-aiding, information management, and advanced crew station interfaces. The objective of this effort is to reduce crew decision and task execution timelines in a tactically challenging mission environment.</p> <p>FY 2022 Plans:</p>		-	-	1.970

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AL9 / <i>Holistic Sit Awareness and Dec Making Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>Will perform HSI analysis during simulation and flight demonstration to assess and enhance technologies for advanced crew station interfaces, pilot decision-aids, and information management to reduce decision timelines. Will collect pilot performance data and provide knowledge products to assess and help mature crew-enabling technologies.</p> <p><i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> In FY22, work and funds are realigned from PE 0603118 ?Soldier Lethality Advanced Technology?, Project BC4 ?Soldier Decision-Making & Comms Performance Advanced Tech? to this effort.</p>				
Accomplishments/Planned Programs Subtotals		-	4.871	19.529
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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AM3 / <i>Aircraft and Aircrew Protection Advanced Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AM3: <i>Aircraft and Aircrew Protection Advanced Tech</i>	-	4.361	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 (FY21) this Project is realigned to: PE 0603465A Future Vertical Lift Advanced Technology * Project AJ5 Digital Vehicle Management & Control Advanced Tech) and the Project terminates.

A. Mission Description and Budget Item Justification

This Project demonstrates and provides solutions for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) platforms that improves crashworthiness, damage tolerance, sustainment, survivability and break-through weight efficiency while maintaining mission performance requirements.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Aircraft and Aircrew Protection	4.361	-	-
Description: Demonstrate integrated, scalable, and structural platform solutions for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) platforms that improves crashworthiness, damage tolerance, sustainment, survivability and break-through weight efficiency while maintaining mission performance requirements.			
Accomplishments/Planned Programs Subtotals	4.361	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) AM3 / <i>Aircraft and Aircrew Protection Advanced Tech</i>
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) AM5 / <i>Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AM5: <i>Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>	-	-	1.925	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In FY22, this Project is administratively realigned to Program Element (PE) 0603465A
 * Project CH7 Power & Thermal Management for FVL Adv Tech

A. Mission Description and Budget Item Justification

This Project develops and demonstrates at the system level, integrated power technologies (including power generation, distribution, and control along with advanced energy storage) and thermal management technologies to provide significantly higher electrical power capability to Future Vertical Lift (FVL) aircraft while addressing consequential size, weight, pulsed power, and thermal issues. Provides power capability for advanced electric aeromechanical effectors, advanced mission systems for route planning and teaming, and for advanced survivability and electronic warfare capability.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology).

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Optimized Energy for C5ISR Platforms Advanced Technology	-	1.925	-
Description: Enable advanced survivability systems on FVL platforms through component development improved high power and energy storage technologies, higher capacity lower Size, Weight, and Power (SWaP) cooling systems, and more efficient electrical architectures.			
FY 2021 Plans: Improve management strategies for loads based on SWaP requirements and aircraft platform constraints which include architectures and intelligent control variants. Mature the high resolution characterization of cyclical, step, and high power load profiles that are generated by lasers and other high power, short duration burst technology to demonstrate modular energy storage technology needed to support the loads. Optimize thermal management technologies to mitigate waste heat generated			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advance d Technology</i>	Project (Number/Name) AM5 / <i>Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
from inefficiencies in power conversion. Demonstrate hybrid energy storage technologies to support cyclic loads such as hybrid batteries or ultra-capacitor technology. Mature intelligent controls for platform-integrated power systems.				
FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, the work for this project is administratively realigned under PE 0603465A (Future Vertical Lift Technology / CH7 (Power and Thermal Management for FVL Adv Tech)				
Accomplishments/Planned Programs Subtotals		-	1.925	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) BP8 / <i>Future Vertical Lift Air Platform Advanced Technology (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BP8: <i>Future Vertical Lift Air Platform Adv Tech (CA)</i>	-	35.000	68.750	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

Congressional Interest Item funding provided for Future Vertical Lift Air Platform Advanced Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Future Vertical Lift Air Platform 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.

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

	FY 2020	FY 2021
<p>Congressional Add: Joint Tactical Aerial Resupply Vehicle</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Joint Tactical Aerial Resupply Vehicle.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Joint Tactical Aerial Resupply Vehicle.</p> <p>Work executed by Army Futures Command.</p>	6.000	8.000
<p>Congressional Add: Advanced Helicopter Seating System</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Advanced Helicopter Seating System.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Advanced Helicopter Seating System.</p> <p>Work executed by Army Futures Command.</p>	5.000	15.000
<p>Congressional Add: Adhesive Technology</p>	3.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) BP8 / <i>Future Vertical Lift Air Platform Advanced Tech (CA)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2020 Accomplishments: Program Increase to support advanced research on Adhesive Technology.</p> <p>Work will be executed under the direction of the Army Futures Command.</p>		
<p>Congressional Add: Helicopter Emergency Oil Systems</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Helicopter Emergency Oil Systems.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Helicopter Emergency Oil Systems.</p> <p>Work executed by Army Futures Command.</p>	2.000	2.000
<p>Congressional Add: UAV Fuel Systems Enhancements</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on UAV Fuel Systems Enhancements.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in UAV Fuel Systems Enhancements.</p> <p>Work executed by Army Futures Command.</p>	2.000	2.000
<p>Congressional Add: Surface Tolerant Advanced Adhesives</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Surface Tolerant Advanced Adhesives.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Surface Tolerant Advanced Adhesives.</p> <p>Work executed by Army Futures Command.</p>	5.000	5.000
<p>Congressional Add: Ferrium Steels for Improved Drive Systems</p>	4.000	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) BP8 / <i>Future Vertical Lift Air Platform Advanced Tech (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p>FY 2020 Accomplishments: Program Increase to support advanced research on Ferrium Steels for Improved Drive Systems.</p> <p>Work will be executed under the direction of the Army Futures Command.</p> <p>FY 2021 Plans: Conduct advanced research in Ferrium Steels for Improved Drive Systems.</p> <p>Work executed by Army Futures Command.</p>		
<p>Congressional Add: Stretch Broken Composite Material Forms</p> <p>FY 2020 Accomplishments: Program Increase to support advanced research on Stretch Broken Composite Material Forms.</p> <p>Work will be executed under the direction of the Army Futures Command.</p>	8.000	-
<p>Congressional Add: Program increase - UH-60 main rotor blade modernization</p> <p>FY 2021 Plans: Conduct advanced research in UH-60 Main Rotor Blade Modernization.</p> <p>Work executed by Army Futures Command.</p>	-	5.000
<p>Congressional Add: Program increase - soldier information interface for aviation fleet management tool</p> <p>FY 2021 Plans: Conduct advanced research in Soldier Information Interface for Aviation Fleet Management Tool.</p> <p>Work executed by Army Futures Command.</p>	-	2.250
<p>Congressional Add: Program increase - displays and safety in DVE</p> <p>FY 2021 Plans: Conduct advanced research in Displays and Safety in DVE.</p> <p>Work executed by Army Futures Command.</p>	-	4.000
<p>Congressional Add: Program increase - digital engineering demonstration</p> <p>FY 2021 Plans: Conduct advanced research in Digital Engineering Demonstration.</p>	-	8.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) BP8 / <i>Future Vertical Lift Air Platform Advanced Tech (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - tethered UAS for all-terrain vehicles	-	12.500
FY 2021 Plans: Conduct advanced research in Tethered UAS for All-Terrain Vehicles.		
Work executed by Army Futures Command.		
Congressional Adds Subtotals	35.000	68.750

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CA8 / <i>Adv Rotorcraft Armaments Protection Sys</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CA8: <i>Adv Rotorcraft Armaments Protection Sys</i>	-	-	0.963	1.234	-	1.234	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 (FY21), this Project was realigned from:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
 * Project AK7 Adv Rotorcraft Armaments Protection Sys Adv Tech
 * Project AK6 Adv Rotorcraft Armaments Protection Sys Tech

A. Mission Description and Budget Item Justification

This Project investigates and demonstrates a holistic lethality solution for Future Vertical Lift (FVL) offensive and defensive applications, focused on but not limited to Future Long Range Assault Aircraft (FLRAA). Develop components for use in multi-role armament solutions for fire control, armament systems, munitions and integration of threat agnostic countermeasures.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 Army Futures Command (AFC).

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

	FY 2020	FY 2021	FY 2022
Title: Advanced Rotorcraft Armanents Protection System-Future Long Range Assault Aircraft	-	0.963	1.234
Description: This effort matures and demonstrates a holistic small caliber lethality solution for FVL offensive applications. Integrates and demonstrates components for use in multi-role armament solutions for fire control, software, and armament systems.			
FY 2021 Plans: Mature a small caliber remote weapon system for integration on FVL. Demonstrate the increased capability of a remotely operated, stabilized armament system versus current aviation armament solutions.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CA8 / <i>Adv Rotocraft Armaments Protection Sys</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will mature designs for enhanced lethality with use of stabilization and holistic fire control in aviation platforms for gunner applications. Will mature architecture and interfaces in conformance with Future Airborne Capability Environment (FACE).				
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase reflects planned lifecycle of this effort in maturation of architecture and interfaces in conformance with FACE				
Accomplishments/Planned Programs Subtotals		-	0.963	1.234
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CC4 / <i>FVL Radar Advanced Technologies</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CC4: <i>FVL Radar Advanced Technologies</i>	-	-	3.207	4.000	-	4.000	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
 In Fiscal Year 2021 (FY21) this Project was realigned from:
 Program Element PE 0603772A / Advanced Tactical Computer Science and Sensor Technology
 * Project 234 Sensors And Signals Processing

A. Mission Description and Budget Item Justification

This Project develops Next Generation Reconfigurable Radar Aperture for detection, tracking and precision targeting, navigation and fire control for both reconnaissance, surveillance, and target acquisition (RSTA) and intelligence, surveillance and reconnaissance (ISR).

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 effort is performed by the United States (US) Army Futures Command.

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

	FY 2020	FY 2021	FY 2022
Title: Multi-mission Airborne Radar	-	3.207	4.000
Description: Advanced Digital radio frequency (RF) processing integration with final demonstration subsystem and system level radar hardware and software designs.			
FY 2021 Plans: Analyze radar modes and operations and conduct detailed system design review. Perform full processing chain modeling and simulation to validate the models. Optimize wide-band tuning applications for RF systems and exercise third party implementation through multi-function demonstrations.			
FY 2022 Plans: Will leverage internal and joint partnerships to advance radar mode software development based upon the results of the system design review, market research and modeling and simulation efforts. Will develop advanced Airborne Moving Target Indicator			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CC4 / <i>FVL Radar Advanced Technologies</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
mode, leveraging existing Air Force airborne search, scan, and track modes, to provide enhanced situational awareness and identification of airborne blue & red forces. Will develop Increment 1 Terrain Profiling radar mode. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding increase in line with the planned lifecycle of the program to reflect development of advanced Airborne Moving Target Indicator mode and first increment of terrain profiling mode.			
Accomplishments/Planned Programs Subtotals	-	3.207	4.000

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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CG1 / <i>Holistic Team Survivability Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CG1: <i>Holistic Team Survivability Adv Tech</i>	-	-	-	6.424	-	6.424	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022, this is an administrative realignment with transitions from Program Element PE 0603465A Future Vertical Lift Advanced Technology
 * AK3 Aviation Survivability Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates increased Future Vertical Lift Family of Systems Survivability (FVL FoS) in an advanced integrated air defense systems environment through a multi-layered approach. The approach focuses on maturing and demonstrating technologies for reducing aircraft susceptibility and vulnerability during pre-mission planning, mission execution (combat survivability and safety), and post-mission repair and return to service.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Advanced RF Countermeasures	-	-	6.424
Description: This effort matures and demonstrates adaptive sensor and countermeasure technologies that provide platform protection against guided threats. It develops software and hardware to increase probability of detection and defeat of threats to aviation platforms using modeling and simulation (M&S), hardware in the loop (HIL) assessment, and field events. It provides integrated software and sensor technologies to counter the characteristics of advanced and agile threats.			
FY 2022 Plans: Will develop technical designs of electronics to support detect, decoy, and disrupt functions for Future Vertical Lift Platforms; will perform technical analysis of threat characteristics, analyze threat progression, and research new attack vectors to disrupt			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CG1 / <i>Holistic Team Survivability Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
or degrade threat performance; will update technical models of electronics to analyze performance and determine technical specifications; will perform laboratory and field demonstrations of targeted payloads in critical technology areas. <i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> Funding for this effort is realigned in FY22 from PE 0603465A FVL Adv Tech, Project AK3 Aviation Survivability for maturation and demonstration of adaptive sensor and countermeasure technologies that provide holistic platform protection against guided threats.			
Accomplishments/Planned Programs Subtotals	-	-	6.424

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CH6 / <i>Adapt & Resilnt Tact Autnmy Cont & Struct Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CH6: <i>Adapt & Resilnt Tact Autnmy Cont & Struct Adv Tech</i>	-	-	-	4.561	-	4.561	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 (FY22) this Project was administratively realigned from:
 Program Element (PE) 0603465A / Future Vertical Lift Advanced Technology
 * Project AJ5 Digital Vehicle Management and Control Advanced Tech.

A. Mission Description and Budget Item Justification

This Project matures, and demonstrates advanced autonomy, controls, and structures technologies that provide manned/unmanned Future Vertical Lift (FVL) platforms the decisive tactical overmatch of near-peer adversaries needed for combat mission success. Matures and demonstrates modeling capabilities, control law development, and handling quality criteria required for fully realizing capabilities of advanced configurations of Army aircraft. Develops and demonstrates structures technologies and mission-adaptive autonomy (MAA) and control algorithms that provide level 1 handling qualities, resilience to extreme and hostile environments, damage-mitigation by reconfiguration of redundant controls, increased agility and speed with minimal fatigue, increased payload and weight efficiency, optional pilotage and manned-unmanned teaming capabilities, cognitive off-loading, and reduction of structural maintenance burden.

Work in this Project is fully coordinated with Program Element (PE) 0602148A (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 2020	FY 2021	FY 2022
Title: Adaptive and Resilient Engineered Structures (ARES) Technology Demonstration	-	-	3.448
Description: Mature, integrate, and demonstrate advanced 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.			
FY 2022 Plans: Will mature and integrate advanced structures technologies that enable multi-domain operations performance, efficiency, survivability, and sustainment, and enhance extreme environment reliability and availability. Will mature and integrate			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CH6 / <i>Adapt & Resilnt Tact Autnmy Cont & Struct Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
leveraged trade studies optimizing the synergy of applicable technologies including weight-saving, fatigue-tolerant, affordable, multifunctional, and damage-tolerant configurations for primary and secondary structure.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding is realigned in FY22 from PE 0603465A, Project AJ5 Digital Vehicle Management and Control Advanced Tech				
Title: Adaptive Tactical Autonomy and Control (ATAC) Technology Demonstration		-	-	1.113
Description: Mature, integrate, and demonstrate 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.				
FY 2022 Plans: Will implement and demonstrate advanced flight control technologies and state-of-the-art autonomy algorithms on Army owned and operated flying laboratories to achieve Technology Readiness Level (TRL) 6. Will mature control strategies for seamless pilot interaction with scalable autonomy as needed for optionally piloted operations. Will demonstrate pilot interface technologies for enhanced situational awareness and optimal cognitive loading across the entire range of mission environments. Will mature high-speed extensions to handling qualities criteria for military rotorcraft including specialized response types and Mission Task Elements (MTE).				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding is realigned in FY22 from PE 0603465A, Project AJ5 Digital Vehicle Management and Control Advanced Tech				
Accomplishments/Planned Programs Subtotals		-	-	4.561
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CH7 / <i>Power & Thermal Management for FVL Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CH7: <i>Power & Thermal Management for FVL Adv Tech</i>	-	-	-	3.402	-	3.402	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year (FY) 2022 this Project is administratively realigned from:
 Program Element (PE) 0603465A Future Vertical Lift Adv Technology
 * Project AM5 Opt Energy Stg & Therm Mgmt for FVL Survivability & Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates at the system level, integrated electrical power technologies (including power generation, distribution, and control along with advanced energy storage) and thermal management technologies to provide significantly higher electrical power capability to Future Vertical Lift (FVL) aircraft while addressing consequential size, weight, pulsed power, and thermal issues. Provides power capability for advanced electric aeromechanical effectors, advanced mission systems that for example, execute algorithms for route planning and teaming, and for advanced survivability and electronic warfare capability. Will demonstrate software-in-the-loop performance of power & thermal management technologies to provide significantly higher electrical power capability to FVL aircraft while addressing consequential SWAP-C & thermal issues.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology).

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

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

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

	FY 2020	FY 2021	FY 2022
Title: Optimized Energy for C5ISR Platforms Advanced Technology	-	-	1.915
Description: Enable advanced Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) and survivability systems on FVL platforms through component development of improved high power and energy storage technologies, higher capacity lower Size, Weight, and Power (SWaP) cooling systems, and more efficient electrical architectures			
FY 2022 Plans: Will improve performance of energy storage technologies to meet the SWaP requirements of target air platforms. Will mature the high resolution characterization of C5ISR devices such as advanced radars and sensors to demonstrate the ability for energy			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CH7 / <i>Power & Thermal Management for FVL Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
<p>storage technologies to meet the electrical power demands of the system. Will demonstrate the effectiveness of integrating power management strategies for electrical sources when powering C5ISR devices. Will demonstrate intelligent controls for platform-integrated power systems.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, the work for this project is administratively realigned from PE 0603465A (Future Vertical Lift Technology /AM5 (Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech)</p>				
<p>Title: Power & Thermal Management Tech Demo</p> <p>Description: Exploits fabrication, and systems integration lab validation testing to TRL 6 of power and thermal management technologies to provide significantly higher electrical power capability to FVL aircraft while addressing thermal issues and reducing system weight/volume</p> <p>FY 2022 Plans: Will perform design of power and thermal management system components to reduce Size, Weight, and Power (SWaP) of target platforms. Will perform design integration efforts to optimally incorporate advanced system components into a power and thermal management system, providing increased electrical power capability and reduced weight, volume, and cost to Future Vertical Lift aircraft.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: In FY22, the work for this project is administratively realigned from PE 0603465A (Future Vertical Lift Technology /AM5 (Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech)</p>		-	-	1.487
Accomplishments/Planned Programs Subtotals		-	-	3.402
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>				Project (Number/Name) CH8 / <i>UAS Survivability Adv Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CH8: <i>UAS Survivability Adv Technology</i>	-	-	-	5.057	-	5.057	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2022 (FY22) this Project is realigned from:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
 * Project AK3 Aviation Survivability Advanced Technology

A. Mission Description and Budget Item Justification

This Project integrates the new technologies of Future Vertical Lift and Air Platform Technologies to address an evolving threat environment by improving UAS survivability in contested environments. This is achieved without impacting UAS performance through tailored signature management for UAS missions, survivability-enhanced mission profiles, UAS survivability behaviors, resilient systems and architectures and electromagnetic (EM) vulnerability reduction. UAS Survivability Advanced Technology will mature UAS survivability technologies and demonstrate increased UAS Survivability in a peer / near-peer environment with minimal impacts to aircraft performance. This work supports Future Vertical Lift and Advanced Unmanned Aircraft Systems.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology).

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

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

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

	FY 2020	FY 2021	FY 2022
Title: UAS Survivability Demonstration	-	-	5.057
Description: This effort focuses on maturing UAS susceptibility and vulnerability reduction technologies to provide increased UAS survivability with minimum impacts to mission performance and UAS system cost and addresses the evolving threat environment to support the Maneuver Force within the Multi-Domain Battle concept. Will develop and demonstrate increased UAS Survivability in a peer / near-peer environment with minimal impacts to aircraft performance, with objectives of tailored signature management for UAS missions, survivability-enhanced mission profiles, UAS survivability behaviors, resilient systems/architectures, and EM vulnerability reduction.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / <i>Future Vertical Lift Advanced Technology</i>	Project (Number/Name) CH8 / <i>UAS Survivability Adv Technology</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Will mature Unmanned Air Systems survivability components for demonstration; will perform data collection to verify technology functionality; will continue to develop, for demonstration Unmanned Air Systems survivability susceptibility and vulnerability reduction technologies; will develop/leverage candidate capabilities concepts for mission effectiveness analysis.			
<i>FY 2021 to FY 2022 Increase/Decrease Statement:</i> In FY22 this effort is realigned from PE 0603465A, Project AK3 Aviation Survivability Advanced Technology for demonstration of increased UAS Survivability in a peer/near-peer environment.			
Accomplishments/Planned Programs Subtotals	-	-	5.057

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	79.817	175.703	48.826	-	48.826	-	-	-	-	-	-
AC8: Low Cost Extended Range Air Defense Adv Tech	-	20.184	-	-	-	-	-	-	-	-	-	-
AD1: High Energy Laser Tactical Vehicle Demo Adv Tech	-	28.822	26.247	26.089	-	26.089	-	-	-	-	-	-
AD4: Maneuver Air Defense Advanced Technology	-	-	19.396	19.737	-	19.737	-	-	-	-	-	-
AD6: Next Generation Fires Radar Advanced Technology	-	7.411	6.899	-	-	-	-	-	-	-	-	-
AE1: Close Combat High Energy Laser Advanced Technology	-	-	2.407	-	-	-	-	-	-	-	-	-
AE3: Unconventional Countermeasures-Survivability ATech	-	1.900	1.254	3.000	-	3.000	-	-	-	-	-	-
BN7: Weapons Components Adv Technology (CA)	-	21.500	119.500	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Work in this PE matures demonstrates technology in support of Army Modernization Priority Air and Missile Defense by maturing, demonstrating and conducting system level experimentation for the development of advanced air defense technologies that reduce the cost curve of missile defense, restore overmatch, survive volley-fire attacks, and operate within sophisticated Anti-Access/Area Denial (A2/AD) and contested domains.

Work in this PE complements PE 0602150A (Air and Missile Defense Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work is performed by the U.S. Army Futures Command (AFC), the United States Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT), and the Engineer Research and Development Center (ERDC), and the United States Army Rapid Capabilities and Critical Technologies Office (RCCTO).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	82.113	58.130	53.396	-	53.396
Current President's Budget	79.817	175.703	48.826	-	48.826
Total Adjustments	-2.296	117.573	-4.570	-	-4.570
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	21.500	119.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-21.500	-			
• SBIR/STTR Transfer	-2.296	-1.927			
• Adjustments to Budget Years	-	-	-4.570	-	-4.570

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

Project: BN7: *Weapons Components Adv Technology (CA)*

- Congressional Add: *Advanced Explosion Resistant Window Systems*
- Congressional Add: *Silicon Carbide Power Electronics Packaging*
- Congressional Add: *Enterprise Science and Technology Demonstration Prototyping*
- Congressional Add: *High-Energy Laser Development for All-Terrain Vehicles*
- Congressional Add: *Program increase*
- Congressional Add: *Program increase - cUAS integration with robotic vehicles*
- Congressional Add: *Program increase - thermal management system for high energy laser*
- Congressional Add: *Program increase - HEL risk reduction*
- Congressional Add: *Program increase - HEL system characterization lab*

Congressional Add Subtotals for Project: BN7

Congressional Add Totals for all Projects

	FY 2020	FY 2021
	2.000	-
	2.500	8.000
	7.000	7.000
	10.000	-
	-	20.000
	-	5.000
	-	7.500
	-	50.000
	-	22.000
Congressional Add Subtotals for Project: BN7	21.500	119.500
Congressional Add Totals for all Projects	21.500	119.500

Change Summary Explanation

FY21 increase due to congressional adds of \$21.500 Million

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology	Project (Number/Name) AC8 / Low Cost Extended Range Air Defense Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AC8: Low Cost Extended Range Air Defense Adv Tech	-	20.184	-	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 this project is realigned to :
 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. Matures and demonstrates key missile technologies for a lower-cost interceptor system to address advanced air defense threats such as medium to large unmanned aerial systems (UAS) and sub-sonic cruise missile systems.

Work in this Project complements missile Applied Research efforts within PE 0602150A (Air and Missile Defense Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Low Cost Extended Range Air Defense (LowER AD) Advanced Technology	20.184	-	-
Description: Mature and demonstrate key missile technologies for a lower-cost interceptor system to address advanced air defense threats such as medium to large unmanned aerial systems (UAS) and sub-sonic cruise missile systems			
Accomplishments/Planned Programs Subtotals	20.184	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) AD1 / High Energy Laser Tactical Vehicle Demo Adv Tech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AD1: High Energy Laser Tactical Vehicle Demo Adv Tech	-	28.822	26.247	26.089	-	26.089	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a greater than 100 kW-class mobile high energy laser (HEL) weapon system on a tactical platform to protect fixed and semi-fixed sites from rocket, artillery and mortar (RAM), unmanned aerial system (UAS), and advanced air defense threats. The major effort under this Project is the phased approach for mobile high power solid state laser (SSL) technology demonstrations that are traceable to the form, fit, and function requirements for a HEL weapon. This effort utilizes open systems architecture to ensure growth, interoperability, and opportunity for technology insertions for maturation of laser, beam control, sensor/radar, integration of power and thermal management subsystems, as well as Battle Management Command, Control, and Computers (BMC3).

Work in this Project complements PE 0602150A (Air and Missile Defense Technology)/ Project AC9 (High Energy Laser Tactical Vehicle Demonstrator Technology).

The cited work 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.

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

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

	FY 2020	FY 2021	FY 2022
Title: High Energy Laser Tactical Vehicle Demonstrator (HEL TVD) Advanced Technology	28.822	26.247	26.089
Description: This effort integrates and demonstrates HEL technologies on an Army tactical platform for transition to the future Indirect Fire Protection Capability Increment 2-Intercept Program of Record. Effort includes integrating technologies developed under PE 0602307A/AC9 into HEL TVD and demonstrating the system against an array of RAM and UAS targets. Technology and knowledge gained from demonstration will be used to inform prototyping decisions by Army Rapid Capabilities and Critical Technologies Office and future material development decisions by Program Executive Office Missiles and Space.			
FY 2021 Plans: Begins integration and checkout of the HEL TVD subsystems. Integrates the electrical and thermal management subsystems into the HEL TVD platform. Begins integration of system software in preparation for FY22 HEL TVD demonstration.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) AD1 / <i>High Energy Laser Tactical Vehicle Demo Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will demonstrate a HEL-TVD system integration and a laboratory demonstration of a greater than 100kW laser weapon system for transition to the future Indirect Fire Protection Capability Program of Record.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		28.822	26.247	26.089
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) AD4 / Maneuver Air Defense Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AD4: <i>Maneuver Air Defense Advanced Technology</i>	-	-	19.396	19.737	-	19.737	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021 (FY21) this Project was realigned from:
 Program Element (PE) 0603466A Air and Missile Defense Advanced Technology
 * Project AC8 Low Cost Extended Range Air Defense Adv Tech

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities. Matures and demonstrates key missile technologies for an affordable short range interceptor to defeat advanced Maneuver-Short Range Air Defense (M-SHORAD) threats (e.g. Rotary Wing, Fixed Wing, Tactical / Lethal Unmanned Aerial Systems, and Subsonic Cruise Missile.

Work in this Project complements PE 0602150A (Air and Missile Defense Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

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

	FY 2020	FY 2021	FY 2022
Title: Maneuver Air Defense Advanced Technology	-	19.396	19.737
Description: Mature and demonstrate missile technologies and components necessary for an affordable short range air defense interceptor capability to defeat Rotary Wing, Fixed Wing, Tactical / Lethal Unmanned Aerial System, and cruise missile threats.			
FY 2021 Plans: Integrate a Guidance Electronics Unit (GEU) for missile hardware-in-the-loop (HWIL) maturation prior to integration with a testbed missile. Integrate GEU with a radome, airframe, motor, control actuation system for flight testing and demonstration.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) AD4 / <i>Maneuver Air Defense Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will continue integration of an interceptor Control Test Vehicle (CTV), then will conduct a CTV flight test to demonstrate expected control, navigation, and mid-course guidance performance; will complete Guidance Test Vehicle (GTV) Integration in a dynamic HWIL environment to verify performance of all major GEU and control subsystems prior to GTV flight test				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		-	19.396	19.737
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) AD6 / Next Generation Fires Radar Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AD6: Next Generation Fires Radar Advanced Technology	-	7.411	6.899	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

A. Mission Description and Budget Item Justification

This Project directly supports Army Modernization Priority Air and Missile Defense capabilities by demonstrating scalable radar open systems architecture software allowing the insertion of modular software components.

Work in this Project complements PE 0602150A (Air and Missile Defense Technology)/ Project AD5 (Next Generation Fires Radar 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 2020	FY 2021	FY 2022
Title: Next Generation Fires Radar Advanced Technology	7.411	6.899	-
Description: This effort matures and demonstrates the architectures, processing and components necessary to deliver next generation capability, flexibility and supportability to the fires family of radar systems. Efforts focus on development of a modular and scalable open architecture that is extensible to multiple radar systems technologies in support of air defense and fixed- and semi-fixed site protection.			
FY 2021 Plans: Mature and demonstrate the complete Fires Radar Open System Technology architecture and back-end processing on the Full Digital Array Radar Testbed and other front end antenna configurations, as available, to verify scalability and modularity; complete the Mode Development Kit (MDK) to improve the performance and optimize the multi-mission capability of next generation Fires radar system; conduct final demonstrations of Fires radar technologies that will provide multi-mode and multi-mission capabilities relevant to current and future radar systems.			
FY 2021 to FY 2022 Increase/Decrease Statement: Funding is realigned to 0602141/CG4 Advanced Radar Concepts and Technologies.			
Accomplishments/Planned Programs Subtotals	7.411	6.899	-

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Ad vanced Technology	Project (Number/Name) AD6 / Next Generation Fires Radar Advanced 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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) AE1 / Close Combat High Energy Laser Advanced Technology			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AE1: Close Combat High Energy Laser Advanced Technology	-	-	2.407	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

This effort has concluded. There is no funding request for Fiscal Year (FY) 2022.

A. Mission Description and Budget Item Justification

This funding matures and demonstrates 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 platforms 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 PE 0602150A (Air and Missile Defense Technology)/ Project AD9 (Close Combat High Energy Laser Technology).

The cited work 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.

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

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

	FY 2020	FY 2021	FY 2022
Title: Close Combat High Energy Laser Advanced Technology	-	2.407	-
Description: This effort develops laser and beam control technologies with extremely low size, weight, and power (SWaP) requirements enabling high energy lasers in smaller, close combat platforms. Extremely low SWaP laser systems will expand the laser weapons mission set. Reduction in SWaP also benefits higher power systems on the large tactical vehicles to counter the current threat set as well as laser-hardened threats more quickly or at longer ranges.			
FY 2021 Plans: Continued developing and validating laser and beam control technologies with extremely low SWaP to integrate on a risk reduction platform. Performed systems engineering analyses, including beam director, environmental, and laser power trade			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) AE1 / <i>Close Combat High Energy Laser Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
studies; conducted modeling and simulation to inform system performance objectives; performed HEL lethality effectiveness analysis and static and live-fire testing against designated threats and/or targets. FY 2021 to FY 2022 Increase/Decrease Statement: This effort has concluded.				
Accomplishments/Planned Programs Subtotals		-	2.407	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) AE3 / Unconventional Countermeasures-Survivability ATech			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
AE3: <i>Unconventional Countermeasures-Survivability ATech</i>	-	1.900	1.254	3.000	-	3.000	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

In Fiscal Year 2021, efforts in Applications of Environmentally-Inspired Unconventional Countermeasures are realigned from:
 PE 0603119A (Ground Advanced Technology)
 * Project BM1 (Protection from Advanced Weapon Affects Advanced Technology)

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies to increase survivability of personnel and critical assets using integrated unconventional countermeasures. These countermeasures include tonedown concepts for signature management using novel materials, rapidly deployable, low-cost, multispectral survivability enhancement technologies as well as intuitive decision support technologies to select and assess non-kinetic protective measures.

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 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 complements PE 0602150A (Air and Missile Defense Technology) / Project AE2 (Unconventional Countermeasures-Survivability Tech).

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

	FY 2020	FY 2021	FY 2022
Title: Development of Unconventional Countermeasures for Enhanced Survivability (DeUCES) Demonstrations	1.900	0.970	2.757
Description: This effort matures and demonstrates countermeasures to detect and defeat near-peer advanced weapons through computational simulations and physical countermeasures and enhanced tonedown measures.			
FY 2021 Plans: Mature and demonstrate integrated unconventional countermeasure protection for fixed and semi-fixed Air and Missile Defense assets.			
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology	Project (Number/Name) AE3 / Unconventional Countermeasures-Survivability ATech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2020	FY 2021	FY 2022
Will demonstrate integrated unconventional countermeasure solutions and optimize their design and employment in fixed and semi-fixed Air and Missile Defense assets, and will document best practices for employment.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding increase in FY22 supports demonstration of and optimization efforts for unconventional countermeasure solutions.				
Title: Applications of Environmentally-Inspired Unconventional Countermeasures		-	0.284	0.243
Description: This effort matures and demonstrates rapidly-deployable, eco-friendly materials with spectral signatures that alter or obscure underlying target spectral signatures.				
FY 2021 Plans: Mature and demonstrate a robust countermeasure spectral feature selection to detect and compare spectral vegetation ranges essential for the performance of unconventional countermeasures.				
FY 2022 Plans: Will use modeling and simulation tools to optimize countermeasure spectral feature selection matching for specific operating environments.				
FY 2021 to FY 2022 Increase/Decrease Statement: Funding decrease in FY22 reflects planned lifecycle for this effort, ending in FY22.				
Accomplishments/Planned Programs Subtotals		1.900	1.254	3.000
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 2022 Army										Date: May 2021		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603466A / Air and Missile Defense Advanced Technology				Project (Number/Name) BN7 / Weapons Components Advanced Technology (CA)			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
BN7: Weapons Components Advanced Technology (CA)	-	21.500	119.500	-	-	-	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
Congressional Interest Item funding provided for Weapons Components Advanced Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Weapons Components 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.

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

	FY 2020	FY 2021
Congressional Add: Advanced Explosion Resistant Window Systems FY 2020 Accomplishments: Program Increase supported advanced research on Advanced Explosion Resistant Window Systems. Work executed under the direction of the Army Futures Command.	2.000	-
Congressional Add: Silicon Carbide Power Electronics Packaging FY 2020 Accomplishments: Program Increase supported advanced research on Silicon Carbide Power Electronics Packaging. Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supports advanced research on Silicon Carbide Power Electronics Packaging. Work executed under the direction of the Army Futures Command.	2.500	8.000
Congressional Add: Enterprise Science and Technology Demonstration Prototyping FY 2020 Accomplishments: Program Increase supported advanced research on Enterprise Science and Technology Demonstration Prototyping.	7.000	7.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) BN7 / <i>Weapons Components Advanced Technology (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
Work executed under the direction of the Army Futures Command. FY 2021 Plans: Program Increase supports advanced research on Enterprise Science and Technology Demonstration Prototyping.		
Work executed under the direction of the Army Futures Command.		
Congressional Add: High-Energy Laser Development for All-Terrain Vehicles FY 2020 Accomplishments: Program Increase supported advanced research on High-Energy Laser Development for All-Terrain Vehicles.	10.000	-
Work executed under the direction of the Army Futures Command. Congressional Add: Program increase FY 2021 Plans: Program increase supporting advanced technology development of High Energy Laser Systems. This effort performs research and development on advanced weapons technology leading to a high energy laser system for vehicles supporting Army Brigade and below operations. It further addresses Size, Weight, and Power/Cost (SWaP-C) and target requirements for enhanced capabilities of current directed energy prototyping efforts. The effort builds upon the advanced laser technologies being developed and integrated on larger vehicles.	-	20.000
Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command. Congressional Add: Program increase - cUAS integration with robotic vehicles FY 2021 Plans: Program increase supporting advanced technology development of Counter-Small Unmanned Aerial Systems Integration with Robotic Vehicles. This effort supports the integration of proven Commercial-Off-The-Shelf (COTS) technologies to provide a modular multi-mission capability to include surveillance (with small Unmanned Aerial Systems (sUAS) detection), Counter-sUAS (C-sUAS) electronic warfare & other hard kill capabilities including High Energy Laser (HEL).	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) BN7 / <i>Weapons Components Advanced Technology (CA)</i>
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
This effort will produce a single integrated prototype system delivered and demonstrated in support of an initial demonstration. Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command.		
Congressional Add: Program increase - thermal management system for high energy laser FY 2021 Plans: Program increase supporting advanced technology development of thermal management systems for high energy lasers. This effort will improve laser diode fiber amplifier cooling with smaller, lighter and more energy efficient thermal management technology. Recent developments in parallel Army programs has proven that novel phase change materials, coordinative complex compound sorption technology, and integrated combinations with vector-drive vapor compression technology, can dramatically reduce size, weight and power (SWaP) of directed energy weapons systems. Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command.	-	7.500
Congressional Add: Program increase - HEL risk reduction FY 2021 Plans: Program increase supporting advanced technology development of High Energy Laser Risk Reduction. The Indirect Fire Protection Capability-High Energy Laser (IFPC-HEL) pre-prototype demonstrator proves out a 300 kW HEL system in a laboratory by the end of FY22. This effort accelerates subsystem development and integration of HEL, Beam Control System (BCS), Beam Director Assembly (BDA), and power and thermal technologies. Integration of these subsystems into an enclosure and onto the platform for range / field demonstrations. Enable final verification of the system against its defined threat portfolio, and provide a potential path forward for follow-on prototype systems delivery to the Warfighter as residual combat capability. Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command.	-	50.000
Congressional Add: Program increase - HEL system characterization lab	-	22.000

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) BN7 / <i>Weapons Components Advanced Technology (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021
<p><i>FY 2021 Plans:</i> Program increase supporting advanced technology development of high energy laser systems characterization lab.</p> <p>This effort will develop the equipment and instrumentation for a directed energy Systems Characterization Lab (SCL), integrate SCL equipment within High Energy Laser (HEL) lab, and create a capability for government validation of Science & Technology (S&T) performance and testing of HEL prototypes and weapons.</p> <p>Additionally, develop government owned surrogate HEL weapon subsystem performance evaluation frameworks necessary for the stimulation, test, and assessment of new HEL components and subsystems.</p> <p>Finally, this effort will develop laboratory instrumentation to measure HEL Weapon Systems, components, or subsystems.</p> <p>Work executed by the Rapid Capabilities and Critical Technologies Office under the direction of Army Futures Command.</p>		
Congressional Adds Subtotals	21.500	119.500

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 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603920A / <i>Humanitarian Demining</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	-	16.690	8.649	-	8.649	-	-	-	-	-	-
CD5: <i>Humanitarian Demining</i>	-	-	16.690	8.649	-	8.649	-	-	-	-	-	-

Note

This Program Element (PE) is a New Start for Fiscal Year 2021 (FY21).

A. Mission Description and Budget Item Justification

The Humanitarian Demining Research and Development (HD R&D) program develops, demonstrates and validates cost-effective technologies for use in humanitarian demining via Outside Continental United States (OCONUS) operational field evaluations. The HD R&D program's low-cost and highly effective technology reduces the landmine and unexploded ordnance (UXO) / improvised explosive device (IED) threat to deployed United States (US) forces and the local population. The HD R&D program coordinates with the Department of State's Weapons Removal and Abatement Program, the Department of Defense DoD Humanitarian Mine Action (HMA) programs of the Combatant Commands (CCMDs), and international mine action organizations and foreign militaries. New technology requirements and areas of emphasis are identified and validated at annual Requirements Workshop and UXO/IED Working Group Meetings. Technology investments are prioritized using the results of these meetings and CCMD security cooperation and theater campaign plan HMA objectives. The HD R&D program advances the state-of-the-art of demining technologies and evaluates these technologies utilizing host nation humanitarian demining partners.

The HD R&D program supports and bolsters the CCMD stability operations mission as directed under Department of Defense Instruction (DODI) 3000.05 to foster mil-to-mil engagement, and bolster economic security and development with partner nations worldwide. Additionally, the HD R&D program fosters nations' mine action capacity while improving DoD's visibility and access, generating long-term positive perceptions of DoD and the US, and fostering collaborative relationships with host nation governments. It also directly supports the National Defense Strategy through ensuring common domains remain open and free.

The HD R&D Program utilizes a research and development plan based on operational test data gained through Operational Field Evaluations (OFEs). These OFEs provide the HD R&D program a unique capability to collect this data against live mines/UXO in actual minefields around the world. This data is unavailable to any other DoD organization. This OFE data drives future HD R&D program investment decisions and is shared and leveraged by the U.S. Army's Army Futures Command programs to further improve U.S. forces' technologies. In addition, the HD R&D program provides mine and UXO detector training to the CCMDs at the Humanitarian Demining Training Center (HDTTC) in support of Military to Military training and partnerships. Since 1995 the program has fielded technologies for 234 evaluations in 43 countries, including Afghanistan, Angola, Cambodia, Colombia, Iraq, Kosovo, Ukraine, and Vietnam. The program's technologies have cleared 71.2 million square meters of the world's toughest minefields, and found or destroyed 213,220 mines and UXO.

The HD R&D program supports the DoD's strategic guidance to address instability and reduce the demand for significant US force commitments to stability operations; with (DODI) 3000.05 (Stability Operations) and Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3207.01C (Department of Defense Support to Humanitarian Mine Action) to reduce the social, economic and environmental impact of landmines and unexploded ordnance.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603920A / <i>Humanitarian Demining</i>
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This PE will be executed by the Army Futures Command (AFC).

Work in this PE was previously conducted under DoD PE 0603920D8Z, Humanitarian Demining.

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	0.000	8.515	8.756	-	8.756
Current President's Budget	0.000	16.690	8.649	-	8.649
Total Adjustments	0.000	8.175	-0.107	-	-0.107
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	8.485			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-0.310			
• Adjustments to Budget Years	-	-	-0.107	-	-0.107

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

Project: CD5: *Humanitarian Demining*

Congressional Add: *Program increase*

	FY 2020	FY 2021
	-	8.485
Congressional Add Subtotals for Project: CD5	-	8.485
Congressional Add Totals for all Projects	-	8.485

Change Summary Explanation

The FY21 increase is the result of a transfer from DoD PE 0603920D8Z, Humanitarian Demining.

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army **Date:** May 2021

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603920A / Humanitarian Demining				Project (Number/Name) CD5 / Humanitarian Demining			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CD5: <i>Humanitarian Demining</i>	-	-	16.690	8.649	-	8.649	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

Note

This Project is a New Start for Fiscal Year 2021 (FY21).

A. Mission Description and Budget Item Justification

The Humanitarian Demining Research and Development (HD R&D) program develops, demonstrates and validates cost-effective technologies for use in humanitarian demining via Outside Continental United States (OCONUS) operational field evaluations. The HD R&D program's low-cost and highly effective technology reduces the landmine and unexploded ordnance (UXO) / improvised explosive device (IED) threat to deployed United States (US) forces and the local population. The HD R&D program coordinates with the Department of State's Weapons Removal and Abatement Program, the Department of Defense DoD Humanitarian Mine Action (HMA) programs of the Combatant Commands (CCMDs), and international mine action organizations and foreign militaries. New technology requirements and areas of emphasis are identified and validated at annual Requirements Workshop and UXO/IED Working Group Meetings. Technology investments are prioritized using the results of these meetings and CCMD security cooperation and theater campaign plan HMA objectives. The HD R&D program advances the state-of-the-art of demining technologies and evaluates these technologies utilizing host nation humanitarian demining partners.

The HD R&D program supports and bolsters the CCMD stability operations mission as directed under Department of Defense Instruction (DODI) 3000.05 to foster mil-to-mil engagement, and bolster economic security and development with partner nations worldwide. Additionally, the HD R&D program fosters nations' mine action capacity while improving DoD's visibility and access, generating long-term positive perceptions of DoD and the US, and fostering collaborative relationships with host nation governments. It also directly supports the National Defense Strategy through ensuring common domains remain open and free.

The HD R&D Program utilizes a research and development plan based on operational test data gained through Operational Field Evaluations (OFEs). These OFEs provide the HD R&D program a unique capability to collect this data against live mines/UXO in actual minefields around the world. This data is unavailable to any other DoD organization. This OFE data drives future HD R&D program investment decisions and is shared and leveraged by the U.S. Army's Army Futures Command programs to further improve U.S. forces' technologies. In addition, the HD R&D program provides mine and UXO detector training to the CCMDs at the Humanitarian Demining Training Center (HDTTC) in support of Military to Military training and partnerships. Since 1995 the program has fielded technologies for 234 evaluations in 43 countries, including Afghanistan, Angola, Cambodia, Colombia, Iraq, Kosovo, Ukraine, and Vietnam. The program's technologies have cleared 71.2 million square meters of the world's toughest minefields, and found or destroyed 213,220 mines and UXO.

The HD R&D program supports the DoD's strategic guidance to address instability and reduce the demand for significant US force commitments to stability operations; with (DODI) 3000.05 (Stability Operations) and Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3207.01C (Department of Defense Support to Humanitarian Mine Action) to reduce the social, economic and environmental impact of landmines and unexploded ordnance.

This PE will be executed by the Army Futures Command (AFC).

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603920A / Humanitarian Demining	Project (Number/Name) CD5 / Humanitarian Demining
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Work in this PE was previously conducted under DoD PE 0603920D8Z, Humanitarian Demining.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
<p>Title: Humanitarian Demining Technologies</p> <p>Description: The HD R&D program adapts commercial-off-the-shelf equipment, integrates mature technologies, and leverages R&D activity within the Army, particularly the AFC CCDC Command, Control, Communications, Computers, Combat Systems, Intelligence, Surveillance, and Reconnaissance (C5ISR) Night Vision and Electronic Sensors Directorate (NVESD) Tactical Countermine mission area. This effort aims to improve existing technologies for mine/UXO detection, technical survey/area reduction, mechanical mine/UXO clearance, vegetation clearance, and mechanical mine neutralization.</p> <p>FY 2021 Plans: Deploys new technologies, including the Scorpion UXO detection system, Amulet IED detector and a mechanical dozer mounted mine clearance system to Afghanistan; Scorpion UXO detection system to Lebanon; Badger and Little Storm mine/UXO clearance systems to Cambodia; Little Storm and multiple Rambo demining technologies to Colombia; multi sensor handheld mine detectors to Colombia and Lebanon; commercial off-the-shelf (COTS) UXO detector and a mechanical screener to Israel, Robomax area preparation and Vehicle-Mounted Mine Detection Systems to Ukraine. Completes ongoing equipment developments/modifications and test technology including survey and mine/UXO detection technologies such as Combined Auxiliary Positioning System, Empact 3D, Minelab MDS-10, Minelab F3Ci, Minelab F3 Compact, Vallon VMH4, Vallon VMR3, Vallon VR-1, Cobham Amulet, Ceia CMD3 and Minex 4.600; and vegetation and mine clearance and neutralization technologies. Continues the successful ongoing operational evaluations from FY20 and support the combatant commands Embassy staffs by conducting new site surveys and country assessments in Colombia, Laos, Lebanon, Thailand, Vietnam. Convenes HD R&D Requirements Workshop to identify technology needs for humanitarian mine action and will develop, test and evaluate new prototype technologies based on feedback from the field and requirements workshop.</p> <p>FY 2022 Plans: Will identify, develop, and assess new technologies that provide individual mine/UXO detection, mechanical mine/UXO and vegetation clearance, and mechanical mine neutralization. Will demonstrate emerging mine/UXO defeat technologies and capabilities in relevant environments. Will execute threat surveys and country assessments. Will execute HD R&D requirements workshop to define global technology needs for humanitarian mine action. Will continue the ongoing successful operational evaluations from FY21.</p> <p>FY 2021 to FY 2022 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>	-	8.205	8.649
Accomplishments/Planned Programs Subtotals	-	8.205	8.649

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Army	Date: May 2021
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603920A / <i>Humanitarian Demining</i>	Project (Number/Name) CD5 / <i>Humanitarian Demining</i>
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	FY 2020	FY 2021
Congressional Add: Program increase	-	8.485
FY 2021 Plans: Program Increase supported advanced research on Humanitarian Demining Technologies.		
Work executed by Army Futures Command.		
Congressional Adds Subtotals	-	8.485

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

N/A

Remarks

D. Acquisition Strategy

N/A