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**Department of Defense
Fiscal Year (FY) 2021 Budget Estimates**

February 2020



Army

Justification Book of

Research, Development, Test & Evaluation, Army

RDT&E – Volume I, Budget Activity 3

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Army • Budget Estimates FY 2021 • RDT&E Program

Table of Contents

Introduction and Explanation of Contents..... ii

Comptroller Exhibit R-1..... ix

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

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

Exhibit R-2s..... 1

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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, \$12,770,165,000.00 to remain available for obligation until September 30, 2022.

COST STATEMENT

The following Justification Books were prepared at a cost of \$460,861: 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 2021 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 2020.

2. **Relationship of the FY 2021 Budget Submitted to Congress to the FY 2020 Budget Submitted to Congress.** This paragraph provides a list of program elements/projects that are major new starts, restructures, developmental transitions, and terminated programs. Explanations for these changes can be found in the narrative sections of the Program Element R-2A Exhibits.

New Start Programs:

<i>Budget Activity</i>	<i>OSDPE / Project</i>	<i>Project Title</i>
02	0602115A / EB2	HIV Biomedical Technology
02	0602134A / CD2	Counter Improvised-Threat Advanced Studies
02	0602146A / AQ2	EW Techniques Technology
02	0602146A / AQ7	High Tempo Data Driven Decision Tools Technology
03	0603002A / MP3	Phys Chem Toxicity Assessment Sys Adv Tech
03	0603115A / EB3	HIV Medical Development
03	0603134A / CD3	Counter Improvised-Threat Simulation
03	0603463A / AQ8	High Tempo Data Driven Decision Tools Adv Tech
03	0603463A / AR8	Sensing in Contested Environments Adv Tech
03	0603463A / AU2	Optimization of Geospatial Data for Visualization
03	0603463A / AV1	GEOInt/Ops Logistics Integration-Planning Adv Tech
03	0603463A / AW6	Modular GPS Independent Sensors Advanced Tech
03	0603920A / CD5	Humanitarian Demining
04	0603804A / EW8	Armored Engineer Vehicles
04	0604115A / AX3	Technology Maturation Initiatives

04	0604134A / CD4	Counter Improvised-Threat Demonstration
05	0304270A / FJ5	Terrestrial Layer System (MIP)
05	0604601A / S64	Common Remotely Operated Wpn Sys (CROWS)
05	0604604A / BX8	Cold Weather All-Terrain Vehicle (CATV)
05	0604622A / E50	TRAILER DEVELOPMENT
05	0604802A / XT2	40mm Door Breach
05	0605145A / CD6	Medical Products and Support Systems Development
06	0605801A / M23	US Army Corps of Engineers Base Operations
06	0606105A / CD7	Medical Program-Wide Activities
07	0203802A / VV2	TOW
07	0607145A / FD5	Apache Product Improvement
07	0203802A / VT9	Lethal Miniature Aerial Missile System (LMAMS)

Program Element/Project Restructures:

<u>Budget Activity</u>	<u>Old OSDPE / Project: Title</u>	<u>New OSDPE / Project</u>
02	0602141A / AH5: Projectile and Multi-Function Warhead Technologies	0602143A/AY6, 0602145A/BK5
02	0602143A / AN1: Narrowband SATCOM Technology	0602146A/BZ6, 060346A/AN2
02	0602143A / BE1: Support Technology to Mission Command	0602146A/AQ9
02	0602144A / BL4: Countermine Technology	0602145A/BF9
02	0602145A / BH2: C4ISR Modular Autonomy Technology	0602145A/BF9
02	0602145A / BH7: Enhanced VETRONICS Technology	0602145A/BH5
02	0602145A / BJ3: Hydrogen Based Combat System Technology	0602145A/BH5
02	0602145A / BJ7: Detection of Explosive Hazards Technology	0602145A/BF9
02	0602146A / AN3: Non Traditional Waveforms Technology	0603463A/AP6
02	0602146A / AV7: Atmospheric Modeling and Meteorological Technology	0603772A/101
02	0602147A / AF5: Simulation and Aerostructures Technology	0602147A/AE7
02	0602147A / AF6: Structures Technology	0602147A/AE7
02	0602147A / AF7: Warhead Integration Technology	0602147A/AE7

02	0602147A / AF9: Precision and Accuracy Technology	0602147A/AE7
02	0602147A / AG1: Missile Electronics Technology	0602147A/AE7
02	0602147A / AG2: Information and Signal Processing Technology	0602147A/AE7
02	0602147A / AG8: Advanced Energetics Technology	0602141A/AH9
02	0602147A / AG9: Multiple Simul Engagement Technologies (MSET) Tech	0602148A/AK4
02	0602148A / AI7: Alternative Concept Engine Technology	0602148A/AM4
02	0602148A / AK1: UAS Survivability Technology	0603465A/AK3
02	0602148A / AK6: Advanced Rotorcraft Armaments Protection System Te	0603465A/AK7, 0633465A/CA8
02	0602148A / AM2: Aircraft and Aircrew Protection Technology	0602148A/AJ4
02	0602150A / AD7: Missile Fire Control Sensors Technology	0602150A/AD3
02	0602787A / 874: Cbt Casualty Care Tech	0602787A/MM4
03	0603002A / MG4: Tech Base/Enabling Res in Mil Occup Med Adv Tech	0603002A/MN7, MN9, MO3, MO8, MP3
03	0603002A / MM5: Tech Base/Enabling Res Combat Cas Care Adv Tech	0603002A/MN3, MN4, MN5, MO2, MO4, MO7
03	0603002A / MM9: Tech Base/Enabling Rsrch for Infect Dis Adv Tech	0603002A/MO9, 0602787A/MM8
03	0603002A / MN8: Drugs to Prevent and Treat Malaria Advanced Tech	0602787A/MM8
03	0603002A / MO3: Military Occupational Fitness Standards Adv Tech	0603002A/MN7
03	0603118A / AZ8: Soldier Squad Small Arms Armaments Adv Tech	0602143/AY8, 0603463A/AQ1
03	0603462A / BH3: C4ISR Modular Autonomy Advanced Technology	0603462A/BZ9
03	0603462A / BI1: Protection for Autonomous Systems Adv Tech	0603462A/BG7
03	0603462A / BJ6: Hydrogen Based Combat System Advanced Technology	0603462A/BH6
03	0603462A / BJ8: Detection of Explosive Hazards Advanced Technology	0602145A/BF9
03	0603463A / AR2: Energy Informed Operations Advanced Technology	0603465A/AM5
03	0603463A / AU6: Automated Analytics for Operational Environment AT	0602146/AT7
03	0603464A / AF4: Missile Simulation Advanced Technology	0602147/AF8
03	0603464A / AH3: Single Multi-mission Attack Missile Adv Tech	0603465A/AK5
03	0603464A / BS3: Strategic Missile Advanced Technology	0603464A/BY2
03	0603465A / AI6: Next Gen Tactical UAS TD Advanced Technology	0603465A
03	0603465A / AM3: Aircraft and Aircrew Protection Advanced Tech	0603465A/AJ5
03	0603466A / AC8: Low Cost Extended Range Air Defense Adv Tech	0603466A/AD4
04	1206120A / FJ8: Assured Positioning, Navigation and Timing (PNT)	0604120A/ED5, BV4

04	1206120A / FJ9: Dismounted A-PNT	0604120A/EH8
04	1206120A / FK2: Mounted A-PNT	0604120A/EJ2
04	1206120A / FK3: Anti-Jam Antenna	0604120A/EJ2
04	1206308A / FE5: Space And Missile Defense Integration	0603308A/990
04	0603639A / EB8: OWL for Small Caliber Ammunition	0604802A/EP4
04	0603639A / EC2: Adv Armor-Piercing (ADVAP) for Small Cal Ammo	0604802A/FL4
04	0603639A / EU3: .50 Caliber All-Purpose Tactical Cartridge (APTC)	0604802A/EU5
04	0604541A / BT1: Interoperability	0604541A/BT3, BT5
04	0604541A / BT4: Network Technology Maturation Initiatives (NTMI)	0604541A/BT5
05	0604798A / DY3: NIE Test & Evaluation	0604798A/DY7
05	0604798A / DZ6: Army Integration Management & Coordination	0605054A/FL7
06	0605326A / 33B: Soldier-Centered Analyses For Future Force	0605604A/675
07	1203142A / FE1: Dscs-Dcs (Phase II)	0303142A/253
07	1203142A / FE2: MILSATCOM System Engineering	0303142A/456
07	1203142A / FI8: Protected Anti-JAM Tactical SATCOM	0303142A/456
07	1208053A / FE7: Joint Tact Grd Station-P3I(MIP)	0208053A/635
07	0303028A / FG2: Counterintelligence & Human Intel Modernization	0607150A/BS5
07	0303028A / H13: Information Dominance Center (IDC) - Tiara	0607150A/BS5
07	0305232A / RA7: RQ-11 Raven (MIP)	0604101A/BR6, 0605205A/BR7

Program Terminations (including transfers to Procurement and Sustainment):

<u>Budget Activity</u>	<u>OSDPE / Project</u>	<u>Project Title</u>
02	0602146A / AN5	Protected SATCOM-WB Global SATCOM Inter Canc Tech
02	0602146A / AU5	Automated Analytics for Operational Environment
02	0602146A / AW5	Modular GPS Independent Sensors Technology
02	0602147A / AH2	Single Multi-mission Attack Missile (SMAM) Technol
02	0602213A / CY9	Decoy and Deterrence Technology
02	0602787A / VB4	System Biology And Network Science Technology
03	0603457A / 7CY	Decoy and Deterrence Advanced Technology

03	0603462A / BF5	Adv Lethality & Accuracy Sys for Med Cal Adv Tech
03	0603463A / AW2	Autonomous Navigation Advanced Technology
03	0603464A / AE6	Strategic Long Range Cannon Advanced Technology
03	0603465A / AI4	Joint Multi-Role (JMR) Demonstration Advanced Tech
03	0603465A / AL6	Degraded Vis Environ Mitigation (DVE-M) Adv Tech
04	1206120A / FK1	PSEUDOLITES
04	0603804A / G11	Adv Elec Energy Con Ad
04	0604115A / AX8	Adv Leth and Accuracy Sys for Med Calber (ALAS-MC)
04	0604644A / MR1	Mobile Intermediate Range Missile
05	0604201A / EW7	Degraded Visual Environment
05	0604601A / FI2	Lightweight 30mm Cannon
05	0604710A / L76	Dismounted Fire Support Laser Targeting Systems
05	0604802A / ED7	Advanced Multipurpose (AMP) Cartridge
05	0604802A / EU7	Enhanced Lethality Cannon Munitions
05	0604804A / FG4	Ultra-Lightweight Camouflage Net System (ULCANS)
05	0604804A / L43	ENGINEER SUPPORT EQUIPMENT - ED
05	0604827A / S65	Platoon Power Generator
05	0604852A / XU9	Active Protection System
05	0604854A / 509	LIGHTWEIGHT 155M HOWITZER
05	0605013A / 193	Medical Communications For Combat Casualty
05	0605013A / XV6	Army Leader Dashboard
05	0605029A / EQ2	IntegGrdSecSurvRespC(IGSSR-C)
05	0605034A / EQ4	Tactical Security System (TSS)
05	0605036A / EQ5	Combating Weapons of Mass Destruction (CWMD)
05	0605049A / XT4	Advanced Threat Detection System (ATDS)
05	0605053A / FB2	Man Transportable Robotic System (MTRS) Inc II
05	0605053A / FB9	MTRS Standardization
06	0605805A / 857	DoD Explosives Safety Standards
06	0606001A / FD4	Military Ground-Based CREW Technology
07	0303150A / C86	Army Global C2 System

07	0305233A / RQ7	RQ-7 Shadow UAV
07	0307665A / FL5	Next Gen Biometric Collection Capability (MIP)
07	0607138A / ES5	Fixed Wing Product Improvement Program
07	0607665A / DT2	Non-MIP Biometrics

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.

Department of Defense
FY 2021 President's Budget
Exhibit R-1 FY 2021 President's Budget
Total Obligational Authority
(Dollars in Thousands)

17 Jan 2020

Appropriation	FY 2019	FY 2020	FY 2020	FY 2020	FY 2020	FY 2020
	(Base + OCO)	Base Enacted	Emergency	OCO Enacted	OCO Enacted	Total Enacted (Base+Emerg+ OCO)
Research, Development, Test & Eval, Army	11,371,268	12,543,435		147,304		12,690,739
Total Research, Development, Test & Evaluation	11,371,268	12,543,435		147,304		12,690,739

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Department of Defense
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

Appropriation	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)
Research, Development, Test & Eval, Army	12,587,343		182,824	182,824	12,770,167
Total Research, Development, Test & Evaluation	12,587,343		182,824	182,824	12,770,167



Department of Defense
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

Summary Recap of Budget Activities	FY 2019	FY 2020	FY 2020	FY 2020	FY 2020	FY 2020
	(Base + OCO)	Base Enacted	Emergency	OCO Enacted	OCO Enacted	Total Enacted (Base+Emerg+ OCO)
Basic Research	491,263	574,484				574,484
Applied Research	1,553,764	1,259,374				1,259,374
Advanced Technology Development	1,561,576	1,531,516				1,531,516
Advanced Component Development & Prototypes	1,213,569	2,975,681		11,114		2,986,795
System Development & Demonstration	3,119,552	2,989,779		100,147		3,089,926
Management Support	1,710,179	1,368,475		1,875		1,370,350
Operational Systems Development	1,721,365	1,844,126		34,168		1,878,294
Software and Digital Technology Pilot Programs						
Total Research, Development, Test & Evaluation	11,371,268	12,543,435		147,304		12,690,739
Summary Recap of FYDP Programs						
General Purpose Forces	646,373	765,324				765,324
Intelligence and Communications	311,699	236,563		37,368		273,931
Research and Development	10,090,836	11,139,975		109,936		11,249,911
Central Supply and Maintenance	106,766	108,348				108,348
Administration and Associated Activities	358					
Space	209,281	285,952				285,952
Classified Programs	5,955	7,273				7,273
Total Research, Development, Test & Evaluation	11,371,268	12,543,435		147,304		12,690,739

UNCLASSIFIED

Department of Defense
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)
<u>Summary Recap of Budget Activities</u>					
Basic Research	463,359				463,359
Applied Research	920,881		2,000	2,000	922,881
Advanced Technology Development	1,203,590				1,203,590
Advanced Component Development & Prototypes	3,421,608		2,520	2,520	3,424,128
System Development & Demonstration	3,199,798		97,825	97,825	3,297,623
Management Support	1,333,123		5,137	5,137	1,338,260
Operational Systems Development	1,998,539		75,342	75,342	2,073,881
Software and Digital Technology Pilot Programs	46,445				46,445
Total Research, Development, Test & Evaluation	12,587,343		182,824	182,824	12,770,167
<u>Summary Recap of FYDP Programs</u>					
General Purpose Forces	923,370		2,300	2,300	925,670
Intelligence and Communications	309,698		76,942	76,942	386,640
Research and Development	11,289,280		103,582	103,582	11,392,862
Central Supply and Maintenance	61,012				61,012
Administration and Associated Activities					
Space					
Classified Programs	3,983				3,983
Total Research, Development, Test & Evaluation	12,587,343		182,824	182,824	12,770,167

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

Summary Recap of Budget Activities	FY 2019	FY 2020	FY 2020	FY 2020	FY 2020
	(Base + OCO)	Base Enacted	Emergency	OCO Enacted	Total Enacted (Base+Emerg+ OCO)
Basic Research	491,263	574,484			574,484
Applied Research	1,553,764	1,259,374			1,259,374
Advanced Technology Development	1,561,576	1,531,516			1,531,516
Advanced Component Development & Prototypes	1,213,569	2,975,681		11,114	2,986,795
System Development & Demonstration	3,119,552	2,989,779		100,147	3,089,926
Management Support	1,710,179	1,368,475		1,875	1,370,350
Operational Systems Development	1,721,365	1,844,126		34,168	1,878,294
Software and Digital Technology Pilot Programs					
Total Research, Development, Test & Evaluation	11,371,268	12,543,435		147,304	12,690,739
Summary Recap of FYDP Programs					
General Purpose Forces	646,373	765,324			765,324
Intelligence and Communications	311,699	236,563		37,368	273,931
Research and Development	10,090,836	11,139,975		109,936	11,249,911
Central Supply and Maintenance	106,766	108,348			108,348
Administration and Associated Activities	358				
Space	209,281	285,952			285,952
Classified Programs	5,955	7,273			7,273
Total Research, Development, Test & Evaluation	11,371,268	12,543,435		147,304	12,690,739

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Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)
Summary Recap of Budget Activities					
Basic Research	463,359				463,359
Applied Research	920,881		2,000	2,000	922,881
Advanced Technology Development	1,203,590				1,203,590
Advanced Component Development & Prototypes	3,421,608		2,520	2,520	3,424,128
System Development & Demonstration	3,199,798		97,825	97,825	3,297,623
Management Support	1,333,123		5,137	5,137	1,338,260
Operational Systems Development	1,998,539		75,342	75,342	2,073,881
Software and Digital Technology Pilot Programs	46,445				46,445
Total Research, Development, Test & Evaluation	12,587,343		182,824	182,824	12,770,167
Summary Recap of FYDP Programs					
General Purpose Forces	923,370		2,300	2,300	925,670
Intelligence and Communications	309,698		76,942	76,942	386,640
Research and Development	11,289,280		103,582	103,582	11,392,862
Central Supply and Maintenance	61,012				61,012
Administration and Associated Activities					
Space					
Classified Programs	3,983				3,983
Total Research, Development, Test & Evaluation	12,587,343		182,824	182,824	12,770,167

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
1	0601101A In-House Laboratory Independent Research	01	11,391				U
2	0601102A Defense Research Sciences	01	306,347	354,480			354,480 U
3	0601103A University Research Initiatives	01	62,813	87,858			87,858 U
4	0601104A University and Industry Research Centers	01	110,712	127,164			127,164 U
5	0601121A Cyber Collaborative Research Alliance	01		4,982			4,982 U
Basic Research			491,263	574,484			574,484
6	0602105A Materials Technology	02	79,432				U
7	0602115A Biomedical Technology	02					U
8	0602120A Sensors and Electronic Survivability	02	90,023				U
9	0602122A TRACTOR HIP	02	8,674				U
10	0602126A TRACTOR JACK	02	400				U
11	0602134A Counter Improvised-Threat Advanced Studies	02					U
12	0602141A Lethality Technology	02		69,961			69,961 U
13	0602142A Army Applied Research	02		30,819			30,819 U
14	0602143A Soldier Lethality Technology	02		145,900			145,900 U
15	0602144A Ground Technology	02		143,899			143,899 U
16	0602145A Next Generation Combat Vehicle Technology	02		263,547			263,547 U
17	0602146A Network C3I Technology	02		138,016			138,016 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

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Department of the Army
FY 2021 President's Budget
Exhibit R-1 FY 2021 President's Budget
Total Obligational Authority
(Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
1	0601101A	In-House Laboratory Independent Research	01						U
2	0601102A	Defense Research Sciences	01	303,257				303,257	U
3	0601103A	University Research Initiatives	01	67,148				67,148	U
4	0601104A	University and Industry Research Centers	01	87,877				87,877	U
5	0601121A	Cyber Collaborative Research Alliance	01	5,077				5,077	U
		Basic Research		463,359				463,359	
6	0602105A	Materials Technology	02						U
7	0602115A	Biomedical Technology	02	11,835				11,835	U
8	0602120A	Sensors and Electronic Survivability	02						U
9	0602122A	TRACTOR HIP	02						U
10	0602126A	TRACTOR JACK	02						U
11	0602134A	Counter Improvised-Threat Advanced Studies	02	2,000				2,000	U
12	0602141A	Lethality Technology	02	42,425				42,425	U
13	0602142A	Army Applied Research	02	30,757				30,757	U
14	0602143A	Soldier Lethality Technology	02	125,435				125,435	U
15	0602144A	Ground Technology	02	28,047				28,047	U
16	0602145A	Next Generation Combat Vehicle Technology	02	217,565		2,000	2,000	219,565	U
17	0602146A	Network C3I Technology	02	114,404				114,404	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

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Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)	
18 0602147A	Long Range Precision Fires Technology	02		120,327			120,327	U
19 0602148A	Future Verticle Lift Technology	02		98,359			98,359	U
20 0602150A	Air and Missile Defense Technology	02		95,771			95,771	U
21 0602211A	Aviation Technology	02	80,424					U
22 0602213A	C3I Applied Cyber	02		18,947			18,947	U
23 0602270A	Electronic Warfare Technology	02	25,127					U
24 0602303A	Missile Technology	02	90,496					U
25 0602307A	Advanced Weapons Technology	02	43,454					U
26 0602308A	Advanced Concepts and Simulation	02	28,623					U
27 0602601A	Combat Vehicle and Automotive Technology	02	102,899					U
28 0602618A	Ballistics Technology	02	86,737					U
29 0602622A	Chemical, Smoke and Equipment Defeating Technology	02	4,884					U
30 0602623A	Joint Service Small Arms Program	02	11,890					U
31 0602624A	Weapons and Munitions Technology	02	379,833					U
32 0602705A	Electronics and Electronic Devices	02	98,855					U
33 0602709A	Night Vision Technology	02	33,218					U
34 0602712A	Countermine Systems	02	26,594					U
35 0602716A	Human Factors Engineering Technology	02	23,755					U
36 0602720A	Environmental Quality Technology	02	15,364					U

R-121PB; FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

UNCLASSIFIED

Department of the Army
FY 2021 President's Budget
Exhibit R-1 FY 2021 President's Budget
Total Obligational Authority
(Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
18	0602147A	Long Range Precision Fires Technology	02	60,553			60,553	60,553	U
19	0602148A	Future Verticle Lift Technology	02	96,484			96,484	96,484	U
20	0602150A	Air and Missile Defense Technology	02	56,298			56,298	56,298	U
21	0602211A	Aviation Technology	02						U
22	0602213A	C3I Applied Cyber	02	18,816			18,816	18,816	U
23	0602270A	Electronic Warfare Technology	02						U
24	0602303A	Missile Technology	02						U
25	0602307A	Advanced Weapons Technology	02						U
26	0602308A	Advanced Concepts and Simulation	02						U
27	0602601A	Combat Vehicle and Automotive Technology	02						U
28	0602618A	Ballistics Technology	02						U
29	0602622A	Chemical, Smoke and Equipment Defeating Technology	02						U
30	0602623A	Joint Service Small Arms Program	02						U
31	0602624A	Weapons and Munitions Technology	02						U
32	0602705A	Electronics and Electronic Devices	02						U
33	0602709A	Night Vision Technology	02						U
34	0602712A	Countermine Systems	02						U
35	0602716A	Human Factors Engineering Technology	02						U
36	0602720A	Environmental Quality Technology	02						U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)	
37	0602782A Command, Control, Communications Technology	02	51,685					U
38	0602783A Computer and Software Technology	02	14,622					U
39	0602784A Military Engineering Technology	02	96,922					U
40	0602785A Manpower/Personnel/Training Technology	02	17,157	20,873			20,873	U
41	0602786A Warfighter Technology	02	55,467					U
42	0602787A Medical Technology	02	87,229	112,955			112,955	U
	Applied Research		1,553,764	1,259,374			1,259,374	
43	0603001A Warfighter Advanced Technology	03	40,501					U
44	0603002A Medical Advanced Technology	03	94,575	83,030			83,030	U
45	0603003A Aviation Advanced Technology	03	165,035					U
46	0603004A Weapons and Munitions Advanced Technology	03	240,862					U
47	0603005A Combat Vehicle and Automotive Advanced Technology	03	171,448					U
48	0603006A Space Application Advanced Technology	03	48,542					U
49	0603007A Manpower, Personnel and Training Advanced Technology	03	6,270	11,038			11,038	U
50	0603009A TRACTOR HIKE	03	22,631					U
51	0603015A Next Generation Training & Simulation Systems	03	27,711					U
52	0603115A Medical Development	03						U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U S e C
37 0602782A	Command, Control, Communications Technology	02						U
38 0602783A	Computer and Software Technology	02						U
39 0602784A	Military Engineering Technology	02						U
40 0602785A	Manpower/Personnel/Training Technology	02	20,766				20,766	U
41 0602786A	Warfighter Technology	02						U
42 0602787A	Medical Technology	02	95,496				95,496	U
	Applied Research		920,881		2,000	2,000	922,881	
43 0603001A	Warfighter Advanced Technology	03						U
44 0603002A	Medical Advanced Technology	03	38,896				38,896	U
45 0603003A	Aviation Advanced Technology	03						U
46 0603004A	Weapons and Munitions Advanced Technology	03						U
47 0603005A	Combat Vehicle and Automotive Advanced Technology	03						U
48 0603006A	Space Application Advanced Technology	03						U
49 0603007A	Manpower, Personnel and Training Advanced Technology	03	11,659				11,659	U
50 0603009A	TRACTOR HIKE	03						U
51 0603015A	Next Generation Training & Simulation Systems	03						U
52 0603115A	Medical Development	03	27,723				27,723	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

XX

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
53 0603117A	Army Advanced Technology Development	03		66,338			66,338 U
54 0603118A	Soldier Lethality Advanced Technology	03		135,968			135,968 U
55 0603119A	Ground Advanced Technology	03		136,793			136,793 U
56 0603125A	Combating Terrorism - Technology Development	03	43,910				U
57 0603130A	TRACTOR NAIL	03	4,896				U
58 0603131A	TRACTOR EGGS	03	6,041				U
59 0603134A	Counter Improvised-Threat Simulation	03					U
60 0603270A	Electronic Warfare Technology	03	40,461				U
61 0603313A	Missile and Rocket Advanced Technology	03	92,404				U
62 0603322A	TRACTOR CAGE	03	16,845				U
63 0603457A	C3I Cyber Advanced Development	03		23,769			23,769 U
64 0603461A	High Performance Computing Modernization Program	03	211,457	224,755			224,755 U
65 0603462A	Next Generation Combat Vehicle Advanced Technology	03		260,535			260,535 U
66 0603463A	Network C3I Advanced Technology	03		142,899			142,899 U
67 0603464A	Long Range Precision Fires Advanced Technology	03		189,386			189,386 U
68 0603465A	Future Vertical Lift Advanced Technology	03		174,892			174,892 U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	See
53	0603117A	Army Advanced Technology Development	03	62,663				62,663	U
54	0603118A	Soldier Lethality Advanced Technology	03	109,608				109,608	U
55	0603119A	Ground Advanced Technology	03	14,795				14,795	U
56	0603125A	Combating Terrorism - Technology Development	03						U
57	0603130A	TRACTOR NAIL	03						U
58	0603131A	TRACTOR EGGS	03						U
59	0603134A	Counter Improvised-Threat Simulation	03	25,000				25,000	U
60	0603270A	Electronic Warfare Technology	03						U
61	0603313A	Missile and Rocket Advanced Technology	03						U
62	0603322A	TRACTOR CAGE	03						U
63	0603457A	C3I Cyber Advanced Development	03	23,357				23,357	U
64	0603461A	High Performance Computing Modernization Program	03	188,024				188,024	U
65	0603462A	Next Generation Combat Vehicle Advanced Technology	03	199,358				199,358	U
66	0603463A	Network C3I Advanced Technology	03	158,608				158,608	U
67	0603464A	Long Range Precision Fires Advanced Technology	03	121,060				121,060	U
68	0603465A	Future Vertical Lift Advanced Technology	03	156,194				156,194	U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
69 0603466A	Air and Missile Defense Advanced Technology	03		82,113			82,113 U
70 0603606A	Landmine Warfare and Barrier Advanced Technology	03	16,860				U
71 0603607A	Joint Service Small Arms Program	03	22,628				U
72 0603710A	Night Vision Advanced Technology	03	69,094				U
73 0603728A	Environmental Quality Technology Demonstrations	03	28,079				U
74 0603734A	Military Engineering Advanced Technology	03	100,359				U
75 0603772A	Advanced Tactical Computer Science and Sensor Technology	03	45,799				U
76 0603794A	C3 Advanced Technology	03	45,168				U
77 0603920A	Humanitarian Demining	03					U
	Advanced Technology Development		1,561,576	1,531,516			1,531,516
78 0603305A	Army Missile Defense Systems Integration	04	60,301	59,487			59,487 U
79 0603308A	Army Space Systems Integration	04					U
80 0603327A	Air and Missile Defense Systems Engineering	04	44,743	52,480		500	52,980 U
81 0603619A	Landmine Warfare and Barrier - Adv Dev	04	40,255	82,915			82,915 U
82 0603627A	Smoke, Obscurant and Target Defeating Sys-Adv Dev	04	19,852				U
83 0603639A	Tank and Medium Caliber Ammunition	04	40,358	77,696			77,696 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	See
69	0603466A	Air and Missile Defense Advanced Technology	03	58,130				58,130	U
70	0603606A	Landmine Warfare and Barrier Advanced Technology	03						U
71	0603607A	Joint Service Small Arms Program	03						U
72	0603710A	Night Vision Advanced Technology	03						U
73	0603728A	Environmental Quality Technology Demonstrations	03						U
74	0603734A	Military Engineering Advanced Technology	03						U
75	0603772A	Advanced Tactical Computer Science and Sensor Technology	03						U
76	0603794A	C3 Advanced Technology	03						U
77	0603920A	Humanitarian Demining	03	8,515				8,515	U
		Advanced Technology Development		1,203,590				1,203,590	
78	0603305A	Army Missile Defense Systems Integration	04	11,062				11,062	U
79	0603308A	Army Space Systems Integration	04	26,230				26,230	U
80	0603327A	Air and Missile Defense Systems Engineering	04	26,482		500	500	26,982	U
81	0603619A	Landmine Warfare and Barrier - Adv Dev	04	64,092				64,092	U
82	0603627A	Smoke, Obscurant and Target Defeating Sys-Adv Dev	04						U
83	0603639A	Tank and Medium Caliber Ammunition	04	92,753				92,753	U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
84 0603645A	Armored System Modernization - Adv Dev	04	80,106	144,234			144,234 U
85 0603747A	Soldier Support and Survivability	04	8,067	6,514		3,000	9,514 U
86 0603766A	Tactical Electronic Surveillance System - Adv Dev	04	35,667	37,490			37,490 U
87 0603774A	Night Vision Systems Advanced Development	04	7,072	200,791			200,791 U
88 0603779A	Environmental Quality Technology - Dem/Val	04	14,190	19,561			19,561 U
89 0603790A	NATO Research and Development	04	3,564	5,406			5,406 U
90 0603801A	Aviation - Adv Dev	04	93,885	505,890			505,890 U
91 0603804A	Logistics and Engineer Equipment - Adv Dev	04	18,845	6,254		1,085	7,339 U
92 0603807A	Medical Systems - Adv Dev	04	38,371	36,975			36,975 U
93 0603827A	Soldier Systems - Advanced Development	04	30,384	26,113			26,113 U
94 0604017A	Robotics Development	04	70,745	84,381			84,381 U
95 0604020A	Cross Functional Team (CFT) Advanced Development & Prototyping	04	8,225				U
96 0604021A	Electronic Warfare Technology Maturation (MIP)	04		23,043			23,043 U
97 0604035A	Low Earth Orbit (LEO) Satellite Capability	04					U
98 0604100A	Analysis Of Alternatives	04	9,396	10,023			10,023 U

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element Number	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	See
84	0603645A	Armored System Modernization - Adv Dev	04	151,478			151,478	151,478	U
85	0603747A	Soldier Support and Survivability	04	5,841			5,841	5,841	U
86	0603766A	Tactical Electronic Surveillance System - Adv Dev	04	194,775			194,775	194,775	U
87	0603774A	Night Vision Systems Advanced Development	04	24,316			24,316	24,316	U
88	0603779A	Environmental Quality Technology - Dem/Val	04	13,387			13,387	13,387	U
89	0603790A	NATO Research and Development	04	4,762			4,762	4,762	U
90	0603801A	Aviation - Adv Dev	04	647,937			647,937	647,937	U
91	0603804A	Logistics and Engineer Equipment - Adv Dev	04	4,761			4,761	4,761	U
92	0603807A	Medical Systems - Adv Dev	04	28,520			28,520	28,520	U
93	0603827A	Soldier Systems - Advanced Development	04	26,138			26,138	26,138	U
94	0604017A	Robotics Development	04	121,207			121,207	121,207	U
95	0604020A	Cross Functional Team (CFT) Advanced Development & Prototyping	04						U
96	0604021A	Electronic Warfare Technology Maturation (MIP)	04	22,840			22,840	22,840	U
97	0604035A	Low Earth Orbit (LEO) Satellite Capability	04	22,678			22,678	22,678	U
98	0604100A	Analysis Of Alternatives	04	10,082			10,082	10,082	U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted (Base+Emerg+ OCO)	
99 0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04						U
100 0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	12,393	40,745			40,745	U
101 0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	84,981	379,772			379,772	U
102 0604115A	Technology Maturation Initiatives	04	91,749	179,676			179,676	U
103 0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	75,711	42,900			42,900	U
104 0604118A	TRACTOR BEAM	04	52,894					U
105 0604119A	Army Advanced Component Development & Prototyping	04		112,806		4,529	117,335	U
106 0604120A	Assured Positioning, Navigation and Timing (PNT)	04						U
107 0604121A	Synthetic Training Environment Refinement & Prototyping	04	39,890	103,621			103,621	U
108 0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04						U
109 0604182A	Hypersonics	04		404,000			404,000	U
110 0604319A	Indirect Fire Protection Capability Increment 2-Intercept (IFPC2)	04	10,324					U
111 0604403A	Future Interceptor	04		2,000			2,000	U
112 0604541A	Unified Network Transport	04		29,700			29,700	U
113 0604644A	Mobile Medium Range Missile	04		5,000			5,000	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
99 0604101A	Small Unmanned Aerial Vehicle (SUAV) (6.4)	04	1,378				1,378	U
100 0604113A	Future Tactical Unmanned Aircraft System (FTUAS)	04	40,083				40,083	U
101 0604114A	Lower Tier Air Missile Defense (LTAMD) Sensor	04	376,373				376,373	U
102 0604115A	Technology Maturation Initiatives	04	156,834				156,834	U
103 0604117A	Maneuver - Short Range Air Defense (M-SHORAD)	04	4,995				4,995	U
104 0604118A	TRACTOR BEAM	04						U
105 0604119A	Army Advanced Component Development & Prototyping	04	170,490				170,490	U
106 0604120A	Assured Positioning, Navigation and Timing (PNT)	04	128,125				128,125	U
107 0604121A	Synthetic Training Environment Refinement & Prototyping	04	129,547				129,547	U
108 0604134A	Counter Improvised-Threat Demonstration, Prototype Development, and Testing	04	13,831				13,831	U
109 0604182A	Hypersonics	04	801,417				801,417	U
110 0604319A	Indirect Fire Protection Capability Increment 2-Intercept (IFPC2)	04						U
111 0604403A	Future Interceptor	04	7,992				7,992	U
112 0604541A	Unified Network Transport	04	40,677				40,677	U
113 0604644A	Mobile Medium Range Missile	04						U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
114 0604785A	Integrated Base Defense (Budget Activity 4)	04		52,102		2,000	2,000 U
115 0305251A	Cyberspace Operations Forces and Force Support	04	52,817	52,102			52,102 U
116 1206120A	Assured Positioning, Navigation and Timing (PNT)	04	123,364	139,110			139,110 U
117 1206308A	Army Space Systems Integration	04	45,420	104,996			104,996 U
	Advanced Component Development & Prototypes		1,213,569	2,975,681		11,114	2,986,795
118 0604201A	Aircraft Avionics	05	31,401	8,414			8,414 U
119 0604270A	Electronic Warfare Development	05	56,310	59,539			59,539 U
120 0604328A	TRACTOR CAGE	05	27,050				U
121 0604601A	Infantry Support Weapons	05	74,629	87,179			87,179 U
122 0604604A	Medium Tactical Vehicles	05	3,905				U
123 0604611A	JAVELIN	05	5,250	14,997			14,997 U
124 0604622A	Family of Heavy Tactical Vehicles	05	11,182	13,125			13,125 U
125 0604633A	Air Traffic Control	05	11,580	5,781			5,781 U
126 0604642A	Light Tactical Wheeled Vehicles	05	1,013	2,965			2,965 U
127 0604645A	Armored Systems Modernization (ASM) - Eng Dev	05	359,017	285,136			285,136 U
128 0604710A	Night Vision Systems - Eng Dev	05	139,337	143,696			143,696 U
129 0604713A	Combat Feeding, Clothing, and Equipment	05	4,393	7,393			7,393 U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	S
114	0604785A Integrated Base Defense (Budget Activity 4)	04			2,020	2,020	2,020	U
115	0305251A Cyberspace Operations Forces and Force Support	04	50,525				50,525	U
116	1206120A Assured Positioning, Navigation and Timing (PNT)	04						U
117	1206308A Army Space Systems Integration	04						U
	Advanced Component Development & Prototypes		3,421,608		2,520	2,520	3,424,128	
118	0604201A Aircraft Avionics	05	2,764				2,764	U
119	0604270A Electronic Warfare Development	05	62,426				62,426	U
120	0604328A TRACTOR CAGE	05						U
121	0604601A Infantry Support Weapons	05	91,574				91,574	U
122	0604604A Medium Tactical Vehicles	05	8,523				8,523	U
123	0604611A JAVELIN	05	7,493				7,493	U
124	0604622A Family of Heavy Tactical Vehicles	05	24,792				24,792	U
125	0604633A Air Traffic Control	05	3,511				3,511	U
126	0604642A Light Tactical Wheeled Vehicles	05	1,976				1,976	U
127	0604645A Armored Systems Modernization (ASM) - Eng Dev	05	135,488				135,488	U
128	0604710A Night Vision Systems - Eng Dev	05	61,445				61,445	U
129	0604713A Combat Feeding, Clothing, and Equipment	05	2,814				2,814	U

XXX

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
130 0604715A	Non-System Training Devices - Eng Dev	05	42,604	30,912			30,912 U
131 0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	208,965	33,502			33,502 U
132 0604742A	Constructive Simulation Systems Development	05	21,354	11,636			11,636 U
133 0604746A	Automatic Test Equipment Development	05	10,104	10,915			10,915 U
134 0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	8,423	7,801			7,801 U
135 0604768A	Brilliant Anti-Armor Submunition (BAT)	05	6,568	20,000			20,000 U
136 0604780A	Combined Arms Tactical Trainer (CATT) Core	05	20,514	9,241			9,241 U
137 0604798A	Brigade Analysis, Integration and Evaluation	05	48,030	38,303			38,303 U
138 0604802A	Weapons and Munitions - Eng Dev	05	173,713	186,323			186,323 U
139 0604804A	Logistics and Engineer Equipment - Eng Dev	05	70,096	107,826			107,826 U
140 0604805A	Command, Control, Communications Systems - Eng Dev	05	15,366	12,595			12,595 U
141 0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	45,054	48,264			48,264 U
142 0604808A	Landmine Warfare/Barrier - Eng Dev	05	39,261	37,108			37,108 U
143 0604818A	Army Tactical Command & Control Hardware & Software	05	163,229	129,974			129,974 U
144 0604820A	Radar Development	05	37,847	95,720			95,720 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
130 0604715A	Non-System Training Devices - Eng Dev	05	28,036				28,036	U
131 0604741A	Air Defense Command, Control and Intelligence - Eng Dev	05	43,651		27,000	27,000	70,651	U
132 0604742A	Constructive Simulation Systems Development	05	10,150				10,150	U
133 0604746A	Automatic Test Equipment Development	05	5,578				5,578	U
134 0604760A	Distributive Interactive Simulations (DIS) - Eng Dev	05	7,892				7,892	U
135 0604768A	Brilliant Anti-Armor Submunition (BAT)	05	24,975				24,975	U
136 0604780A	Combined Arms Tactical Trainer (CAT) Core	05	3,568				3,568	U
137 0604798A	Brigade Analysis, Integration and Evaluation	05	19,268				19,268	U
138 0604802A	Weapons and Munitions - Eng Dev	05	265,811				265,811	U
139 0604804A	Logistics and Engineer Equipment - Eng Dev	05	49,694				49,694	U
140 0604805A	Command, Control, Communications Systems - Eng Dev	05	11,079				11,079	U
141 0604807A	Medical Materiel/Medical Biological Defense Equipment - Eng Dev	05	49,870				49,870	U
142 0604808A	Landmine Warfare/Barrier - Eng Dev	05	9,589				9,589	U
143 0604818A	Army Tactical Command & Control Hardware & Software	05	162,513				162,513	U
144 0604820A	Radar Development	05	109,259				109,259	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ e OCO)
145 0604822A	General Fund Enterprise Business System (GFEBES)	05	35,468	42,883			42,883 U
146 0604823A	Firefinder	05	25,856	17,294			17,294 U
147 0604827A	Soldier Systems - Warrior Dem/Val	05	10,044	4,803			4,803 U
148 0604852A	Suite of Survivability Enhancement Systems - EMD	05	50,380	85,198			85,198 U
149 0604854A	Artillery Systems - EMD	05	1,722	10,732			10,732 U
150 0605013A	Information Technology Development	05	74,551	88,689			88,689 U
151 0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	158,807	102,073			102,073 U
152 0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	107,521	83,830			83,830 U
153 0605029A	Integrated Ground Security Surveillance Response Capability (IGSSR-C)	05	3,104	6,699			6,699 U
154 0605030A	Joint Tactical Network Center (JTNC)	05	15,287	15,882			15,882 U
155 0605031A	Joint Tactical Network (JTN)	05	42,134	40,808			40,808 U
156 0605032A	TRACTOR TIRE	05	107,926				U
157 0605033A	Ground-Based Operational Surveillance System - Expeditionary (GBOSS-E)	05	4,980	3,847			3,847 U
158 0605034A	Tactical Security System (TSS)	05	4,326	6,928			6,928 U
159 0605035A	Common Infrared Countermeasures (CIRCM)	05	32,025	23,179			23,179 U
160 0605036A	Combating Weapons of Mass Destruction (CWMD)	05	10,883	10,000			10,000 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
145 0604822A	General Fund Enterprise Business System (GFEBs)	05	21,201				21,201	U
146 0604823A	Firefinder	05	20,008				20,008	U
147 0604827A	Soldier Systems - Warrior Dem/Val	05	6,534				6,534	U
148 0604852A	Suite of Survivability Enhancement Systems - EMD	05	82,459				82,459	U
149 0604854A	Artillery Systems - EMD	05	11,611				11,611	U
150 0605013A	Information Technology Development	05	142,678				142,678	U
151 0605018A	Integrated Personnel and Pay System-Army (IPPS-A)	05	115,286				115,286	U
152 0605028A	Armored Multi-Purpose Vehicle (AMPV)	05	96,594				96,594	U
153 0605029A	Integrated Ground Security Surveillance Response Capability (IGSSR-C)	05						U
154 0605030A	Joint Tactical Network Center (JTNC)	05	16,264				16,264	U
155 0605031A	Joint Tactical Network (JTN)	05	31,696				31,696	U
156 0605032A	TRACTOR TIRE	05						U
157 0605033A	Ground-Based Operational Surveillance System - Expeditionary (GBOSS-E)	05	5,976				5,976	U
158 0605034A	Tactical Security System (TSS)	05						U
159 0605035A	Common Infrared Countermeasures (CIRCM)	05	23,321		2,300	2,300	25,621	U
160 0605036A	Combating Weapons of Mass Destruction (CWMD)	05						U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

xxxiv

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No Number	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
161 0605038A	Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV) Sensor Suite	05	14,517	6,054			6,054 U
162 0605041A	Defensive CYBER Tool Development	05	33,796	50,662			50,662 U
163 0605042A	Tactical Network Radio Systems (Low-Tier)	05	18,761	28,404			28,404 U
164 0605047A	Contract Writing System	05	40,341	17,082			17,082 U
165 0605049A	Missile Warning System Modernization (MWSM)	05	7,321	1,539			1,539 U
166 0605051A	Aircraft Survivability Development	05	56,067	55,057		77,420	132,477 U
167 0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	92,674	194,366			194,366 U
168 0605053A	Ground Robotics	05	65,311	26,104			26,104 U
169 0605054A	Emerging Technology Initiatives	05	46,451	37,696			37,696 U
170 0605145A	Medical Products and Support Systems Development	05					0 U
171 0605203A	Army System Development & Demonstration	05	15,379	164,883		19,527	184,410 U
172 0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05					0 U
173 0605380A	AMF Joint Tactical Radio System (JTRS)	05					0 U
174 0605450A	Joint Air-to-Ground Missile (JAGM)	05	12,440	6,585			6,585 U
175 0605457A	Army Integrated Air and Missile Defense (AIAMD)	05	318,850	208,638			208,638 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

XXXV

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	Se c
161 0605038A	Nuclear Biological Chemical Reconnaissance Vehicle (NBCRV) Sensor Suite	05	4,846				4,846	U
162 0605041A	Defensive CYBER Tool Development	05	28,544				28,544	U
163 0605042A	Tactical Network Radio Systems (Low-Tier)	05	28,178				28,178	U
164 0605047A	Contract Writing System	05	22,860				22,860	U
165 0605049A	Missile Warning System Modernization (MWSM)	05						U
166 0605051A	Aircraft Survivability Development	05	35,893	64,625	64,625	64,625	100,518	U
167 0605052A	Indirect Fire Protection Capability Inc 2 - Block 1	05	235,770				235,770	U
168 0605053A	Ground Robotics	05	13,710				13,710	U
169 0605054A	Emerging Technology Initiatives	05	294,739				294,739	U
170 0605145A	Medical Products and Support Systems Development	05	954				954	U
171 0605203A	Army System Development & Demonstration	05	150,201				150,201	U
172 0605205A	Small Unmanned Aerial Vehicle (SUAV) (6.5)	05	5,999				5,999	U
173 0605380A	AMF Joint Tactical Radio System (JTRS)	05						U
174 0605450A	Joint Air-to-Ground Missile (JAGM)	05	8,891				8,891	U
175 0605457A	Army Integrated Air and Missile Defense (AIAMD)	05	193,929				193,929	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

xxxvi

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
176 0605625A	Manned Ground Vehicle	05		205,620			205,620 U
177 0605766A	National Capabilities Integration (MIP)	05	12,340	7,835			7,835 U
178 0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	05		7,232			7,232 U
179 0605830A	Aviation Ground Support Equipment	05	7,616	1,664			1,664 U
180 0303032A	TROJAN - RH12	05	5,721	3,936			3,936 U
181 0303267A	Auctioned Spectrum Relocation Fund	05	18,381				U
182 0303367A	Spectrum Access Research and Development	05	285				U
183 0304270A	Electronic Warfare Development	05	8,922	15,232		3,200	18,432 U
184 1205117A	Tractor Bears	05	23,170				U
	System Development & Demonstration		3,119,552	2,989,779		100,147	3,089,926
185 0604256A	Threat Simulator Development	06	46,732	42,117			42,117 U
186 0604258A	Target Systems Development	06	31,286	28,327			28,327 U
187 0604759A	Major T&E Investment	06	79,214	146,565			146,565 U
188 0605103A	Rand Arroyo Center	06	19,071	13,113			13,113 U
189 0605301A	Army Kwajalein Atoll	06	237,414	238,691			238,691 U
190 0605326A	Concepts Experimentation Program	06	30,667	36,922			36,922 U
191 0605502A	Small Business Innovative Research	06	303,386				U
192 0605601A	Army Test Ranges and Facilities	06	311,027	336,468			336,468 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U C
176 0605625A	Manned Ground Vehicle	05	327,732				327,732	U
177 0605766A	National Capabilities Integration (MIP)	05	7,670				7,670	U
178 0605812A	Joint Light Tactical Vehicle (JLTV) Engineering and Manufacturing Development Ph	05	1,742				1,742	U
179 0605830A	Aviation Ground Support Equipment	05	1,467				1,467	U
180 0303032A	TROJAN - RH12	05	3,451				3,451	U
181 0303267A	Auctioned Spectrum Relocation Fund	05						U
182 0303367A	Spectrum Access Research and Development	05						U
183 0304270A	Electronic Warfare Development	05	55,855		3,900	3,900	59,755	U
184 1205117A	Tractor Bears	05						U
	System Development & Demonstration		3,199,798		97,825	97,825	3,297,623	
185 0604256A	Threat Simulator Development	06	14,515				14,515	U
186 0604258A	Target Systems Development	06	10,668				10,668	U
187 0604759A	Major T&E Investment	06	106,270				106,270	U
188 0605103A	Rand Arroyo Center	06	13,481				13,481	U
189 0605301A	Army Kwajalein Atoll	06	231,824				231,824	U
190 0605326A	Concepts Experimentation Program	06	54,898				54,898	U
191 0605502A	Small Business Innovative Research	06						U
192 0605601A	Army Test Ranges and Facilities	06	350,359				350,359	U

UNCLASSIFIED

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted (Base+Emergency OCO)
193 0605602A	Army Technical Test Instrumentation and Targets	06	82,617	61,974			61,974 U
194 0605604A	Survivability/Lethality Analysis	06	39,886	35,075			35,075 U
195 0605606A	Aircraft Certification	06	3,796	3,461			3,461 U
196 0605702A	Meteorological Support to RDT&E Activities	06	9,495	6,233			6,233 U
197 0605706A	Matériel Systems Analysis	06	21,043	21,342			21,342 U
198 0605709A	Exploitation of Foreign Items	06	15,026	11,168			11,168 U
199 0605712A	Support of Operational Testing	06	52,139	52,723			52,723 U
200 0605716A	Army Evaluation Center	06	56,532	60,815			60,815 U
201 0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	2,708	2,527			2,527 U
202 0605801A	Programwide Activities	06	60,218	58,175			58,175 U
203 0605803A	Technical Information Activities	06	28,237	30,060			30,060 U
204 0605805A	Munitions Standardization, Effectiveness and Safety	06	66,678	54,458			54,458 U
205 0605857A	Environmental Quality Technology Mgmt Support	06	3,138	4,681			4,681 U
206 0605898A	Army Direct Report Headquarters - R&D - MHA	06	53,526	53,820			53,820 U
207 0606001A	Military Ground-Based CREW Technology	06	4,241	2,141			2,141 U
208 0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	60,808	62,069			62,069 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	S e c
193 0605602A	Army Technical Test Instrumentation and Targets	06	48,475				48,475	U
194 0605604A	Survivability/Lethality Analysis	06	36,001				36,001	U
195 0605606A	Aircraft Certification	06	2,736				2,736	U
196 0605702A	Meteorological Support to RDT&E Activities	06	6,488				6,488	U
197 0605706A	Materiel Systems Analysis	06	21,859				21,859	U
198 0605709A	Exploitation of Foreign Items	06	7,936		1,000	1,000	8,936	U
199 0605712A	Support of Operational Testing	06	54,470				54,470	U
200 0605716A	Army Evaluation Center	06	63,141				63,141	U
201 0605718A	Army Modeling & Sim X-Cmd Collaboration & Integ	06	2,572				2,572	U
202 0605801A	Programwide Activities	06	87,472				87,472	U
203 0605803A	Technical Information Activities	06	26,244				26,244	U
204 0605805A	Munitions Standardization, Effectiveness and Safety	06	40,133				40,133	U
205 0605857A	Environmental Quality Technology Mgmt Support	06	1,780				1,780	U
206 0605898A	Army Direct Report Headquarters - R&D - MHA	06	55,045				55,045	U
207 0606001A	Military Ground-Based CREW Technology	06						U
208 0606002A	Ronald Reagan Ballistic Missile Defense Test Site	06	71,306				71,306	U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO)
209 0606003A	CounterIntel and Human Intel Modernization	06	2,636	1,050		1,875	2,925 U
210 0606105A	Medical Program-Wide Activities	06					U
211 0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	88,300	4,500			4,500 U
212 0909980A	Judgment Fund Reimbursement	06	122				U
213 0909999A	Financing for Cancelled Account Adjustments	06	236				U
	Management Support		1,710,179	1,368,475		1,875	1,370,350
214 0603778A	MLRS Product Improvement Program	07	6,574	14,615			14,615 U
215 0603813A	TRACTOR PULL	07	4,067				U
216 0605024A	Anti-Tamper Technology Support	07	7,159	8,491			8,491 U
217 0607131A	Weapons and Munitions Product Improvement Programs	07	17,992	15,645			15,645 U
218 0607133A	TRACTOR SMOKE	07	12,357				U
219 0607134A	Long Range Precision Fires (LRPF)	07	152,573	156,682			156,682 U
220 0607135A	Apache Product Improvement Program	07	22,914				U
221 0607136A	Blackhawk Product Improvement Program	07	33,906	23,039			23,039 U
222 0607137A	Chinook Product Improvement Program	07	139,003	171,471			171,471 U
223 0607138A	Fixed Wing Product Improvement Program	07	2,146				U
224 0607139A	Improved Turbine Engine Program	07	173,766	206,434			206,434 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U C
209 0606003A	CounterIntel and Human Intel Modernization	06	1,063		4,137	4,137	5,200	U
210 0606105A	Medical Program-Wide Activities	06	19,891				19,891	U
211 0606942A	Assessments and Evaluations Cyber Vulnerabilities	06	4,496				4,496	U
212 0909980A	Judgment Fund Reimbursement	06						U
213 0909999A	Financing for Cancelled Account Adjustments	06						U
	Management Support		1,333,123		5,137	5,137	1,338,260	
214 0603778A	MLRS Product Improvement Program	07	10,157				10,157	U
215 0603813A	TRACTOR PULL	07						U
216 0605024A	Anti-Tamper Technology Support	07	8,682				8,682	U
217 0607131A	Weapons and Munitions Product Improvement Programs	07	20,409				20,409	U
218 0607133A	TRACTOR SMOKE	07						U
219 0607134A	Long Range Precision Fires (LRPF)	07	122,733				122,733	U
220 0607135A	Apache Product Improvement Program	07						U
221 0607136A	Blackhawk Product Improvement Program	07	11,236				11,236	U
222 0607137A	Chinook Product Improvement Program	07	46,091				46,091	U
223 0607138A	Fixed Wing Product Improvement Program	07						U
224 0607139A	Improved Turbine Engine Program	07	249,257				249,257	U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted S (Base+Emerg+ OCO) C
225 0607142A	Aviation Rocket System Product Improvement and Development	07	35,211	1,927			1,927 U
226 0607143A	Unmanned Aircraft System Universal Products	07	36,488	18,132			18,132 U
227 0607145A	Apache Future Development	07		5,448			5,448 U
228 0607150A	Intel Cyber Development	07					U
229 0607312A	Army Operational Systems Development	07		45,026			45,026 U
230 0607665A	Family of Biometrics	07	2,320	1,702			1,702 U
231 0607865A	Patriot Product Improvement	07	72,895	87,430			87,430 U
232 0203728A	Joint Automated Deep Operation Coordination System (JADOCs)	07	29,782	47,398			47,398 U
233 0203735A	Combat Vehicle Improvement Programs	07	321,513	277,633			277,633 U
234 0203743A	155mm Self-Propelled Howitzer Improvements	07	35,681	199,274			199,274 U
235 0203744A	Aircraft Modifications/Product Improvement Programs	07	13,629	9,278			9,278 U
236 0203752A	Aircraft Engine Component Improvement Program	07	146	144			144 U
237 0203758A	Digitization	07	6,077	5,270			5,270 U
238 0203801A	Missile/Air Defense Product Improvement Program	07	3,588	1,287			1,287 U
239 0203802A	Other Missile Product Improvement Programs	07	4,760				U
240 0203808A	TRACTOR CARD	07	34,050				U

R-1211PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Line No	Program Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U
225	0607142A	Aviation Rocket System Product Improvement and Development	07	17,155				17,155	U
226	0607143A	Unmanned Aircraft System Universal Products	07	7,743				7,743	U
227	0607145A	Apache Future Development	07	77,177				77,177	U
228	0607150A	Intel Cyber Development	07	14,652				14,652	U
229	0607312A	Army Operational Systems Development	07	35,851				35,851	U
230	0607665A	Family of Biometrics	07	1,324				1,324	U
231	0607865A	Patriot Product Improvement	07	187,840				187,840	U
232	0203728A	Joint Automated Deep Operation Coordination System (JADOCs)	07	44,691				44,691	U
233	0203735A	Combat Vehicle Improvement Programs	07	268,919				268,919	U
234	0203743A	155mm Self-Propelled Howitzer Improvements	07	427,254				427,254	U
235	0203744A	Aircraft Modifications/Product Improvement Programs	07	11,688				11,688	U
236	0203752A	Aircraft Engine Component Improvement Program	07	80				80	U
237	0203758A	Digitization	07	4,516				4,516	U
238	0203801A	Missile/Air Defense Product Improvement Program	07	1,288				1,288	U
239	0203802A	Other Missile Product Improvement Programs	07	79,424		2,300	2,300	81,724	U
240	0203808A	TRACTOR CARD	07						U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted (Base+Emerg+ OCO)
241 0205402A	Integrated Base Defense - Operational System Dev	07	8,000				U
242 0205410A	Materials Handling Equipment	07	1,132				U
243 0205412A	Environmental Quality Technology - Operational System Dev	07	249	10,000			10,000 U
244 0205456A	Lower Tier Air and Missile Defense (AMD) System	07	74,295	97,746			97,746 U
245 0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	113,471	117,294			117,294 U
246 0208053A	Joint Tactical Ground System	07					U
248 0303028A	Security and Intelligence Activities	07	40,002	13,845		12,904	26,749 U
249 0303140A	Information Systems Security Program	07	40,148	25,710			25,710 U
250 0303141A	Global Combat Support System	07	51,415	60,076			60,076 U
251 0303142A	SATCOM Ground Environment (SPACE)	07					U
252 0303150A	WWMCCS/Global Command and Control System	07	1,966	2,073			2,073 U
255 0305172A	Combined Advanced Applications	07	1,500				U
256 0305179A	Integrated Broadcast Service (IBS)	07	450	459			459 U
257 0305204A	Tactical Unmanned Aerial Vehicles	07	6,000	5,097		17,050	22,147 U
258 0305206A	Airborne Reconnaissance Systems	07	26,416	11,177		2,000	13,177 U
259 0305208A	Distributed Common Ground/Surface Systems	07	27,109	28,821			28,821 U
260 0305219A	MQ-1C Gray Eagle UAS	07		5,000			5,000 U

R-121PB: FY 2021 President's Budget (Published Version), as of January 17, 2020 at 11:58:58

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	U C
241 0205402A	Integrated Base Defense - Operational System Dev	07						U
242 0205410A	Materials Handling Equipment	07						U
243 0205412A	Environmental Quality Technology - Operational System Dev	07	259				259	U
244 0205456A	Lower Tier Air and Missile Defense (AMD) System	07	166				166	U
245 0205778A	Guided Multiple-Launch Rocket System (GMLRS)	07	75,575				75,575	U
246 0208053A	Joint Tactical Ground System	07	9,510				9,510	U
248 0303028A	Security and Intelligence Activities	07		23,367		23,367	23,367	U
249 0303140A	Information Systems Security Program	07	29,270				29,270	U
250 0303141A	Global Combat Support System	07	86,908				86,908	U
251 0303142A	SATCOM Ground Environment (SPACE)	07	18,684				18,684	U
252 0303150A	WWMCCS/Global Command and Control System	07						U
255 0305172A	Combined Advanced Applications	07						U
256 0305179A	Integrated Broadcast Service (IBS)	07	467				467	U
257 0305204A	Tactical Unmanned Aerial Vehicles	07	4,051		34,100	34,100	38,151	U
258 0305206A	Airborne Reconnaissance Systems	07	13,283		15,575	15,575	28,858	U
259 0305208A	Distributed Common Ground/Surface Systems	07	47,204				47,204	U
260 0305219A	MQ-1C Gray Eagle UAS	07						U

Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2019 (Base + OCO)	FY 2020 Base Enacted	FY 2020 Emergency	FY 2020 OCO Enacted	FY 2020 Total Enacted (Base+Emerg+ OCO)	
261	0305232A RQ-11 UAV	07	6,180	3,218			3,218	U
262	0305233A RQ-7 UAV	07	17,863	7,817			7,817	U
263	0307665A Biometrics Enabled Intelligence	07	6,524	2,000		2,214	4,214	U
264	0708045A End Item Industrial Preparedness Activities	07	106,766	108,348			108,348	U
265	1203142A SATCOM Ground Environment (SPACE)	07	9,927	34,169			34,169	U
266	1208053A Joint Tactical Ground System	07	7,400	7,677			7,677	U
9999	9999999999 Classified Programs		5,955	7,273			7,273	U
	Operational Systems Development		1,721,365	1,844,126		34,168	1,878,294	U
267	0608041A Defensive CYBER - Software Prototype Development	08						U
	Software and Digital Technology Pilot Program							
Total Research, Development, Test & Eval, Army			11,371,268	12,543,435		147,304	12,690,739	

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Department of the Army
 FY 2021 President's Budget
 Exhibit R-1 FY 2021 President's Budget
 Total Obligational Authority
 (Dollars in Thousands)

17 Jan 2020

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

Program Line Element No	Item	Act	FY 2021 Base	FY 2021 OCO for Base Requirements	FY 2021 OCO for Direct War and Enduring Costs	FY 2021 Total OCO	FY 2021 Total (Base + OCO)	Se c
261	0305232A RQ-11 UAV	07						U
262	0305233A RQ-7 UAV	07						U
263	0307665A Biometrics Enabled Intelligence	07						U
264	0708045A End Item Industrial Preparedness Activities	07	61,012				61,012	U
265	1203142A SATCOM Ground Environment (SPACE)	07						U
266	1208053A Joint Tactical Ground System	07						U
9999	9999999999 Classified Programs		3,983				3,983	U
	Operational Systems Development		1,998,539		75,342	75,342	2,073,881	
267	0608041A Defensive CYBER - Software Prototype Development	08	46,445				46,445	U
	Software and Digital Technology Pilot Program		46,445				46,445	
Total Research, Development, Test & Eval, Army			12,587,343		182,824	182,824	12,770,167	

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Army • Budget Estimates FY 2021 • 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
43	03	0603001A	Warfighter Advanced Technology.....	1
44	03	0603002A	Medical Advanced Technology.....	15
45	03	0603003A	Aviation Advanced Technology.....	76
46	03	0603004A	Weapons and Munitions Advanced Technology.....	87
47	03	0603005A	Combat Vehicle and Automotive Advanced Technology.....	99
48	03	0603006A	Space Application Advanced Technology.....	114
49	03	0603007A	Manpower, Personnel and Training Advanced Technology.....	119
50	03	0603009A	TRACTOR HIKE.....	123
51	03	0603015A	Next Generation Training & Simulation Systems.....	126
52	03	0603115A	Medical Development.....	133
53	03	0603117A	Army Advanced Technology Development.....	140
54	03	0603118A	Soldier Lethality Advanced Technology.....	141
55	03	0603119A	Ground Advanced Technology.....	188
56	03	0603125A	Combating Terrorism - Technology Development.....	209
57	03	0603130A	TRACTOR NAIL.....	214
58	03	0603131A	TRACTOR EGGS.....	215

UNCLASSIFIED

UNCLASSIFIED

Army • Budget Estimates FY 2021 • RDT&E Program

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

Line #	Budget Activity	Program Element Number	Program Element Title	Page
59	03	0603134A	Counter Improvised-Threat Simulation.....	216
60	03	0603270A	Electronic Warfare Technology.....	221
61	03	0603313A	Missile and Rocket Advanced Technology.....	230
62	03	0603322A	TRACTOR CAGE.....	239
63	03	0603457A	C3I Cyber Advanced Development.....	240
64	03	0603461A	High Performance Computing Modernization Program.....	253
65	03	0603462A	Next Generation Combat Vehicle Advanced Technology.....	262
66	03	0603463A	Network C3I Advanced Technology.....	332
67	03	0603464A	Long Range Precision Fires Advanced Technology.....	414
68	03	0603465A	Future Vertical Lift Advanced Technology.....	438
69	03	0603466A	Air and Missile Defense Advanced Technology.....	490
70	03	0603606A	Landmine Warfare and Barrier Advanced Technology.....	506
71	03	0603607A	Joint Service Small Arms Program.....	511
72	03	0603710A	Night Vision Advanced Technology.....	516
73	03	0603728A	Environmental Quality Technology Demonstrations.....	523
74	03	0603734A	Military Engineering Advanced Technology.....	530
75	03	0603772A	Advanced Tactical Computer Science and Sensor Technology.....	539
76	03	0603794A	C3 Advanced Technology.....	546

UNCLASSIFIED

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Army • Budget Estimates FY 2021 • RDT&E Program

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

Line #	Budget Activity	Program Element Number	Program Element Title	Page
77	03	0603920A	Humanitarian Demining.....	553

UNCLASSIFIED

UNCLASSIFIED

Army • Budget Estimates FY 2021 • RDT&E Program

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

Program Element Title	Program Element Number	Line #	BA	Page
Advanced Tactical Computer Science and Sensor Technology	0603772A	75	03.....	539
Air and Missile Defense Advanced Technology	0603466A	69	03.....	490
Army Advanced Technology Development	0603117A	53	03.....	140
Aviation Advanced Technology	0603003A	45	03.....	76
C3 Advanced Technology	0603794A	76	03.....	546
C3I Cyber Advanced Development	0603457A	63	03.....	240
Combat Vehicle and Automotive Advanced Technology	0603005A	47	03.....	99
Combating Terrorism - Technology Development	0603125A	56	03.....	209
Counter Improvised-Threat Simulation	0603134A	59	03.....	216
Electronic Warfare Technology	0603270A	60	03.....	221
Environmental Quality Technology Demonstrations	0603728A	73	03.....	523
Future Vertical Lift Advanced Technology	0603465A	68	03.....	438
Ground Advanced Technology	0603119A	55	03.....	188
High Performance Computing Modernization Program	0603461A	64	03.....	253
Humanitarian Demining	0603920A	77	03.....	553
Joint Service Small Arms Program	0603607A	71	03.....	511
Landmine Warfare and Barrier Advanced Technology	0603606A	70	03.....	506

UNCLASSIFIED

UNCLASSIFIED

Army • Budget Estimates FY 2021 • RDT&E Program

Program Element Title	Program Element Number	Line #	BA	Page
Long Range Precision Fires Advanced Technology	0603464A	67	03.....	414
Manpower, Personnel and Training Advanced Technology	0603007A	49	03.....	119
Medical Advanced Technology	0603002A	44	03.....	15
Medical Development	0603115A	52	03.....	133
Military Engineering Advanced Technology	0603734A	74	03.....	530
Missile and Rocket Advanced Technology	0603313A	61	03.....	230
Network C3I Advanced Technology	0603463A	66	03.....	332
Next Generation Combat Vehicle Advanced Technology	0603462A	65	03.....	262
Next Generation Training & Simulation Systems	0603015A	51	03.....	126
Night Vision Advanced Technology	0603710A	72	03.....	516
Soldier Lethality Advanced Technology	0603118A	54	03.....	141
Space Application Advanced Technology	0603006A	48	03.....	114
TRACTOR CAGE	0603322A	62	03.....	239
TRACTOR EGGS	0603131A	58	03.....	215
TRACTOR HIKE	0603009A	50	03.....	123
TRACTOR NAIL	0603130A	57	03.....	214
Warfighter Advanced Technology	0603001A	43	03.....	1
Weapons and Munitions Advanced Technology	0603004A	46	03.....	87

UNCLASSIFIED

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603001A / Warfighter Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	40.501	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	40.501
242: Airdrop Equipment	-	1.597	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.597
C07: Joint Service Combat Feeding Tech Demo	-	1.219	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.219
FF6: Individual Protection	-	11.175	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.175
J50: Future Warrior Technology Integration	-	21.340	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.340
J52: WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)	-	2.500	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.500
XW6: Small Unit Expeditionary Maneuver	-	2.670	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.670

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PE:
* 0603118A Soldier Lethality Advanced Technology

A. Mission Description and Budget Item Justification

This PE provides Soldiers and Small Combat Units with the most effective personal clothing, equipment, combat rations, shelters, and logistical support items with the least weight and sustainment burden. This PE supports the maturation and demonstration of technologies associated with aerial delivery of personnel and cargo, rapid ammunition/munitions deployability and resupply, combat rations and combat feeding equipment, combat clothing and personal equipment (including protective equipment such as personal armor, helmets, and eyewear), and expeditionary base camps with an emphasis on emerging operating environments and missions that require expeditionary maneuver. The Projects focus on the challenge of integrating clothing and individual equipment on the Soldier to effectively bridge the gap between humans, technology, and equipment design. The Projects in this PE adhere to Tri-Service Agreements on clothing, textiles, and food with coordination provided through the Cross-Service Warfighter Equipment Board, the Soldier as a System Integrated Concepts Development Team, and the Department of Defense (DoD) Combat Feeding Research and Engineering Board.

Work in this PE is related to, and fully coordinated with, PE 0602786A (Warfighter Technology), PE 0602105A (Materials Technology), PE 0602618A (Ballistics Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602787A (Medical Technology), PE 0602716A (Human Factors Engineering Technology), PE 0602308A (Advanced Concepts and Simulation), PE 0603015A (Next Generation Training and Simulation Systems), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), PE 0603710A (Night

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603001A / <i>Warfighter Advanced Technology</i>
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Vision Advanced Technology), PE 0602784A (Military Engineering Technology), PE 0603734A (Military Engineering Advanced Technology), PE 0603125A (Combating Terrorism Technology Development), and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. 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. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	41.795	0.000	0.000	-	0.000
Current President's Budget	40.501	0.000	0.000	-	0.000
Total Adjustments	-1.294	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-1.294	-			

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

Project: J52: *WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)*

Congressional Add: *Non-Centroidal Helmets*

	FY 2019	FY 2020
	2.500	-
Congressional Add Subtotals for Project: J52	2.500	-
Congressional Add Totals for all Projects	2.500	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) 242 / <i>Airdrop Equipment</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>242: Airdrop Equipment</i>	-	1.597	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.597

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project BE5 Personnel & Airdrop Safety Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates equipment and innovative techniques for precision aerial delivery of cargo and personnel. Aerial delivery is a key capability for rapid force projection and global precision delivery. 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 which integrate 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, reduction of Soldier load, and initial delivery of key expeditionary base camp assets. Demonstrated technologies transition to Product Manager (PM) Force Sustainment Systems (PM FSS), PM-Soldier Clothing and Individual Equipment (PM SCIE) as well as other Army PMs.

Work in this Project is fully coordinated with PE 0602786A (Warfighter Technology) and supports Anti-Access/Area Denial (A2/AD) and manned-unmanned teaming (MUM-T) operational concepts by demonstrating precision aerial delivery and airdrop from non-traditional platforms.

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

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

	FY 2019	FY 2020	FY 2021
Title: Airdrop/Aerial Delivery	1.597	-	-
Description: This effort matures and demonstrates parachute materials and designs, precision guidance and navigation software and hardware, and tracking sensors and safety devices to increase the accuracy of delivering cargo to remote locations and/or complex terrains. This effort also provides technologies that increase safety during personnel insertions into theaters of operation. This work further evolves breakthroughs from PE 0602786A (Warfighter Technology) / Project 283 (Airdrop Adv Tech) and is coordinated with PE 0602786A (Warfighter Technology) / Project VT4 (Expeditionary Mobile Base Camp Technology). This effort supports capability demonstrations for the Army Top Challenge of easing overburdened Soldiers in small units through the use of			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) 242 / <i>Airdrop Equipment</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
tactical aerial resupply technologies, and supporting A2/AD and MUM-T operational concepts by demonstrating airdrop from non-traditional platforms.			
Accomplishments/Planned Programs Subtotals	1.597	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) C07 / <i>Joint Service Combat Feeding Tech Demo</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>C07: Joint Service Combat Feeding Tech Demo</i>	-	1.219	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.219

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project BE2 Joint Service Combat Feeding Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies for military combat feeding systems and combat rations. Areas of emphasis include: enhanced nutrient composition to maximize cognitive and physical performance on the battlefield; cutting edge food stabilization and preservation techniques that increase the variety and quality of rations used by the Joint Services; novel ration packaging solutions to minimize degradation of combat rations during storage; field portable biosensors for food-borne pathogen detection and identification as well as predictive modeling tools to protect the Warfighter from food-borne illnesses. This Project demonstrates combat feeding equipment with reduced logistics (in component parts, weight, volume, fuel, and water) and labor requirements, while improving the quality of food service. The Project, a Department of Defense (DoD) program for which the Army has Executive Agent responsibility, provides technology development for Joint Service Combat Feeding. The DoD Combat Feeding Research and Engineering Board provides oversight for this project. Demonstrated field feeding equipment is transitioned to Product Manager Force Sustainment Systems (PM FSS), Product Manager Combat Support Equipment (PM CSE), Naval Sea Systems Command (NAVSEA)/Naval Supply Systems Command (NAVSUP), and/or United States Air Force Basic Expeditionary Airfield Resources (BEAR) Program Office. Demonstrated ration technologies are transitioned to the Combat Feeding Directorate for Advanced Component Development & Prototypes under PE 0603747A (Soldier Support and Survivability).

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

Work in this Project complements and is fully coordinated with PE 0602787A (Medical Technology) and PE 0602786A (Warfighter Technology).

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

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

	FY 2019	FY 2020	FY 2021
Title: Joint Service Combat Feeding Technical Demonstration	1.219	-	-
Description: This effort matures and demonstrates novel nutritional biochemistry, food processing, and packaging technologies to enhance nutrition, improve food stabilization, and optimize ration packaging to support Warfighter physical and cognitive performance on the battlefield. This effort will demonstrate technologies in support of the Defense Health Agency Veterinary Services (DHA VS) to improve field detection and identification capabilities of chemical and biological threats in foods. This effort provides new threat detection tools and sensors for food inspectors. This effort also demonstrates equipment and energy			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) C07 / <i>Joint Service Combat Feeding Tech Demo</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
technologies to expand the capability and reduce the logistics footprint of field feeding systems. This work further evolves breakthroughs from PE 0602786A (Warfighter Technology) / Project H99 (Joint Service Combat Feeding Technology) and is coordinated with PE 0602787A (Medical Technology) / Project 869 (Warfighter Health Prot & Perf Stnds).			
Accomplishments/Planned Programs Subtotals	1.219	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>				Project (Number/Name) FF6 / <i>Individual Protection</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
FF6: <i>Individual Protection</i>	-	11.175	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.175

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project AY9 Body Armor & Integrated Headborne Advanced Tech
 * Project AZ6 Soldier Signature Management Advanced Technology
 * Project AZ8 Soldier Squad Small Arms Armaments Adv Tech
 * Project BB3 Dismounted Soldier Survivability Equip/Tech Integ

A. Mission Description and Budget Item Justification

This Project matures, demonstrates, and integrates Soldier protective clothing and equipment required to enhance Soldier survivability from multiple battlefield threats, impact unit readiness, and potentially debilitate Soldiers. 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, antimicrobial, etc.), and Soldier system components and system limitations (e.g. size, weight, and bulk). This effort includes the demonstration and validation of integrated technologies, novel subsystems/systems, and test methods related to the development of personnel armor, helmets, hearing protection, eyewear, uniforms, hand-wear, footwear, and other clothing and individual equipment items. Efforts apply human systems integration principles and practices to protective equipment designs to advance the understanding of trade-offs between protection, lethality and mobility.

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 realignments to this Project are due to financial restructuring in support of Army Modernization Priorities.

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

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

Title: Soldier/Small Unit Multi-Threat Protection	FY 2019	FY 2020	FY 2021
Description: This effort focuses on maturing and demonstrating multifunctional protective component materials, sub-systems, protection technologies, and test methodologies that have the potential to significantly increase protection afforded by Soldier clothing and individual protective equipment. This effort also focuses on the maturation and demonstration of ballistic, blast, and integrated protection technologies that support tradeoff optimization in component design. Work includes small arms and fragmentation protection, flame and thermal, environmental, and multispectral concealment capabilities as well as novel hydration and water purification technologies for the individual Soldier. This work is fully coordinated with PE 0602786A (Warfighter Technology) / Project H98 (Clothing & Equipm Tech), PE 0602716A (Human Factors Engineering Technology) / Project H70	3.775	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) FF6 / <i>Individual Protection</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
(Human Fact Eng Sys Dev), and PE 0602705A (Electronics and Electronic Devices) / Project H94 (Elec & Electronic Dev). Demonstrated technologies transition to various Program Executive Office (PEO) Soldier Product Managers. This effort supports Force Protection capability demonstrations for Soldiers and Small Units.			
Title: Soldier Ballistic and Blast Protection Description: This effort focuses on maturing and demonstrating ballistic and blast personal protection capabilities worn by the individual Soldier and validating advanced test methods of personal protective equipment against small arms, fragmentation and blast threats. These developmental efforts focus on the objective of significantly increase the survivability afforded by Soldier individual protective equipment by increasing sub-system and system material performance against intended threats, reduce sub-system and system weight and inform future requirements linking threat lethality to Soldier survivability. This work is fully coordinated with PE 0602786A (Warfighter Technology) / Project H98 (Clothing & Equipm Tech), PE 0602716A (Human Factors Engineering Technology) / Project H70 (Human Fact Eng Sys Dev), and PE 0602705A (Electronics and Electronic Devices) / Project H94 (Elec & Electronic Dev). Demonstrated technologies transition to various PEO Soldier Product Managers. This effort supports Force Protection capability demonstrations for Soldiers and Small Units.	7.400	-	-
Accomplishments/Planned Programs Subtotals	11.175	-	-

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>				Project (Number/Name) J50 / <i>Future Warrior Technology Integration</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>J50: Future Warrior Technology Integration</i>	-	21.340	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.340

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project BB6 Physical Augmentation: Adv Tech for Field Demo
 * Project BB8 Soldier Centric Advanced Technology
 * Project BC1 Human Performance Adv Tech for Mobility & Lethality
 * Project BD7 Soldier Sys Interfaces/Integration-Sensor Adv Tech
 * Project BD9 Soldier & Sm Unit Tactical Energy Adv Tech

A. Mission Description and Budget Item Justification

This Project matures, demonstrates, and integrates lightweight and multifunctional materials and components to provide the Soldier and small units with the most effective protection and mobility systems. This Project also invests in understanding the trade-offs of integrating state-of-the-art technology with Soldiers' personal protection, electronics connectivity, power and energy, user interfaces and display content, and other mission specific equipment that seeks to reduce physical weight, cognitive burden, and sustainment needs of the small unit. This Project develops, matures, and maintains a Soldier Systems Engineering Architecture (SSEA) framework that represents human factors consideration in development of major Army platforms. Efforts in this Project focus on integrating and demonstrating system-level personal protection, durable Soldier protective clothing and individual equipment, environmental threats, and power management solutions. In addition, special focus is on understanding and demonstrating the impacts of physical and cognitive load on Soldier mission performance by implementing strategies to reduce load and/or optimize loads to reduce injuries, and the creation of user interfaces that mitigate the impact of increasing technologies and sensors worn and carried by Soldiers. These efforts integrate geographically dispersed laboratory environments to conduct comprehensive assessments and report the technical viability of Soldier system solutions and conducts field demonstrations to obtain relevant feedback for user acceptance and performance validation. This Project also matures and demonstrates mission command and power and energy technologies for the dismounted Soldier and small unit operating in a networked operating environment.

Efforts in this Project support the Under Secretary of Defense for Research and Engineering Science and Technology (S&T) priorities 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 complements and is fully coordinated with Program Element (PE) 0602786A (Warfighter Technology), PE 0602618A (Ballistics Technology), PE 0602105A (Materials Technology), PE 0602787A (Medical Technology), PE 0602716A (Human Factors Engineering Technology), PE 0602308A (Advanced Concepts and Simulation), PE 0603015A (Next Generation Training and Simulation Systems), PE 0602705A (Electronics and Electronic Devices), PE 0603710A (Night Vision Advanced Technology), PE 0602624A (Weapons and Munitions Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), and PE 0603004A (Weapons and Munitions Advanced Technology).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) J50 / <i>Future Warrior Technology Integration</i>

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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Soldier and Small Unit Mission Command/Situational Awareness (SA) and Power and Energy Integration</p> <p>Description: This effort matures and demonstrates mission command and power and energy technologies for the dismounted Soldier and small unit. The goal is to fully support the situational awareness mission information tools and power needs of a dismounted mission in an electronically equipped battlefield. This effort is fully coordinated with PE 0602705A (Electronics and Electronic Devices) / Projects H11 (Tactical And Component Power Technology) and H94 (Elec & Electronic Dev), and PE 0603710A (Night Vision Advanced Technology) / Project K70 (Night Vision Adv Tech).</p>	7.462	-	-
<p>Title: Soldier Interfaces</p> <p>Description: This effort matures and demonstrates low-cognitive workload user interfaces for display and control of dismounted Soldier mission command systems to enhance interactions of Soldiers and systems required to react effectively on the battlefield. Applies human systems engineering principles to develop design guidelines and techniques for integrating Soldiers and complex technical systems by assessing Soldier responses and capabilities in operational contexts. Matures and validates human performance metrics to design/assess systems and user interfaces to ensure that interactions between humans and machines provides effective operation and control to aid Soldier decision-making processes. Technologies, metrics, and tools developed in this effort will transition to PEO Product Managers and Training and Doctrine Command (TRADOC) and be integrated into the SSEA and Systems Integration Laboratory environment.</p>	6.680	-	-
<p>Title: Soldier Sensors and Robotics Architectures</p> <p>Description: This effort builds and matures architectures that link dismounted Soldiers to air and ground robotics platforms. Enables small Soldiers-borne and operated autonomous systems that function as scouts, load carriers, resupply platforms, and/or communication nodes to enable greater reach and expeditionary dismounted maneuver. Applies complex Human Soldier Integration principles to air and ground control and teleoperation for emerging robotic vehicles and sensors display content. Integrates reconnaissance and surveillance sensors and robotics with Nett Warrior system. Technologies, metrics, and tools developed in this effort will transition to PEO Product Managers and TRADOC and be integrated into the Soldier Systems architecture and Systems Integration Laboratory environment.</p>	7.182	-	-
<p>Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p> <p>Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p>	0.016	-	-
Accomplishments/Planned Programs Subtotals	21.340	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) J50 / <i>Future Warrior Technology Integration</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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>				Project (Number/Name) J52 / <i>WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
J52: <i>WARFIGHTER ADVANCED TECHNOLOGY INITIATIVES (CA)</i>	-	2.500	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.500

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Warfighter Advanced Technology development.

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

	FY 2019	FY 2020
Congressional Add: Non-Centroidal Helmets	2.500	-
FY 2019 Accomplishments: Non-Centroidal Helmets		
Congressional Adds Subtotals	2.500	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>				Project (Number/Name) <i>XW6 / Small Unit Expeditionary Maneuver</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>XW6: Small Unit Expeditionary Maneuver</i>	-	2.670	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.670

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project BE5 Personnel & Airdrop Safety Advanced Technology

A. Mission Description and Budget Item Justification

This Project funds the maturation, validation and demonstration of innovative technologies which provide maneuver capabilities such as precision aerial delivery of cargo and personnel and expeditionary maneuver platforms to enable and enhance mission command and human performance in response to emerging operational environments that require expeditionary logistics for aggregated and disaggregated Soldiers and units. Technologies that allow dismounted units to move to positions of advantage rapidly, and then to operate for hours, days, weeks without resupply while sustaining a high tempo for periods of up to seven days. Efforts funded in this Project support all Military Services, the Special Operations Command, and the Defense Logistics Agency. Demonstrated technologies transition to a variety of partners, including Product Manager Force Sustainment Systems (PdM-FSS), Product Manager Combat Support Equipment (PM CSE), and/or Naval Sea Systems Command (NAVSEA)/Naval Supply Systems Command (NAVSUP).

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 2019	FY 2020	FY 2021
Title: Small Unit Expeditionary Maneuver	2.670	-	-
Description: This effort optimizes technologies that enable Soldier and Small Unit survivability, mission readiness and effectiveness during highly mobile, dispersed operations that may occur in the absence of conventional logistics support. This effort matures and demonstrates technologies that enhance equipment, materiel, and personnel aerial delivery in an Anti-Access/Area Denial (A2/AD) environment; stabilization techniques and nutrient compositions to maximize the Warfighter's physical and cognitive performance; and technologies to enhance field detection and identification capabilities of chemical and biological threats in foods.			
Accomplishments/Planned Programs Subtotals	2.670	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603001A / <i>Warfighter Advanced Technology</i>	Project (Number/Name) XW6 / <i>Small Unit Expeditionary Maneuver</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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	94.575	83.030	38.896	-	38.896	41.136	38.778	37.247	36.747	0.000	370.409
810: <i>Ind Base Id Vacc&Drug</i>	-	15.359	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	15.359
814: <i>NEUROFIBROMATOSIS (CA)</i>	-	15.000	15.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.000
840: <i>Combat Injury Mgmt</i>	-	17.565	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.565
945: <i>BREAST CANCER STAMP PROCEEDS</i>	-	0.621	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.621
97T: <i>NEUROTOXIN EXPOSURE TREATMENT (CA)</i>	-	16.000	16.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	32.000
ET5: <i>Adv Tech Dev in Clinical & Rehabilitative Medicine</i>	-	7.083	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.083
MG4: <i>Tech Base/Enabling Res in Mil Occup Med Adv Tech</i>	-	0.000	8.144	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.144
MM2: <i>MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)</i>	-	8.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.000
MM3: <i>Warfighter Medical Protection & Performance</i>	-	14.947	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.947
MM5: <i>Tech Base/Enabling Res Combat Cas Care Adv Tech</i>	-	0.000	2.408	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.408
MM7: <i>Enabling Med Cap to Support Dispersed OPS Adv Tech</i>	-	0.000	1.819	3.024	-	3.024	3.881	4.569	5.152	6.162	0.000	24.607
MM9: <i>Tech Base/Enabling Rsrch for Infect Dis Adv Tech</i>	-	0.000	2.976	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.976
MN3: <i>Immediate Cardiopulmonary Stabilization Adv Tech</i>	-	0.000	1.903	2.109	-	2.109	2.047	2.183	2.476	2.476	0.000	13.194

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020		
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								
MN4: Advanced Life Support Advanced Technology	-	0.000	3.801	3.685	-	3.685	4.838	5.509	5.915	5.916	0.000	29.664	
MN5: Next Generation Blood Products Advanced Technology	-	0.000	5.964	6.854	-	6.854	6.964	7.292	7.625	7.627	0.000	42.326	
MN6: Blast & Head Impact Exposure Monitor Advanced Tech	-	0.000	1.412	1.949	-	1.949	1.860	0.749	0.000	0.000	0.000	5.970	
MN7: Musculoskeletal Injury Screening Tool Adv Tech	-	0.000	0.300	3.398	-	3.398	4.298	1.149	0.649	0.749	0.000	10.543	
MN8: Drugs to Prevent and Treat Malaria Advanced Tech	-	0.000	2.146	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.146	
MN9: Far Forward Behavioral Health Care Advanced Tech	-	0.000	0.266	1.121	-	1.121	1.029	0.000	0.000	0.000	0.000	2.416	
MO2: Traumatic Brain Injury (TBI) Treatment Adv Tech	-	0.000	4.285	4.825	-	4.825	4.875	4.626	1.832	1.832	0.000	22.275	
MO3: Military Occupational Fitness Standards Adv Tech	-	0.000	0.250	0.000	-	0.000	0.000	0.000	0.000	1.050	0.000	1.300	
MO4: Burn Recovery Optimization Advanced Technology	-	0.000	2.084	3.405	-	3.405	2.438	2.714	3.082	3.083	0.000	16.806	
MO7: Improved Bone Repair Advanced Technology	-	0.000	1.539	1.623	-	1.623	1.519	1.666	2.033	2.033	0.000	10.413	
MO8: Expeditionary Performance Nutrition Advanced Techn	-	0.000	0.200	2.141	-	2.141	2.275	2.361	1.907	0.000	0.000	8.884	
MO9: Vaccines to Prevent Dengue Fever Advanced Tech	-	0.000	2.533	2.074	-	2.074	2.357	4.025	4.701	4.701	0.000	20.391	
MP3: Phys Chem Toxicity Assessment Sys Adv Tech	-	0.000	0.000	2.688	-	2.688	2.755	1.935	1.875	1.118	0.000	10.371	

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army Date: February 2020

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*

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.

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.

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.

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.

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	101.442	42.030	47.041	-	47.041
Current President's Budget	94.575	83.030	38.896	-	38.896
Total Adjustments	-6.867	41.000	-8.145	-	-8.145
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	41.000			
• Congressional Directed Transfers	0.621	-			
• Reprogrammings	-5.819	-			
• SBIR/STTR Transfer	-1.669	-			
• Adjustments to Budget Years	-	-	-8.145	-	-8.145

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

	FY 2019	FY 2020
Project: 814: NEUROFIBROMATOSIS (CA)		
Congressional Add: <i>Peer-reviewed Neurofibromatosis Research</i>	15.000	15.000
Congressional Add Subtotals for Project: 814	15.000	15.000
Project: 945: BREAST CANCER STAMP PROCEEDS		
Congressional Add: <i>Breast Cancer Stamp Proceeds</i>	0.621	-
Congressional Add Subtotals for Project: 945	0.621	-
Project: 97T: NEUROTOXIN EXPOSURE TREATMENT (CA)		
Congressional Add: <i>Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research</i>	16.000	16.000
Congressional Add Subtotals for Project: 97T	16.000	16.000
Project: MM2: MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)		
Congressional Add: <i>Peer-reviewed Military Burn Research Program</i>	8.000	10.000
Congressional Add Subtotals for Project: MM2	8.000	10.000
Congressional Add Totals for all Projects	39.621	41.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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*

Change Summary Explanation

Funds reprogrammed out for higher priority Army requirements.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) 810 / <i>Ind Base Id Vacc&Drug</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
810: <i>Ind Base Id Vacc&Drug</i>	-	15.359	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	15.359

Note

In Fiscal Year (FY) 2020 this Project is being realigned to the following Projects within this Program Element (PE):

- * MM9 Tech Base/Enabling Rsrch for Infect Dis Adv Tech
- * MN8 Drugs to Prevent and Treat Malaria Advanced Tech
- * MO9 Vaccines to Prevent Dengue Fever Advanced Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates United States (U.S.) Food and Drug Administration (FDA)-regulated medical countermeasures such as drugs, vaccines, and diagnostic (identification of the nature and cause of a particular disease) systems to naturally occurring infectious diseases that are threats to deployed United States military forces. The focus of the Project is on prevention, diagnosis, and treatment of diseases that can adversely impact military mobilization, deployment, and operational effectiveness. Prior to licensure of a new drug or vaccine to treat or prevent disease, the FDA requires testing in human subjects. Studies 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 study, and third to demonstrate effectiveness in large, diverse human populations. All test results are submitted to the FDA for evaluation to ultimately obtain approval (licensure) for medical use. This Project supports the studies for safety and effectiveness testing on small study groups after which they transition to the next phase of development for completion of expanded safety and initial studies for effectiveness in larger populations. If success is achieved for a product in this Project, the effort will transition into Advanced Development. The Project also supports testing of personal protective measures that can reduce disease transmission from arthropods to include products such as repellents and insecticides, which are regulated by the Environmental Protection Agency (EPA).

Research conducted in this Project focuses on the following four areas:

- (1) Prevention/Treatment of Parasitic (organism living in or on another organism) Diseases
- (2) Bacterial Disease Threats (diseases caused by bacteria)
- (3) Viral Disease Threats (diseases caused by viruses)
- (4) Diagnostic Systems and Vector Identification and Control

Research is conducted in compliance with FDA regulations for medical products for human use and EPA regulations for insect-control products that impact humans or the environment (e.g., repellents and insecticides).

Work is managed by the 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.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) 810 / <i>Ind Base Id Vacc&Drug</i>

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

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

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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Advanced Technology Research on drugs and vaccines against parasitic diseases</p> <p>Description: This effort selects promising anti-parasitic drug candidates for treating malaria and leishmaniasis for testing in humans, and prepares data packages required for FDA approval of testing in humans. Studies have shown that the malaria parasite can become resistant to existing drugs, which makes it necessary to continually develop new and more effective and safe treatments. This effort selects candidate vaccines for various types of malaria, including the severe form of malaria (<i>Plasmodium falciparum</i>) and the less severe but relapsing form (<i>Plasmodium vivax</i>), prepares technical data packages required for FDA approval of testing in humans, and conducts testing of promising malaria vaccine candidates in humans. A malaria vaccine would minimize the progression and impact of drug resistance and eliminate the need to take preventive anti-malarial drugs.</p>	6.010	-	-
<p>Title: Bacterial Disease Threats</p> <p>Description: This effort selects promising candidate vaccines against each of the three main bacterial causes of diarrhea (enterotoxigenic <i>E. coli</i> (ETEC), <i>Campylobacter</i>, and <i>Shigella</i>) that pose significant threat during initial deployments, for testing in human subjects. Data packages are prepared, as required for FDA approval, and testing is conducted in human subjects.</p>	3.635	-	-
<p>Title: Viral Disease Threats</p> <p>Description: This effort progresses the most promising vaccine candidates against dengue fever (a severe debilitating disease caused by a virus and transmitted by a mosquito) and hantavirus (severe viral infection that causes internal bleeding and is contracted from close contact with rodents), conducts FDA-required nonclinical safety and protection testing (laboratory- based) in animals, prepares FDA investigational new drug technical data packages, and conducts clinical testing of candidate vaccines in humans.</p>	5.169	-	-
<p>Title: Diagnostics and Disease Transmission Control</p> <p>Description: This effort provides detailed, scientifically-driven entomological intelligence upon which Command can make informed decisions to maintain force readiness and best protect the deployed Warfighter, in chartered and uncharted theatres on the global stage.</p>	0.545	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) 810 / <i>Ind Base Id Vacc&Drug</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Accomplishments/Planned Programs Subtotals	15.359	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) 814 / <i>NEUROFIBROMATOSIS (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
814: <i>NEUROFIBROMATOSIS (CA)</i>	-	15.000	15.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	30.000

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 2019	FY 2020
Congressional Add: Peer-reviewed Neurofibromatosis Research	15.000	15.000
FY 2019 Accomplishments: Peer-reviewed Neurofibromatosis Research		
FY 2020 Plans: Peer-reviewed Neurofibromatosis Research		
Congressional Adds Subtotals	15.000	15.000

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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>				Project (Number/Name) 840 / <i>Combat Injury Mgmt</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
840: <i>Combat Injury Mgmt</i>	-	17.565	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.565

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM5 Tech Base/Enabling Res Combat Cas Care Adv Tech
 * Project MN3 Immediate Cardiopulmonary Stabilization Adv Tech
 * Project MN4 Advanced Life Support Advanced Technology
 * Project MN5 Next Generation Blood Products Advanced Technology
 * Project MO2 Traumatic Brain Injury (TBI) Treatment Adv Tech
 * Project MO4 Burn Recovery Optimization Advanced Technology
 * Project MO7 Improved Bone Repair Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures, demonstrates, and validates promising medical technologies and new clinical practices for control of severe bleeding, treatment for traumatic brain injury (TBI), resuscitation and stabilization of trauma patients, acute treatment of extremity (arms and legs) and facial injuries, treatment of severe burn wounds, treatment of single and multiple organ failures due to trauma, and predictive indicators and decision aids for life support systems. Emphasis is placed on provision of prolonged field care when evacuation to theater hospitals is delayed.

Research conducted in this Project focuses on combat casualty care in the following four areas:

- (1) Damage Control Resuscitation
- (2) Combat Trauma Therapies
- (3) Traumatic Brain Injury
- (4) Combat Critical Care Engineering

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 Advanced Technology), Project 874 (Medical Advanced 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).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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) 840 / <i>Combat Injury Mgmt</i>
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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 2019	FY 2020	FY 2021
<p>Title: Damage Control Resuscitation</p> <p>Description: This effort supports work required to validate safety and effectiveness of drugs and medical procedures to control or stop bleeding, maintain metabolism (the chemical processes that are required to maintain life), minimize harmful inflammation after major trauma preserving tissue function, and prevent or minimize secondary organ failure (including brain and spinal cord injury).</p>	5.093	-	-
<p>Title: Combat Trauma Therapies</p> <p>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.</p>	5.659	-	-
<p>Title: Traumatic Brain Injury (TBI)</p> <p>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.</p>	3.598	-	-
<p>Title: Combat Critical Care Engineering</p> <p>Description: This effort supports development of diagnostic and therapeutic medical devices, algorithms, software, and data-processing systems for resuscitation, stabilization and life support, and development of improved critical care nursing practices. The aim is to improve care of severely injured or ill casualties during transport and in theater hospitals, and to develop and evaluate technologies to treat vital organ failure caused by traumatic injury.</p>	3.215	-	-
Accomplishments/Planned Programs Subtotals	17.565	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) 945 / <i>BREAST CANCER STAMP PROCEEDS</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>945: BREAST CANCER STAMP PROCEEDS</i>	-	0.621	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.621

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 2019	FY 2020
<i>Congressional Add:</i> Breast Cancer Stamp Proceeds	0.621	-
<i>FY 2019 Accomplishments:</i> Breast Cancer Stamp Proceeds		
Congressional Adds Subtotals	0.621	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) 97T / <i>NEUROTOXIN EXPOSURE TREATMENT (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
97T: <i>NEUROTOXIN EXPOSURE TREATMENT (CA)</i>	-	16.000	16.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	32.000

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 2019	FY 2020
Congressional Add: Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research	16.000	16.000
FY 2019 Accomplishments: Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research		
FY 2020 Plans: Peer-reviewed Neurotoxin Exposure Treatment Parkinson's Research		
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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) ET5 / Adv Tech Dev in Clinical & Rehabilitative Medicine
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>ET5: Adv Tech Dev in Clinical & Rehabilitative Medicine</i>	-	7.083	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.083

Note

This Project ends in FY 2019.

A. Mission Description and Budget Item Justification

This Project supports basic research on experimental models that are developed to support in-depth trauma research studies. This Project includes studies to understand the healing of burned or traumatically injured tissues including eye, bone, nerve, skin, muscle, organs and composite tissues. Such efforts will minimize lost duty time and provide military medical capabilities for post-evacuation restorative and rehabilitative care.

Research conducted in this Project focuses on clinical and rehabilitative medicine.

Work in this Project complements and is fully coordinated with Program Element (PE) 0602787A (Medical Technology).

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 and Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2019	FY 2020	FY 2021
Title: Clinical and Rehabilitative Medicine	7.083	-	-
Description: This effort supports clinical studies to advance treatment and restoration strategies of traumatically-injured tissues, to include skin, nerve, bone and ocular (eye) tissue to ultimately restore function and appearance. Areas of interest for regenerative medicine include healing without scarring, repair of compartment syndrome (muscle and nerve damage following reduced blood flow caused by swelling), replacement skin, facial reconstruction and vision restoration.			
Accomplishments/Planned Programs Subtotals	7.083	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) ET5 / Adv Tech Dev in Clinical & Rehabilitative Medicine

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MG4: Tech Base/Enabling Res in Mil Occup Med Adv Tech	-	0.000	8.144	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.144

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM3 Warfighter Medical Protection & Performance

In FY21 this Project is realigned to:
 PE 0603002A Medical Advanced Technology
 * Project MN7 Musculoskeletal Injury Screening Tool Adv Tech
 * Project MN9 Far Forward Behavioral Health Care Advanced Tech
 * Project MO3 Military Occupational Fitness Standards Adv Tech
 * Project MO8 Expeditionary Performance Nutrition Advanced Techn
 * Project MP3 Phys Chem Toxicity Assessment Sys Adv Tech

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.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

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 2019	FY 2020	FY 2021
<p>Title: Injury Prevention & Reduction</p> <p>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.</p> <p>FY 2020 Plans: Will continue to validate musculoskeletal injury risk models and return-to-duty criteria from data collected from training and theater. Will continue to validate cervical spine injury risk (Head Supported Mass Criteria) criteria that will inform acquisition of new head mounted technologies the Army CFTs are pursuing. Will validate health hazard and medical requirements that will inform Army Aviation fitness for duty and Future Vertical Lift requirements.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MG4 ends in FY20. Funding under this effort is realigned to Project MN6 (Blast & Head Impact Exposure Monitor Advanced Tech) and Project MN7 (Musculoskeletal Injury Screening Tool Adv Tech) in All Settings.</p>	-	0.822	-
<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> <p>FY 2020 Plans: Will evaluate impact of sleep on high operational tempo military performance. Will demonstrate the impact of sleep deprivation and caffeine on operationally relevant complex cognitive processes. Will validate time-restricted spectral analyses of standard polysomnography to predict future behavior and estimate previous sleep quality and quantity. Will evaluate low-current brain stimulation as a cognitive enhancer during periods of sleep loss. Will evaluate psychophysiological indicators of aviator flight performance under workload conditions. Will mature evidence-based algorithmic modelling of aircrew clinical risk. Will evaluate effects of refractive/corrective eye surgery and corneal aberration on contrast sensitivity and flight safety. Will validate dining satisfaction and quality surveys at military dining facilities.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	-	2.502	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Project MG4 (Tech Base/Enabling Res in Mil Occup Med Adv Tech) ends in FY20. Funding under this effort is realigned to Project MO8 (Expeditionary Performance Nutrition Advanced Techn)n in all Settings.				
<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> <p>FY 2020 Plans: Will deliver a decision-making support tool to guide management of suicide-related events in garrison. Will conduct suicide prevention studies to evaluate effectiveness of Internet-delivered brief interventions to improve Service member mental health during transition periods. Will conduct studies to validate easy-to-use evidence-based interventions to improve behavioral health in units by leveraging individual, team and leader-specific behaviors at platoon and company levels. Will evaluate optimally tailored resilience training paradigm incorporating different resiliency readiness profiles matched to tailored resilience training. Will conduct studies to validate cognitive bias modification tools to improve behavioral health and performance. Will conduct clinical field trial of a repurposed Food and Drug Administration (FDA) approved drug for treating sleep problems in a deployed setting. Will deliver biologically based biomarkers for onset of stress disorders and for resilience to stress disorders. Will fund clinical trials evaluating effectiveness of provider tool-kit for behavioral health return to duty (RTD) decision making and clinical trials for brief far-forward interventions for behavioral health problems and accompanying provider training in their use.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MG4 (Tech Base/Enabling Res in Mil Occup Med Adv Tech) ends in FY20. Funding under this effort is realigned to Project MN9 (Far Forward Behavioral Health Care Advanced Tech) and Project MO3 (Military Occupational Fitness Standards Adv Tech).</p>		-	2.773	-
<p>Title: Environmental Health & Protection</p> <p>Description: This effort supports and maturates 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</p>		-	1.870	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>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> <p>FY 2020 Plans: Will provide validated tools that sustain lethality and optimize performance to prevent injuries related to multi-environmental stressors. Will provide a capability to improve performance and thermal comfort in hot environments using cooling technology with skin temperature feedback control. Will provide a capability to increase finger and toe temperatures to improve manual dexterity and performance in cold weather operations. Will provide a capability a measure of cognitive fatigue due to sustained, effortful cognitive activity (workload) from exposure to stress and environmental extremes. Will provide accurate signal detection of toxic environmental hazards and physiological algorithms to detect degraded performance post-chemical exposure. Will provide a capability for mission planning and the documenting of toxic chemical or hazardous material exposures. Will provide risk management criteria for Commanders/leaders to make decisions in real-time regarding the severity of the exposure and the likelihood of clinical manifestation of a toxic exposure.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MG4 (Tech Base/Enabling Res in Mil Occup Med Adv Tech) ends in FY20. Funding under this effort is realigned to Project MP3 (Phys Chem Toxicity Assessment Sys Adv Tech).</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.177	-
Accomplishments/Planned Programs Subtotals	-	8.144	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MM2: <i>MEDICAL ADVANCE TECHNOLOGY INITIATIVES (CA)</i>	-	8.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.000

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 2019	FY 2020
Congressional Add: Peer-reviewed Military Burn Research Program	8.000	10.000
FY 2019 Accomplishments: Peer-reviewed Military Burn Research Program		
FY 2020 Plans: Peer-reviewed Military Burn Research Program		
Congressional Adds Subtotals	8.000	10.000

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

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MM3 / Warfighter Medical Protection & Performance
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MM3: <i>Warfighter Medical Protection & Performance</i>	-	14.947	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.947

Note

In Fiscal Year (FY) 2020 this Project was realigned to:
 Program Element (PE) 0603002A Medical Advanced Technology, Projects:
 * MG4 Tech Base/Enabling Res in Mil Occup Med Adv Tech
 * MN6 Blast & Head Impact Exposure Monitor Advanced Tech
 * MN7 Musculoskeletal Injury Screening Tool Adv Tech
 * MN9 Far Forward Behavioral Health Care Advanced Tech
 * MO3 Military Occupational Fitness Standards Adv Tech
 * MO8 Expeditionary Performance Nutrition Advanced Techn
 * MP3 Phys Chem Toxicity Assessment Sys Adv Tech

A. Mission Description and Budget Item Justification

This Project supports the medical and survivability technology areas of the future force with laboratory validation studies and field demonstrations of biomedical products designed to protect, sustain, and enhance Soldier performance in the face of myriad environmental and physiological (human physical and biochemical functions) stressors and materiel hazards encountered in training and operational environments. This effort focuses on demonstrating and transitioning technologies as well as validated tools associated with biomechanical-based health risks, injury assessment and prediction, Soldier survivability, and performance during continuous operations.

The four main thrust areas are:
 (1) Physiological Health,
 (2) Environmental Protection,
 (3) Injury Prevention and Reduction
 (4) Psychological (mental) Health and Resilience.

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 Combat Capabilities Development Command Soldier Center.

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.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM3 / <i>Warfighter Medical Protection & Performance</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Title: Physiological Health Description: This effort supports and matures laboratory prototypes, nutritional formulations and interventions, and decision aids for the validation of physiological status and prediction of Soldier performance in extreme environments.		2.347	-	-
Title: Environmental Health & Protection 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.		5.093	-	-
Title: Injury Prevention and Reduction 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. 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).		4.591	-	-
Title: Psychological Health and Resilience 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 post-traumatic stress disorder (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.		2.916	-	-
Accomplishments/Planned Programs Subtotals		14.947	-	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM3 / <i>Warfighter Medical Protection & Performance</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 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>MM5: Tech Base/Enabling Res Combat Cas Care Adv Tech</i>	-	0.000	2.408	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.408

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

In FY21 this Project is realigned to:
 PE 0603002A Medical Advanced Technology
 * Project MN3 Immediate Cardiopulmonary Stabilization Adv Tech
 * Project MN4 Advanced Life Support Advanced Technology
 * Project MN5 Next Generation Blood Products Advanced Technology
 * Project MO2 Traumatic Brain Injury (TBI) Treatment Adv Tech
 * Project MO4 Burn Recovery Optimization Advanced Technology
 * Project MO7 Improved Bone Repair Advanced Technology

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.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Title: Combat Trauma Therapies</p> <p>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.</p> <p>FY 2020 Plans: Will continue studies in animals to evaluate effectiveness of products to combat wound infection, inflammation and scarring of delayed wound healing.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MM5 (Tech Base/Enabling Res Combat Cas Care Adv Tech) is eliminated in FY21; funds are realigned for programmatic clarity to Projects MN3 (Immediate Cardiopulmonary Stabilization Adv Tech), MN4 (Advanced Life Support Advanced Technology), MN5 (Next Generation Blood Products Advanced Technology), MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech), MO4 (Burn Recovery Optimization Advanced Technology) and MO7 (Improved Bone Repair Advanced Technology).</p>		-	1.030	-
<p>Title: Pre-Hospital Tactical Combat Casualty Care</p> <p>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.</p> <p>FY 2020 Plans: Will begin clinical testing of an automated system for assessing injury severity.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MM5 is eliminated in FY20; funds are realigned for programmatic clarity to Projects MN3 Immediate Cardiopulmonary Stabilization Advanced Technology, MN4 Advanced Life Support Advanced Technology, MN5 Next Generation Blood Products Advanced Technology, MO2 Traumatic Brain Injury (TBI) Treatment Advanced Technology, MO4 Burn Recovery Optimization Advanced Technology and MO7 Improved Bone Repair Advanced Technology.</p>		-	0.455	-
<p>Title: Traumatic Brain Injury</p> <p>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.</p> <p>FY 2020 Plans:</p>		-	0.835	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will evaluate alternative therapies that promote brain-remodeling and restoration of function following severe TBI. FY 2020 to FY 2021 Increase/Decrease Statement: Project MM5 (Tech Base/Enabling Res Combat Cas Care Adv Tech) is eliminated in FY21; funds are realigned for programmatic clarity to Projects MN3 (Immediate Cardiopulmonary Stabilization Adv Tech), MN4 (Advanced Life Support Advanced Technology), MN5 (Next Generation Blood Products Advanced Technology), MO2 (Traumatic Brain Injury (TBI) Treatment Adv Tech), MO4 (Burn Recovery Optimization Advanced Technology) and MO7 (Improved Bone Repair Advanced Technology).				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.088	-
Accomplishments/Planned Programs Subtotals		-	2.408	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MM7: Enabling Med Cap to Support Dispersed OPS Adv Tech	-	0.000	1.819	3.024	-	3.024	3.881	4.569	5.152	6.162	0.000	24.607

A. Mission Description and Budget Item Justification

This Project will support a task area to develop a tool capable of providing actionable treatment recommendations for "non-expert" providers (such as combat lifesavers and combat medics) operating in resource constrained environments. This tool will use machine learning and predictive analytic techniques to 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. It will mature and demonstrate a tele-monitored and remote-controlled medical module to support medical resupply and casualty evacuation. The medical module will be optimized to be self-contained and provide a "roll-on, roll-off" medical capability to future multi-purpose Unmanned Aerial Systems (UAS).

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 and Development Command (USAMRDC), Fort Detrick, MD

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

	FY 2019	FY 2020	FY 2021
<p>Title: Combat Evacuation Mission Module</p> <p>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.</p> <p>FY 2020 Plans: Will complete vehicle flight instrumentation of the first generation Combat Evacuation Mission Module prototype for calibration and check out in preparation for flight testing. Will complete flight test plans, procure test components, and prepare the Medical Module for transport to the flight test facility.</p> <p>Will construct a full-sized mock-up of the second generation Combat Evacuation Mission Module, based on current Objective vehicle UAS design, using rapid-prototyping capabilities to begin the determination of equipment configurations, placements, implementations, and interface requirements. Will medically-equip the mock-up second generation Mission Module using conceptual representations/ prototypes of emerging systems for remotely operated, or semi-autonomous/closed-loop patient</p>	-	1.736	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
monitoring, diagnostic, and intervention that would either support an attending medic during en route care or provide a remote en route care capability if there is no medic available to attend during transport.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding within this Project realigned to Medical Robotic and Autonomous Systems effort.				
Title: Medical Robotic and Autonomous Systems		-	-	3.024
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.				
FY 2021 Plans: Will 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 will consist 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. Will optimize 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. Will 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, will prototype and demonstrate a mission-based flight control interface system integrating with a relevant (optionally-manned FVL variant or similar) UAS flight control system. Will 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. Will demonstrate clinical knowledge authoring and knowledge base development techniques. Based on previous applied research, will 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. Will integrate the DSS with prototype closed loop technologies such as the Navy's Autonomous Critical Care System (ACCS).				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding increase due to new MedRAS investments in the Clinical Decision Support System for Combat Medic.				
Title: FY 2020 SBIR/STTR Transfer		-	0.083	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	1.819	3.024
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MM9 / Tech Base/Enabling Rsrch for Infect Dis Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MM9: Tech Base/Enabling Rsrch for Infect Dis Adv Tech	-	0.000	2.976	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.976

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 810 Ind Base Id Vacc & Drug

In FY21 this Project was realigned to:
 PE 0603002A Medical Advanced Technology
 * Project MO9 Vaccines to Prevent Dengue Fever Advanced Tech
 PE 0602787A Medical Technology
 * Project MM8 Infectious Diseases and Applied Rsch Technology

A. Mission Description and Budget Item Justification

Technology development, demonstration, and transition of Food and Drug Administration (FDA) - regulated medical countermeasures such as drugs and vaccines to naturally-occurring infectious diseases of military importance, as identified by worldwide medical surveillance and capability needs assessments.

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.

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 USAMRDC, Fort Detrick, MD.

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM9 / <i>Tech Base/Enabling Rsrch for Infect Dis Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Advanced Technology Research on drugs and vaccines against parasitic diseases</p> <p>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.</p> <p>FY 2020 Plans: Will initiate safety and analytic studies to assess natural break-down of candidate drugs within the human body to improve drug safety and effectiveness for treatment and prevention of malaria for selected triazine lead compound. Will complete clinical trials to assess performance of lead Plasmodium falciparum malaria vaccine candidates. These activities enable down- selection of a lead vaccine for transition to advanced development. Will validate laboratory-based immune measures of protection and correlate with protective effectiveness among candidate vaccines undergoing clinical trials.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Project MM9 (Tech Base/Enabling Rsrch for Infect Dis Adv Tech) ends in FY20; funds are realigned to Project MO9 (Vaccines to Prevent Dengue Fever Advanced Tech) and to PE 0602787 (Medical Technology) Project MM8 (Infectious Diseases and Applied Rsch Technology).</p>	-	1.399	-
<p>Title: Viral Disease Threats</p> <p>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.</p> <p>FY 2020 Plans: Will continue to evaluate safety and initial effectiveness of commercial partner dengue vaccine candidates undergoing testing in Southeast Asia and Latin America. Will continue to complete vaccine immunogenicity (ability to provoke an immune response) testing followed by dengue human infection model challenge and effectiveness testing of human subjects immunized with combination inactivated and weakened forms of virus vaccines. Will continue to engage commercial partner to pursue development of purified inactivated dengue virus in combination with live attenuated product. Will continue to pursue an expanded Hemorrhagic Fever with Renal Syndrome (HFRS) Deoxyribonucleic acid (DNA) vaccine clinical trial in a country/region that has endemic HFRS cases. Will continue to test for safety and effectiveness of the HFRS DNA vaccine.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	-	1.560	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MM9 / <i>Tech Base/Enabling Rsrch for Infect Dis Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Project MM9 (Tech Base/Enabling Rsrch for Infect Dis Adv Tech) ends in FY20; funds are realigned to Project MO9 (Vaccines to Prevent Dengue Fever Advanced Tech) and to PE 0602787 (Medical Technology) Project MM8 (Infectious Diseases and Applied Rsch Technology).			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.017	-
Accomplishments/Planned Programs Subtotals	-	2.976	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN3: <i>Immediate Cardiopulmonary Stabilization Adv Tech</i>	-	0.000	1.903	2.109	-	2.109	2.047	2.183	2.476	2.476	0.000	13.194

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

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 Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2019	FY 2020	FY 2021
Title: Immediate Cardiopulmonary Stabilization Advanced Technology	-	1.903	2.109
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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will conduct preclinical and early clinical evaluation of devices indicated for use to facilitate autonomous intubation and airway management in combat casualties with obstructed airways, advanced hemostatic dressings that are effective independent of the patient's blood clotting system, as well as new tourniquet technologies having prolonged effectiveness.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Increase due to additional funding allocated for validation / demonstration of new, minimally invasive, interventional treatments for non-compressible hemorrhage.</p>				
Accomplishments/Planned Programs Subtotals		-	1.903	2.109
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MN4 / Advanced Life Support Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN4: <i>Advanced Life Support Advanced Technology</i>	-	0.000	3.801	3.685	-	3.685	4.838	5.509	5.915	5.916	0.000	29.664

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

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 Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2019	FY 2020	FY 2021
Title: Battlefield Sustainment of Critical Organ Function Capability Set 1	-	3.700	3.685
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 2020 Plans: Will demonstrate devices indicated for use to control oxygen and carbon dioxide exchange in casualties with acute lung injury, and/or to deliver blood purification in critically injured/ill casualties with acute kidney injury. Will demonstrate improved means			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>to control bleeding within the chest and abdomen through use of a specialized catheter that maintains normal blood pressure within the brain, heart and lungs and minimizes lack of blood flow to other organs and lower body until definitive surgical care is available.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding decrease is a result of level of effort required.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.101	-
Accomplishments/Planned Programs Subtotals		-	3.801	3.685
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MN5 / Next Generation Blood Products Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN5: Next Generation Blood Products Advanced Technology	-	0.000	5.964	6.854	-	6.854	6.964	7.292	7.625	7.627	0.000	42.326

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

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 Development Command (USAMRDC), Fort Detrick, MD.

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

Title: Next Generation Human-Derived Blood Replacement	FY 2019	FY 2020	FY 2021
Description: Develop, demonstrate in pre-clinical and early-clinical studies, and transition new blood products with increased shelf life and functionality. 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.	-	5.701	6.854
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Will demonstrate preclinical and early clinical technologies to optimize shelf life and functionality of cold stored platelets, and pharmacologic replacement of fibrinogen to assist early hemorrhage control.</p> <p>FY 2021 Plans: Will 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 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 2020 to FY 2021 Increase/Decrease Statement: Increase due to additional funds allocated for validation / demonstration of multiple maturing products scheduled to transition to advanced development.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.263	-
Accomplishments/Planned Programs Subtotals	-	5.964	6.854

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

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN6: Blast & Head Impact Exposure Monitor Advanced Tech	-	0.000	1.412	1.949	-	1.949	1.860	0.749	0.000	0.000	0.000	5.970

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM3 Warfighter Medical Protection & Performance

A. Mission Description and Budget Item Justification

This effort will validate 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).

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 2019	FY 2020	FY 2021
Title: Blast & Head Impact Exposure Monitor	-	1.348	-
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.			
FY 2020 Plans: Will support the Environmental Sensors in Training (ESiT) program. Will support additional sites for data collection in high risk exposure communities: blast (heavy weapons training, breaching) and head impact (airborne).			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
This effort ends and FY21 funding is aligned to the effort "Injury Criteria for Informing the Development of New Tactical Headborne Systems", within this Project			
<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: Will 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. Will refine and validate cervical neck injury criteria for next generation head borne and protection systems.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The "Blast & Head Impact Exposure Monitor" within this Project</p>	-	-	1.949
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.064	-
Accomplishments/Planned Programs Subtotals	-	1.412	1.949

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN7: Musculoskeletal Injury Screening Tool Adv Tech	-	0.000	0.300	3.398	-	3.398	4.298	1.149	0.649	0.749	0.000	10.543

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM3 Warfighter Medical Protection & Performance

A. Mission Description and Budget Item Justification

This capability will deliver validated leader and medical provider tools that can provide objective assessments of bone stress fracture to aid in determining whether a Soldier can return to duty after musculoskeletal injury and reduce the risk of re-injury.

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 2019	FY 2020	FY 2021
Title: Musculoskeletal Injury Screening Tool	-	0.286	-
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.			
FY 2020 Plans: Will develop objective medical assessments of Return-to-Duty. Will support data collection in support of Center for Initial Military Training TRADOC (CIMT) led effort.			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to the Leader and Medical effort within this Project.			
Title: Leader and Medical Provider Tools to Prevent and Reduce Musculoskeletal Injury in All Settings	-	-	3.398

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Description: This capability will deliver validated leader and medical provider tools that can provide objective assessments of bone stress fracture that can aid in determining whether a Soldier can return to duty after musculoskeletal injury and can reduce the risk of re-injury.</p> <p>FY 2021 Plans: Will complete primary data collection and processing of established biomarkers for stress fracture from 1,500 participants; will 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 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from the Musculoskeletal Injury Screening Tool effort within this Project.</p> <p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>			
Accomplishments/Planned Programs Subtotals	-	0.014	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN8: <i>Drugs to Prevent and Treat Malaria Advanced Tech</i>	-	0.000	2.146	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.146

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 810 Ind Base Id Vacc & Drug

In FY21 this Project is realigned to:
 PE 06002787A 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)

Title: Drugs to Prevent and Treat Malaria Advanced Technology	FY 2019	FY 2020	FY 2021
	-	2.048	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>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.</p> <p>FY 2020 Plans: Will complete clinical trial study data analysis then identify a single lead for use in humans. Will optimize lead formulation and test safety and toxicity in animals. Will initiate activities to perform a clinical trial in a small number of healthy human volunteers to test drug safety and effectiveness against P. falciparum malaria using controlled human malaria infection.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to PE 0602787A (Medical Technology) Project MM8 (Infectious Diseases and Applied Rsch Technology) to support next lead candidate studies.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.098	-
Accomplishments/Planned Programs Subtotals	-	2.146	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MN9: Far Forward Behavioral Health Care Advanced Tech	-	0.000	0.266	1.121	-	1.121	1.029	0.000	0.000	0.000	0.000	2.416

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM3 Warfighter Medical Protection & Performance

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 2019	FY 2020	FY 2021
Title: Optimal Delivery of Far Forward Behavioral Health Care	-	0.254	-
Description: The effort will deliver improved psychological treatment interventions to keep Soldiers in the fight under high intensity operational stressors.			
FY 2020 Plans: The most promising brief psychotherapy interventions, self-administered computer apps, and treatment protocols for use with Service members deployed far forward will be identified and adapted and ready for initial clinical trials. An Food and Drug Administration (FDA) - approved drug will also be under clinical trial evaluation for use to address Service member?s sleep problems in a far-forward setting for improved physical and psychological readiness and performance.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
This effort ends in FY20; funds are aligned to effort "Far Forward Behavioral Health Care" within this Project.				
<p>Title: Far Forward Behavioral Health Care</p> <p>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.</p> <p>FY 2021 Plans: Will 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 reduce individual isolation, a major risk factor in behavioral health; mature components for enhancing behavioral health leadership skills and deliver new training.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The effort "Optimal Delivery of Far Forward Behavioral Health Care" ends in FY20; all Project funds are aligned to this effort starting FY21.</p>		-	-	1.121
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.012	-
Accomplishments/Planned Programs Subtotals		-	0.266	1.121
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / Medical Advanced Technology	Project (Number/Name) MO2 / Traumatic Brain Injury (TBI) Treatment Adv Tech
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO2: Traumatic Brain Injury (TBI) Treatment Adv Tech	-	0.000	4.285	4.825	-	4.825	4.875	4.626	1.832	1.832	0.000	22.275

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

A. Mission Description and Budget Item Justification

This Project covers development, demonstration, and transition of technologies for acute battlefield management of brain trauma. 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.

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)

Title: Drugs to Prevent and Treat Brain Injury (TBI)	FY 2019	FY 2020	FY 2021
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.	-	4.090	4.825
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Will demonstrate stem cell transplantation as a strategy to repair and regenerate the injured brain. Will have preclinical demonstration of a device that provides selective cooling of the brain, to protect the brain and reduce mortality in severe TBI while preventing the secondary adverse effects associated with whole body cooling.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Increase due to allocation of additional funds for validation / demonstration of new drugs and drug delivery platforms.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.195	-
Accomplishments/Planned Programs Subtotals		-	4.285	4.825
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO3: <i>Military Occupational Fitness Standards Adv Tech</i>	-	0.000	0.250	0.000	-	0.000	0.000	0.000	0.000	1.050	0.000	1.300

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project MM3 Warfighter Medical Protection & Performance

In FY21 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 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.

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 2019	FY 2020	FY 2021
Title: Military Occupational Fitness Standards	-	0.239	-
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.			
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO3 / <i>Military Occupational Fitness Standards Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will validate physical fitness standards and Return-to-Duty strategies, including the validation of Return-to-Duty during basic combat training.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to Project MN7 (Musculoskeletal Injury Screening Tool Adv Tech).				
Title: FY 2020 SBIR/STTR Transfer		-	0.011	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	0.250	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO4: <i>Burn Recovery Optimization Advanced Technology</i>	-	0.000	2.084	3.405	-	3.405	2.438	2.714	3.082	3.083	0.000	16.806

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603002A Medical Advanced Technology
 * Project 840 Combat Injury Mgmt

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 2019	FY 2020	FY 2021
Title: Rapid Burn Injury Treatment and Return to Duty Capability Set 1	-	2.040	3.405
Description: Develop, 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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will demonstrate biomarkers to identify skin graft success or failure, and to identify which patients are at heightened risk for scarring. Will develop and demonstrate treatments using mesenchymal stem cells (these are human cells that can, under the right conditions, transform into multiple cell types having ability to repair damaged tissue) to decrease inflammation and limit systemic organ injury following severe burn injury.</p> <p>FY 2021 Plans: Will 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 model of infected deep partial thickness burn. As part of continuing work on burn wound biomarkers, will provide a large animal burn model in which to test burn treatments and grafting.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Increase to allocation of additional funding for validation / demonstration of multiple maturing products scheduled to transition to advanced development.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.044	-
Accomplishments/Planned Programs Subtotals		-	2.084	3.405
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO7 / <i>Improved Bone Repair Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO7: <i>Improved Bone Repair Advanced Technology</i>	-	0.000	1.539	1.623	-	1.623	1.519	1.666	2.033	2.033	0.000	10.413

Note

In Fiscal Year (FY) 2020 this Project was realigned from: Program Element (PE) 0603002A (Medical Advanced Technology)

*Project 840 Combat Injury Mgmt

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 Development Command (USAMRDC), Fort Detrick, MD.

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

	FY 2019	FY 2020	FY 2021
Title: Limb Function Repair and Return to Combat Duty & Field Stabilization on Bone in Preparation for Evac	-	1.469	1.623
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.			
FY 2020 Plans: Will develop technologies to repair deleterious complications that prevent bone union and healing in severe extremity fractures.			
FY 2021 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603002A / <i>Medical Advanced Technology</i>	Project (Number/Name) MO7 / <i>Improved Bone Repair Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>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 2020 to FY 2021 Increase/Decrease Statement: Additional funds allocated for validation / demonstration of extremity compartment syndrome diagnostic and monitoring technologies.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.070	-
Accomplishments/Planned Programs Subtotals		-	1.539	1.623
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO8: <i>Expeditionary Performance Nutrition Advanced Techn</i>	-	0.000	0.200	2.141	-	2.141	2.275	2.361	1.907	0.000	0.000	8.884

Note

In Fiscal Year (FY) 2020 this Project was realigned from: Program Element (PE) 0603002A (Medical Advanced Technology)
*Project MM3 Warfighter Medical Protection & Performance

A. Mission Description and Budget Item Justification

This Project covers the development of strategies and interventions to support sustainment of Soldier readiness and performance in the complex operating environment. These include demonstration and maturation of nutritionally-optimized food products prototypes that allow Soldiers to eat-on-the-go with minimal logistical footprint while ensuring maximal physiological and cognitive performance and interventions to sustain Soldier alertness and performance in all settings.

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)

<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> <p>FY 2020 Plans: Will evaluate and provide components of food prototypes that are nutritionally optimized for cognitive and physical performance, configured for eating-on-the-go and compatible with multiple ration platforms (e.g., Meal-Ready-to-Eat [MRE], First Strike Ration [FSR]), tailorable for mission requirements, e.g., high/low physical or cognitive demand, formulated to enhance immune function and promote readiness and lighter weight with reduced logistical footprint.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	FY 2019	FY 2020	FY 2021
	-	0.191	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Medical Strategies to Sustain Soldier Alertness and Performance in All Settings.			
Title: Medical Strategies to Sustain Soldier Alertness and Performance in All Settings 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. FY 2021 Plans: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from Project MO8 (Expeditionary Performance Nutrition Advanced Techn).	-	-	2.141
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.009	-
Accomplishments/Planned Programs Subtotals	-	0.200	2.141

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MO9: <i>Vaccines to Prevent Dengue Fever Advanced Tech</i>	-	0.000	2.533	2.074	-	2.074	2.357	4.025	4.701	4.701	0.000	20.391

Note

In Fiscal Year (FY) 2020 this Project was realigned from: Program Element (PE) 0603002A (Medical Advanced Technology)

*Project 810 Ind Base Id Vacc & Drug

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 2019	FY 2020	FY 2021
Title: Vaccines to Prevent Dengue Fever Advanced Technology	-	2.467	2.074
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 2020 Plans: Will perform clinical trial where optimized vaccine regimen is tested for safety and immunogenicity in humans. Will perform clinical trial to test for additional safety, immunogenicity and effectiveness against a Dengue challenge model against Dengue serotypes.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Decrease in funding reflecting level of effort required.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.066	-
Accomplishments/Planned Programs Subtotals		-	2.533	2.074
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
MP3: <i>Phys Chem Toxicity Assessment Sys Adv Tech</i>	-	0.000	0.000	2.688	-	2.688	2.755	1.935	1.875	1.118	0.000	10.371

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 Soldiers from current and emerging environmental threats, ensuring a medically ready, fighting force to conduct semi-independent operations in complex and potentially hazardous environments. 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 to prevent Soldier performance degradation from current and emerging environmental threats through countermeasures to ensure greater than 90% medical readiness and to predict unit-level illness/injury risks from environmental exposures, enabling leaders to implement control measures in the training environment and/or during operations to maintain health, fitness & readiness.

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 2019	FY 2020	FY 2021
Title: Solutions to Sustain Warfighter Performance in Extreme Environments	-	-	2.688
Description: The validation of host response signatures of performance decrements to exposure to toxic environmental hazards will provide physiologically based algorithms that predict and detect organ and system toxicity post-exposure. This enables the creation of a risk management tool allowing Commanders to make informed decisions in real-time regarding the risk of exposure to toxic industrial chemicals and materials. The p-Product will ensure sustained Soldier physiological and cognitive performance and improved capacity to be lethal under environmentally challenging operational conditions, such as dense urban environments and subterranean spaces.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p><i>FY 2021 Plans:</i> Will 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 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><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> This Project is a New Start for FY21.</p>			
Accomplishments/Planned Programs Subtotals	-	-	2.688

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	165.035	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	165.035
313: <i>Adv Rotarywing Veh Tech</i>	-	109.610	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	109.610
436: <i>Rotarywing MEP Integ</i>	-	7.192	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.192
447: <i>ACFT Demo Engines</i>	-	3.633	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.633
BAT: <i>AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)</i>	-	44.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	44.600

Note
In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to PE:
* 0603465A Future Vertical Lift Advanced Technology.

A. Mission Description and Budget Item Justification

This PE matures and demonstrates manned and unmanned air vehicle technologies to enable Army aviation modernization. Within this PE, aviation technologies are advanced and integrated into realistic and robust demonstrations. Project 313 matures, demonstrates and integrates enabling component, subsystems and systems in the following areas: rotors and, structures. Project 436 matures, integrates and demonstrates air launched weapons systems, mission equipment packages to enable control of unmanned systems and advanced teaming capabilities. Project 447 matures and demonstrates affordable and efficient engines and drive trains.

Work in this PE contributes to the Army Science and Technology (S&T) Air Systems portfolio and is related to and fully coordinated with PE 0602211A (Aviation Technology), PE 0603313A (Missile and Rocket Advanced Technology), PE 0603710A (Night Vision Advanced technology), and PE 0603270A (Electronic Warfare 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 (U.S.) Army Futures Command (AFC).

FY20 realignments are due to financial restructuring in support of the Army Modernization Priorities.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	169.411	0.000	0.000	-	0.000
Current President's Budget	165.035	0.000	0.000	-	0.000
Total Adjustments	-4.376	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-4.376	-			

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

Project: BA7: *AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)*

- Congressional Add: *Stretch Broken Composite Material Forms*
- Congressional Add: *Advanced Helicopter Seating System*
- Congressional Add: *Data Refinement and Optimization for Aviation Sustainment*
- Congressional Add: *Surface Tolerant Adhesive for Bonded Airframe Structure*
- Congressional Add: *Joint Tactical Aerial Supply Vehicle*
- Congressional Add: *Rotorcraft Automated Component Tracking*
- Congressional Add: *Future Vertical Lift (FVL) Research*

Congressional Add Subtotals for Project: BA7

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	4.000	-
	5.000	-
	1.600	-
	5.000	-
	3.000	-
	6.000	-
	20.000	-
Congressional Add Subtotals for Project: BA7	44.600	-
Congressional Add Totals for all Projects	44.600	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603003A / Aviation Advanced Technology				Project (Number/Name) 313 / Adv Rotarywing Veh Tech			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
313: Adv Rotarywing Veh Tech	-	109.610	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	109.610

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
Program Element (PE) 0603465A Future Vertical Lift Advanced Technology:

- * Project AI4 Joint Multi-Role (JMR) Demonstration Advanced Tech
- * Project AI6 Next Gen Tactical UAS TD Advanced Technology
- * Project AJ3 Next Generation Rotorcraft Transmission Adv Tech
- * Project AJ5 Digital Vehicle Management & Control Advanced Tech
- * Project AJ7 Advanced Rotors Advanced Technology
- * Project AJ9 Integ Mission Equipment for Vert Lift Systems Adv Tech
- * Project AK3 Aviation Survivability Advanced Technology
- * Project AK8 Air Launched Effects Advanced Technology
- * Project AL6 Degraded Visual Environment Mitigation (DVE-M) Adv Tech
- * Project AM3 Aircraft and Aircrew Protection Advanced Tech

A. Mission Description and Budget Item Justification

This Project matures, demonstrates and integrates components, subsystems and systems for vertical lift and unmanned air systems that provide improved aircraft and occupant survivability, reduced maintenance and sustainment costs, and greater performance through improved rotors, drives, vehicle management systems and platform design and structures. Systems demonstrated include rotors and robust airframe structures. A major effort in this Project is the Joint Multi-Role (JMR) Technology Demonstrator (TD) in support of the Future Vertical Lift (FVL) family of aircraft.

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 coordinated with Program Executive Office Aviation (PEO Aviation) and PEO Intelligence, Electronic Warfare, and Sensors (PEO IEW&S).

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Platform Design & Structures Systems	80.337	-	-
Description: Provide demonstration of 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / Aviation Advanced Technology	Project (Number/Name) 313 / Adv Rotarywing Veh Tech		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
operating costs, to inform and reduce future aviation materiel acquisitions. Flight demonstrate operational capabilities of technology demonstrators.				
Title: Rotors & Vehicle Management Systems Description: This effort demonstrates the performance benefits of advanced rotors through the assessment of alternative designs aimed to satisfy future force capability needs for increased system durability, speed, range and payload. This effort also integrates advanced flight controls with real-time aircraft state information into vehicle management systems to enable safe, low-effort maneuvering and real-time adaptation to aircraft state changes (degradation, damage, mission, etc.)		1.292	-	-
Title: Rotorcraft Drive Systems 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 FVL platforms.		1.037	-	-
Title: Survivability for Degraded Visual Environment (DVE) Operations 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. Work in this area is being done in coordination with efforts at United States (U.S.) Army Communications-Electronics Research, Development, and Engineering Center (CERDEC), PE 0603710A (Night Vision Advanced Technology). The program presents an opportunity to North Atlantic Treaty Organization (NATO) nations, global industry, and academia to participate with their own assets in order to foster information exchange and collaboration.		16.377	-	-
Title: Aircraft & Occupant Survivability Systems Description: This effort increases rotorcraft survivability by reducing platform signatures, providing the means to more efficiently counter enemy detection and tracking systems, and also increases protection to the aircraft and aircrew against ballistic munitions, crash landings, and post-crash fire events. This effort enhances air crew situational awareness, allowing manned/unmanned aircraft to avoid enemy air threats.		7.532	-	-
Title: Next Generation Tactical UAS Technology Demonstration (NGTUAS) Description: Develop and demonstrate transformational air vehicle technologies that overcome key barriers to meet the Army's future Unmanned Aircraft System (UAS) performance, survivability, and reliability requirements and operational capabilities. Work		2.888	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>	Project (Number/Name) 313 / <i>Adv Rotarywing Veh Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
in this area is being done in coordination with efforts at the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) PE 0602211A (Aviation Technologies).			
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.147	-	-
Accomplishments/Planned Programs Subtotals	109.610	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / Aviation Advanced Technology	Project (Number/Name) 436 / Rotarywing MEP Integ
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
436: Rotarywing MEP Integ	-	7.192	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.192

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603465 Future Vertical Lift Advanced Technology
 * Project AL1 Adv Teaming for Tactical Aviation Oper Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and validates man-machine integration and mission equipment software and hardware technologies for unmanned and optionally manned aircraft systems and integrated threat protection systems. Efforts focus on artificial intelligence, intelligent agents, cognitive decision aiding, sensors, avionics, communications, and pilot vehicle interfaces. This Project improves the overall mission execution by demonstrating manned and unmanned system teaming, enhanced aircraft pilotage capability, improved crew workload distribution, and new capabilities for both manned and unmanned aircraft. This Project supports Army transformation by providing mature technology to greatly expand the capabilities of unmanned aircraft, in current operating roles and future unmanned wingman roles.

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

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Unmanned and Optionally Manned Systems	5.674	-	-
Description: Mature and apply tactical behavior algorithms and safe-flight technologies to enable unmanned and optionally manned aircraft to maintain safe, responsive, flexible, and tactical formation flight with manned helicopters for unmanned wingman applications in re-supply, reconnaissance, surveillance and attack missions. Develop, mature, apply, and integrate advanced decision aiding, autonomy, and human-machine interface technologies to enable the helicopter flight crew to make full use of the capabilities of an unmanned aircraft system (UAS) without requiring continuous attention. Efforts include development of intelligent algorithms that aid decisions and actions in order to increase situation awareness, maximize use of on-board and off-board sensors, efficiently manage a team of manned and unmanned vehicles and their mission systems, and develop and execute effective and appropriate offensive and defensive responses.			
Title: Advanced Teaming	1.518	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>	Project (Number/Name) 436 / <i>Rotarywing MEP Integ</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Description: Develop and demonstrate teaming behaviors and autonomous decision making for mixed platform formations in combined arms operations. Focus areas include: resilient autonomous algorithms; self-organizing unmanned formations; distributed command and control; and navigation.			
Accomplishments/Planned Programs Subtotals	7.192	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / Aviation Advanced Technology	Project (Number/Name) 447 / ACFT Demo Engines
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
447: ACFT Demo Engines	-	3.633	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.633

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
 * Project A18 Alternative Concept Engine Advanced Technology
 * Project AJ1 Future UAS Engine Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates power system technologies through design, fabrication, and evaluation of advanced engine components in order to improve the performance of turbine engines and drive systems for vertical lift aircraft and Unmanned Aerial Systems (UAS) vehicles. This Project supports Army modernization by demonstrating mature technologies for lighter turbine engines and drives that provide increased power, increased fuel efficiency, improved sustainability and reduced maintenance. These advanced engine designs and drives will significantly improve the overall aircraft performance characteristics and reduce the logistical footprint of Army Aircraft.

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

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Alternative Concept Engine (ACE)	3.633	-	-
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 Army Aviation manned and unmanned platforms. The alternative concept engine technology demonstrations planned for this effort are applicable to current and future platforms. Work in this project is coordinated with efforts in PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech).			
Accomplishments/Planned Programs Subtotals	3.633	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>	Project (Number/Name) 447 / <i>ACFT Demo Engines</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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / Aviation Advanced Technology	Project (Number/Name) BA7 / AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BA7: AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)	-	44.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	44.600

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Aviation advanced technology development.

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

	FY 2019	FY 2020
Congressional Add: Stretch Broken Composite Material Forms	4.000	-
FY 2019 Accomplishments: Stretch Broken Composite Material Forms		
Congressional Add: Advanced Helicopter Seating System	5.000	-
FY 2019 Accomplishments: Advanced Helicopter Seating System		
Congressional Add: Data Refinement and Optimization for Aviation Sustainment	1.600	-
FY 2019 Accomplishments: Data Refinement and Optimization for Aviation Sustainment		
Congressional Add: Surface Tolerant Adhesive for Bonded Airframe Structure	5.000	-
FY 2019 Accomplishments: Surface Tolerant Adhesive for Bonded Airframe Structure		
Congressional Add: Joint Tactical Aerial Supply Vehicle	3.000	-
FY 2019 Accomplishments: Joint Tactical Aerial Supply Vehicle		
Congressional Add: Rotorcraft Automated Component Tracking	6.000	-
FY 2019 Accomplishments: Rotorcraft Automated Component Tracking		
Congressional Add: Future Vertical Lift (FVL) Research	20.000	-
FY 2019 Accomplishments: Future Vertical Lift (FVL) Research		
Congressional Adds Subtotals	44.600	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603003A / <i>Aviation Advanced Technology</i>	Project (Number/Name) BA7 / <i>AVIATION ADVANCED TECHNOLOGY INITIATIVES (CA)</i>

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603004A / Weapons and Munitions Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	240.862	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	240.862
232: Advanced Lethality & Survivability Demo	-	70.696	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	70.696
43A: ADV WEAPONRY TECH DEMO (CA)	-	139.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	139.000
L96: High Energy Laser Technology Demo	-	25.370	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.370
L97: Smoke And Obscurants Advanced Technology	-	5.796	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.796

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is being eliminated, with continuity of effort realigned to the following PEs:
 ? 0603118A Soldier Lethality Advanced Technology
 ? 0603119A Ground Advanced Technology
 ? 0603462A Next Generation Combat Vehicle Advanced Technology
 ? 0603464A Long Range Precision Fires Advanced Technology
 ? 0603465A Future Vertical Lift Advanced Technology
 ? 0603466A High Energy Laser Tactical Vehicle Demonstrator Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures weapons and munitions components/subsystems and demonstrates lethal weapons systems with potential to increase force application and force protection capabilities across the spectrum of operations. Project 232 focuses on affordable delivery of scalable effects for kinetic weapons and munitions including: artillery, mortars, medium caliber, tank fired, Soldier weapons and shoulder fired weapons. Project L96 matures and integrates critical high energy laser subsystems into mobile demonstrators to explore and validate system performance in relevant environments. Project L97 demonstrates performance of advanced obscurants and delivery of mechanisms and conducts forensic analysis of explosives and hazardous materials to enable detection.

Work in this PE is related to, and fully coordinated with, PE 0602120A (Sensors and Electronic Survivability), PE 0602307A (Advanced Weapons Technology), PE 0602618A (Ballistics Technology), PE 0602622A (Chemical, Smoke, and Equipment Defeating Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602782A (Command, Control, Communications Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), and PE 0603313A (Missile and Rocket Advanced Technology).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>
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Beginning in FY20, work in this PE is related to and fully coordinated with PE 0603118A (Soldier Lethality Advanced Technology), PE 0603119A (Ground Advanced Technology), 0603462A (Next Generation Combat Vehicle Advanced Technology), 0603464A (Long Range Precision Fires Advanced Technology), 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. All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The work in this PE is performed by the United States Army Futures Command (AFC) and the United States Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT).

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	241.581	0.000	0.000	-	0.000
Current President's Budget	240.862	0.000	0.000	-	0.000
Total Adjustments	-0.719	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.500	-			
• SBIR/STTR Transfer	-3.219	-			

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

Project: 43A: ADV WEAPONRY TECH DEMO (CA)

- Congressional Add: *Program Increase FY19 Appropriations Act*
- Congressional Add: *Program Increase FY19 Appropriations Act (CCDC)*
- Congressional Add: *Program increase - advanced development of asset protection technologies*
- Congressional Add: *Program increase - accelerate ERCA gun*
- Congressional Add: *Program increase - high energy laser*
- Congressional Add: *Program increase - long range precision fires*
- Congressional Add: *hypersonic capability - transfer from line 71*
- Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun (CCDC)*

	FY 2019	FY 2020
	14.000	-
	28.000	-
	5.000	-
	12.000	-
	20.000	-
	34.821	-
	25.000	-
	0.179	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603004A / <i>Weapons and Munitions Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2019	FY 2020
Congressional Add Subtotals for Project: 43A	139.000	-
Congressional Add Totals for all Projects	139.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) 232 / <i>Advanced Lethality & Survivability Demo</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>232: Advanced Lethality & Survivability Demo</i>	-	70.696	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	70.696

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 PE 0603118A Soldier Lethality Advanced Technology
 * Project AY7 Small Arms Fire Control Advanced Technology
 PE 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BF5 Adv Lethality & Accuracy Sys for Med Cal Adv Tech
 * Project BG5 Extended Line of Sight (ELOS) Advanced Technology
 * Project BI1 Protection for Autonomous Systems Adv Tech
 * Project BK4 Next Gen Intelligent Fire Control(NG-IFC) Adv Tech
 * Project BK6 Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech
 PE 0603464A Long Range Precision Fires Advanced Technology
 * Project AE6 Strategic Long Range Cannon Advanced Technology
 * Project AG3 Extended Range Cannon Artillery (ERCA) Adv Tech
 * Project AG5 Extended Range Artillery Munition Suite Adv Tech
 * Project AG7 Energetic Materials and Adv Processing Adv Tech
 * Project BS3 Strategic Missile Advanced Technology
 PE 0603465A Future Vertical Lift Advanced Technology
 * Project AK7 Adv Rotorcraft Armaments Protection Sys Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies for affordable precision munitions including advanced energetic materials and munitions, novel fuze designs, penetrators, and scalable effects.

Efforts in this Project support the Lethality and Ground Maneuver portfolios.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

Title: Cluster Munitions Replacement Acceleration	FY 2019	FY 2020	FY 2021
	7.748	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020	
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) 232 / <i>Advanced Lethality & Survivability Demo</i>	
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020
Description: This effort matures and demonstrates ultra-high reliability fuzing, advanced kill mechanisms, and alternative dispensing technologies for 155mm artillery to provide increased battlefield lethality with reduced unexploded ordnance (UXO) compliant with the Department of Defense (DoD) cluster munitions policy.			
Title: Medium Caliber Weapon Systems		9.700	-
Description: This effort 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.			-
Title: Scale-up of Energetic Materials		1.937	-
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.			-
Title: Active Protection Armament Technologies		4.358	-
Description: This effort supports the Army's Active Protection System (APS) program to mature and demonstrate APS technologies to reduce vehicle weight while reducing reliance on armor through the use of other means such as sensing, warning, hostile fire detection, and active countermeasures to achieve increased protection against current and emerging threats.			-
Title: Long Range Gun Technology		4.628	-
Description: This effort matures and demonstrates extended range artillery weapon system and projectile technologies that increase the range by 25% without an increase in platform weight.			-
Title: Counter-Unmanned Aviation System (C-UAS) Technology		3.622	-
Description: This effort matures and demonstrates C-UAS technologies designed to encompass the entire kill chain including detection, tracking, classification, and kinetic defeat of UAS for point defense and mobile applications.			-
Title: Accelerated Extended Range Munition Suite		22.152	-
Description: This effort matures and demonstrates extended range artillery technologies including rocket and base bleed propulsion, hybrid lifting surfaces and guidance technologies which increase range and accuracy.			-
Title: Fuze and Power Technology for Munitions		2.360	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) 232 / <i>Advanced Lethality & Survivability Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Description: This effort matures and demonstrates innovative fuze and power technologies for enhanced environment and target sensing/classification, warhead initiation schemes, and advanced fuze setting. These technologies will provide enhanced lethality combined effects on targets and advanced initiation schemes for the next generation munitions.				
Title: Extended Range Armament and Fire Control Integration		3.447	-	-
Description: This effort matures and demonstrates extended range Armament 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.				
Title: Aviation Armament System Technologies		2.433	-	-
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: Extended Line of Site Munition (ELOS)		5.811	-	-
Description: This effort demonstrates a 120mm Tank fired ELOS Munition that counters the growing Anti-Tank Guided Missile (ATGM) threat at extended line of sight ranges beyond current capability.				
Title: AI Test Bed		2.500	-	-
Accomplishments/Planned Programs Subtotals		70.696	-	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603004A / Weapons and Munitions Advanced Technology				Project (Number/Name) 43A / ADV WEAPONRY TECH DEMO (CA)			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
43A: ADV WEAPONRY TECH DEMO (CA)	-	139.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	139.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Advanced Weaponry Technology development.

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

	FY 2019	FY 2020
Congressional Add: Program Increase FY19 Appropriations Act	14.000	-
FY 2019 Accomplishments: Program Increase FY19 Appropriations Act		
Congressional Add: Program Increase FY19 Appropriations Act (CCDC)	28.000	-
FY 2019 Accomplishments: Program Increase FY19 Appropriations Act (CCDC)		
Congressional Add: Program increase - advanced development of asset protection technologies	5.000	-
FY 2019 Accomplishments: Program increase - advanced development of asset protection technologies		
Congressional Add: Program increase - accelerate ERCA gun	12.000	-
FY 2019 Accomplishments: Program increase - accelerate ERCA gun		
Congressional Add: Program increase - high energy laser	20.000	-
FY 2019 Accomplishments: Program increase - high energy laser		
Congressional Add: Program increase - long range precision fires	34.821	-
FY 2019 Accomplishments: Program increase - long range precision fires		
Congressional Add: hypersonic capability - transfer from line 71	25.000	-
FY 2019 Accomplishments: hypersonic capability - transfer from line 71		
Congressional Add: FY 2018 NDAA SEC 825 MDAP Cost Overrun (CCDC)	0.179	-
FY 2019 Accomplishments: FY 2018 NDAA SEC 825 MDAP Cost Overrun (CCDC)		
Congressional Adds Subtotals	139.000	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) 43A / <i>ADV WEAPONRY TECH DEMO (CA)</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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>				Project (Number/Name) L96 / <i>High Energy Laser Technology Demo</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
L96: <i>High Energy Laser Technology Demo</i>	-	25.370	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.370

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603466A Air and Missile Defense Advanced Technology
 * Project AD1 High Energy Laser Tactical Vehicle Demo Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced technologies for future High Energy Laser (HEL) weapons technology. 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. SSL technology has demonstrated the potential to engage and defeat rockets, artillery and mortars (RAM), unmanned aerial vehicles (UAVs), cruise missiles, sensors, and optics at tactically relevant ranges. HELs are expected to complement conventional offensive and defensive weapons at a lower cost-per-shot than current systems and without the need to strategically, operationally, or tactically stockpile ordnance. This effort utilizes a modular building block approach with 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).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

Work is performed by the United States Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT).

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

	FY 2019	FY 2020	FY 2021
Title: Laser System Ruggedization	18.494	-	-
Description: This effort ruggedizes laser systems for integration on Army platforms. Ruggedization includes modifications of the laser system to withstand vibration, temperature, and contamination environments expected on various Army platforms, while ensuring platform volume, weight, and interface specifications are met.			
Title: High Energy Laser Systems Integration and Mobile Demonstrations	6.876	-	-
Description: This effort integrates a 50 kW-class laser into the existing mobile laser demonstrator platform that includes the ruggedized Beam Control System (BCS) built under the HEL Technical Demonstration effort and other required subsystems			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) L96 / <i>High Energy Laser Technology Demo</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
to demonstrate weapon system performance. The goal is to demonstrate and evaluate performance of a complete mobile high energy laser system in a relevant environment.			
Accomplishments/Planned Programs Subtotals	25.370	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) L97 / <i>Smoke And Obscurants Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>L97: Smoke And Obscurants Advanced Technology</i>	-	5.796	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.796

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603119A Ground Advanced Technology, Projects:
 * BL3 Explosives Forensics Advanced Technology
 PE 0603462A Next Generation Combat Vehicle Advanced Technology, Projects:
 * BG7 Ground Systems Active Defense (GSAD) Advanced Tech
 * BG9 Obscuration Advanced Technology

A. Mission Description and Budget Item Justification

The Project matures and demonstrates obscurant technologies with potential to enhance personnel/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. This Project also matures and demonstrates improved detection of explosives and hazardous materials by Soldiers and Small Units.

Work in this Project is related to, and fully coordinated with, PE 0602622A (Chemical, Smoke and Equipment Defeating Technology) / Project 552 (Smoke/Novel Effect Mun) and PE 0603606A (Landmine Warfare and Barrier Advanced Technology / Project 608 (Countermines & Bar Dev).

This Project sustains Army Science and Technology efforts supporting the Ground Maneuver portfolio.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Obscurant Enabling Technologies	1.802	-	-
Description: This effort demonstrates the dissemination of new and advanced obscurants. This effort will support Modular Active Protection System (MAPS) in PE 0603005A (Combat vehicle and Automotive Advanced Technology) / Project 221 (Combat Veh Survivability).			
Title: Forensic Analysis of Explosives	2.065	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603004A / <i>Weapons and Munitions Advanced Technology</i>	Project (Number/Name) L97 / <i>Smoke And Obscurants Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Description: This effort demonstrates improved point and stand-off detection of explosives and homemade explosive (HME) precursors.			
Title: Detection Mechanisms for Contaminants	1.923	-	-
Description: This effort demonstrates improved point and standoff detection of a wide range of hazardous materials.			
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.006	-	-
Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun			
Accomplishments/Planned Programs Subtotals	5.796	-	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603005A / Combat Vehicle and Automotive Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	171.448	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	171.448
221: Combat Veh Survivabltly	-	56.726	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.726
441: Combat Vehicle Mobilty	-	25.773	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.773
497: Combat Vehicle Electro	-	6.993	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.993
515: Robotic Ground Systems	-	24.956	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.956
533: Ground Vehicle Demonstrations (CA)	-	57.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	57.000

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:
 ? 0603119A Ground Advanced Technology
 ? 0603462A Next Generation Combat Vehicle Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures, integrates and demonstrates combat and tactical vehicle automotive technologies that enable a lighter, more mobile and more survivable force. This PE executes the Army's Combat Vehicle Prototyping program to mature, integrate and demonstrate ground vehicle leap ahead technologies in support of future combat vehicles. Project 221 (Combat Vehicle Survivability) matures, integrates and demonstrates protection and survivability technologies such as active protection systems, advanced vehicle armors, blast mitigation and occupant safety devices to address both current and emerging advanced threats to ground vehicles. Project 441 (Combat Vehicle Mobility) matures and demonstrates advanced ground vehicle power and mobility technologies such as powertrains, power generation and storage, water and fuel logistics, and running gear subsystems for military ground vehicles to enable a more efficient, mobile and deployable force. Project 497 (Combat Vehicle Electro) matures, integrates, and demonstrates vehicle electronics hardware (computers, sensors, communications systems, displays, and vehicle command/control/driving mechanisms) and software that result in increased crew efficiencies, vehicle performance, reduced size, weight, and power (SWaP) burdens and vehicle maintenance costs. Project 515 (Robotic Ground Systems) matures and demonstrates unmanned ground vehicle (UGV) technologies with a focus on sensors, perception hardware and software, and robotic control algorithms that enable UGV systems to maneuver on and off road at speeds which meet mission requirements with minimal human intervention.

Work in this PE is coordinated with, PE 0602105A (Materials Technology), 0602120A (Sensors and Electronic Survivability), 0602601A (Combat Vehicle and Automotive Technology), 0602618A (Ballistics Technology), 0602624A (Weapons and Munitions Technology), 0602705A (Electronics and Electronic Devices), 0602784 (Military Engineering Technology), 0603001A (Warfighter Advanced Technology), 0603004A (Weapons and Munitions Advanced Technology), 0603005 (Combat Vehicle and Automotive Advanced Technology), 0603125A (Combating Terrorism Technology Development), 0603270A (Electronic Warfare Technology), 0603313A (Missile and Rocket Advanced Technology), 0603734 (Military Engineering Advanced Technology), 0604115A (Technology Maturation Initiatives), and 0708045A (Manufacturing Technology).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>
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Beginning in FY20, work in this PE is related to, and fully coordinated with PE 0602145A (Next Generation Combat Vehicle Technology), 0603119A (Ground 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. All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	176.622	0.000	0.000	-	0.000
Current President's Budget	171.448	0.000	0.000	-	0.000
Total Adjustments	-5.174	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.600	-			
• SBIR/STTR Transfer	-3.574	-			

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

Project: 533: *Ground Vehicle Demonstrations (CA)*

- Congressional Add: *Program increase - lightweight technology for ground combat and tactical vehicles*
- Congressional Add: *Program increase - advanced water harvesting technology*
- Congressional Add: *Program increase - fuel cell research*
- Congressional Add: *Program increase - airless tire technology demonstration*
- Congressional Add: *Program increase - HMMWV automotive enhancements*
- Congressional Add: *Program increase - HMMWV autonomy*
- Congressional Add: *Program increase - HMMWV power system*
- Congressional Add: *Program increase - HMMWV torque monitoring*
- Congressional Add: *Program increase - multi-sensor augmented reality system*
- Congressional Add: *Program increase - combat vehicle weight reduction initiative*

	FY 2019	FY 2020
	10.000	-
	5.000	-
	5.000	-
	4.000	-
	10.000	-
	3.000	-
	2.000	-
	3.000	-
	5.000	-
	10.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2019	FY 2020
Congressional Add Subtotals for Project: 533	57.000	-
Congressional Add Totals for all Projects	57.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
221: <i>Combat Veh Survivablty</i>	-	56.726	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	56.726

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech
 * Project BH1 Survivability Systems Controls Advanced Technology
 * Project BH4 Ground Vehicle Holistic Defense Adv Tech
 * Project BI5 Materials Application & Integration Adv Tech

A. Mission Description and Budget Item Justification

This Project matures, integrates, and demonstrates protection and survivability technologies such as active protection systems (APS), advanced vehicle armors, blast mitigation and occupant safety devices to address both current and emerging advanced threats to ground vehicles. This Project integrates complimentary survivability technologies to enable advanced protection suites, providing greater survivability and protection against emerging threats. This Project executes the Army's APS program to mature and demonstrate APS technologies in order to increase protection against current and emerging advanced threats while maintaining or reducing vehicle weight by reducing reliance on armor through the use of other means such as sensing, warning, hostile fire detection and active countermeasures. This Project develops an APS Common Architecture that defines the component interface standards and component specifications enabling adaptable APS solutions that can be integrated across Army vehicle platforms as required.

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

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Advanced Armor Technologies	14.964	-	-
Description: This effort matures, fabricates, integrates, and evaluates advanced ground vehicle armor systems such as advanced passive kinetic energy armor, explosive reactive armor, electromagnetic armor, and adaptive armor. The goal is to optimize armor system technologies and integration methodologies to reduce overall armor system weight; create and mature scalable / modular / common armor system integration standards for the advanced armor technologies; create armor system test & evaluation standards for advanced armor technologies and leverages the standards for armor component and armor system maturation; refine armor modeling and simulation system engineering process to incorporate advances in armor technologies.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Blast Mitigation</p> <p>Description: This effort fabricates and matures advanced survivability and protection components, tools, and subsystems for enhanced protection against vehicle mines, improvised explosive devices (IEDs) and other underbody blast threats, and vehicle collision and rollover events that result from blast events. This effort also integrates and improves occupant protection technologies such as seats and restraints. This effort creates the laboratory capability needed to enable expeditious performance evaluation through modeling & simulation (M&S), experimentation, and instrumented test of blast mitigating technologies in such areas as active and passive exterior/hull/cab/kits, interior energy absorbing capabilities for seats, floors, restraints, and sensors for active blast mitigating technologies.</p>		7.174	-	-
<p>Title: Vehicle Fire Protection</p> <p>Description: This effort matures, integrates, and demonstrates technologies to minimize vehicle and crew vulnerabilities to fires in current and future military ground vehicles. Supporting technologies include modeling & simulation, sensor systems, software, chemical agents, fire-resistant materials, and hardware components.</p>		2.628	-	-
<p>Title: Hit Avoidance Technologies</p> <p>Description: This effort matures, integrates, and demonstrates hard-kill (physical countermeasure) and soft-kill (non-kinetic countermeasure such as electronic jamming or spoofing) Active Protection System (APS) components and integrated systems to verify the APS Common Architecture and reduce integrating risk on current systems. In demonstrating hard-kill and soft kill-active protection technologies, requirements, and specifications will be matured for future integration onto tactical and combat vehicle platforms.</p>		28.365	-	-
<p>Title: System Design Optimization for Lightweighting</p> <p>Description: This effort will focus on optimization of platform design to reduce weight in both traditional and novel methods. This effort will demonstrate best practices in cost-conscious, multi-material design for components to reduce ground vehicle weight, as well as demonstrate holistic weight reduction with informed system and component-level design decisions. This will be accomplished by using and evaluating design tools, advanced materials, manufacturing processes and assembly technologies to design lightweight systems, develop lightweight components and enhance the ability to use novel approaches for lightweighting. This effort leverages lessons learned from prior and ongoing individual component efforts within industry, academia and Department of Defense (DoD).</p>		3.465	-	-
<p>Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p> <p>Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p>		0.130	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 221 / <i>Combat Veh Survivablty</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Accomplishments/Planned Programs Subtotals	56.726	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 441 / <i>Combat Vehicle Mobilty</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
441: <i>Combat Vehicle Mobilty</i>	-	25.773	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	25.773

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603119A Ground Advanced Technology
 * Project BK9 Ground System Fluids and Fuels Adv Tech
 PE 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BF7 Crew Augmentation and Optimization Adv Tech
 * Project BG4 Adv Mobility Experimental Prototype Adv Tech Demo
 * Project BH6 Platform Electrification and Mobility Adv Tech
 * Project B18 All-Electric Combat Powertrain Advanced Technology
 * Project BJ1 Vehicle System Security Advanced Technology
 * Project BJ6 Hydrogen Based Combat System Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced mobility and onboard electrical power technologies for combat and tactical vehicles to enable lightweight, agile, deployable, fuel efficient and survivable ground vehicles. Technologies include advanced propulsion, engines, transmissions, power, and electrical components and subsystems. This Project will also mature and demonstrate advanced mechanical and electrical power generation systems to increase available onboard electrical power to enable future capabilities such as next generation communications and networking, improvised explosive device jamming systems and next generation sensor devices can be supported on combat and tactical vehicles. This Project also matures and demonstrates water and fuel logistics technologies.

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

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY 2020 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Onboard Vehicle Electric Power Component Development:	2.838	-	-
Description: This effort focuses on meeting the Army's demand for more onboard vehicle electric power (OBVP) to enable technologies such as advanced survivability systems, situational awareness systems and the Army network. This effort matures, integrates, and demonstrates onboard vehicle power components to include electrical power generation machines and associated power converters such as high temperature inverters and converters, advanced control algorithms, and high efficiency power conversion (mechanical to electrical) components. Additionally, it matures and integrates advanced electric machines such			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 441 / <i>Combat Vehicle Mobility</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
as Integrated Starter Generator and their controls for mild hybrid (System that integrated electric machines to assist internal combustion engines for propulsion) electric propulsion and high power electric generation.				
Title: Advanced Running Gear: Description: This effort matures and demonstrates running gear components and advanced suspension technologies to increase vehicle mobility and durability in response to increased ground vehicle platform weights. Components and subsystems include new elastomer compounds, lightweight, survivable track systems and road wheels, advanced compensating track tensioners, advanced damping suspension technologies, Electronic Stability Control (ESC) systems, and preview sensing technologies linked to advanced suspension designs.		2.140	-	-
Title: Combat Vehicle Subsystem Demonstrations Description: This effort contributes to the Army's ground platform risk reduction efforts which seek to address technical and integration challenges in the areas of mobility, survivability, and vehicle architecture and systems integration. The primary focus of this activity is to mature and demonstrate a series of subsystem demonstrators building off of previous investment in ground combat acquisition and technology programs with the purpose of maturing key technologies to refine and inform future platform requirements and reduce risks in critical ground combat vehicle technology areas. Specifically, this effort focuses on maturing and demonstrating ground combat vehicle mobility technologies such as powertrain subsystems and systems integration technologies such as vehicle structures and concept demonstrators. This effort seeks to optimize platform efficiency and growth potential to ensure the combat fleet is able to accept new technologies as they are developed to bring advanced capability for the Warfighter.		8.112	-	-
Title: Energy Storage Systems Development: Description: The goal of this work is to mature energy storage systems to both enable silent watch capability and increased survivability through power brick energy storage components for pulse power electromagnetic armor. This is accomplished through the maturation and demonstration of advanced ground vehicle energy storage devices such as advanced chemistry batteries, high energy density capacitors, and power brick batteries for pulse power. This effort leverages commercial industry battery development efforts to reduce battery volume and weight while improving their energy and power densities. This effort also matures and optimizes a common specification for battery management systems to improve the battery state of charge indicator accuracy and battery state of health information to reduce the frequency of battery replacement and optimize starting, lighting, and ignition functions.		3.137	-	-
Title: Propulsion and Thermal Technologies: Description: This effort matures high power density engines and transmission systems needed to offset increasing combat vehicle weights (armor), increased electrical power generation needs (onboard communications, surveillance and exportable		4.793	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 441 / <i>Combat Vehicle Mobilty</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
power), improved fuel economy (fuel cost and range), enhanced mobility (survivability), and reduced cooling system burden (size and heat dissipation). This effort also matures thermal management including heat energy recovery, propulsion and cabin thermal management sub-systems to utilize waste heat energy and meet objective power and mobility requirements on combat and tactical vehicles. Lastly, this effort maximizes efficiencies within propulsion and thermal systems to reduce thermal burden on the vehicle while providing the same or greater performance capability.				
Title: Force Projection: Description: This effort focuses on reducing the logistics footprint, improving fuel efficiency, and ensuring mobility by maturing and demonstrating technologies in areas such as water purification, generation, quality monitoring, storage and distribution and wastewater treatment and reuse; petroleum quality monitoring, filtration, storage and distribution, hydraulic fluids; alternative fuels and fuel additives; lubricants, oil, powertrain fluids and coolants.		2.206	-	-
Title: Crew Augmentation Description: This effort focuses on optimizing crew station technologies while reducing crew sizes that will provide the same overall performance by exploiting human interaction technologies, automations, machine intelligence and customization to permit soldiers to achieve performance beyond today?s constrained ground vehicle environment.		2.547	-	-
Accomplishments/Planned Programs Subtotals		25.773	-	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 497 / <i>Combat Vehicle Electro</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
497: <i>Combat Vehicle Electro</i>	-	6.993	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.993

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BH8 Enhanced VETRONICS Advanced Technology

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 is known as the Vehicle Integration for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance / Electronic Warfare (C4ISR/EW) Interoperability (VICTORY), which is a long term technology effort that provides an open architecture that will allow platforms to accept future technologies without the need for significant re design as new technologies are developed and integrated. Additionally this Project matures autonomy architectures that enable 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 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.

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

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY 2020 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Vehicle Electronics Integration Technologies:	2.803	-	-
Description: This effort matures, demonstrates and implements next generation military ground vehicle electronics and electrical power open architectures for future ground combat and tactical vehicle systems. Mature and demonstrate technologies to include: next generation video/data networking and computing equipment, Silicon Carbide high voltage power electronics and low voltage smart power distribution. Technologies will reduce currently fielded vehicle overall size, weight and power concerns for vehicle electronics.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 497 / <i>Combat Vehicle Electro</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Vehicle Electronics Architecture and Standards:</p> <p>Description: This effort matures technologies and standards for existing and future combat and tactical ground vehicles. Open commercial standards will be evaluated and modified for use in military ground vehicles and possible inclusion in the Army's open, non-proprietary intra-vehicle data network e.g., VICTORY. This effort will also evaluate standards and components for suitability of integration into vehicle platforms. This effort also supplements the design of electronic architectures to support the efficient integration of electronic components into vehicle systems through the use of open standards. Additionally, this effort matures and expands the VICTORY effort to interface with the Modular Active Protection System (MAPS) Architecture.</p>		3.015	-	-
<p>Title: Autonomous Vehicle Architecture:</p> <p>Description: This project matures, integrates, and demonstrates an improved, optimized autonomy-enabled distribution architecture that eases integration of new and emerging technologies across the full spectrum of operational and tactical supply movement operations. This project addresses systems integration challenges by providing the appropriate fault tolerant architecture design artifacts that will allow ease of integration for autonomy enablement kits, autonomy enablement software, and end-to-end sustainment and tactical ground resupply capability through use of open systems interfaces.</p>		1.175	-	-
Accomplishments/Planned Programs Subtotals		6.993	-	-
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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>					Project (Number/Name) 515 / <i>Robotic Ground Systems</i>		
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
515: <i>Robotic Ground Systems</i>	-	24.956	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.956

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BF2 Autonomous Ground Resupply (AGR) Adv Tech
 * Project BF4 Combat Vehicle Robotics Adv Tech
 * Project BK1 Autonomous Mobility Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies to enable Unmanned Ground Vehicles (UGV) including sensor technologies, perception hardware and software, and control technologies that allow the Soldier to perform mission tasks more efficiently. Challenges addressed include: obstacle avoidance, overcoming perception limitations, intelligent situational behaviors, command and control by Soldier operators, frequency of human intervention, operations in adverse weather, and autonomy enabled vehicles protecting themselves and their surroundings from intruders. Mature technologies are incorporated onto existing, Army owned UGV technology demonstrators so that performance of the enabling technologies can be evaluated.

The approach builds upon, complements, and does not duplicate previous and ongoing investments conducted under the Joint Robotics Program Office. Work in this Project supports the Army Science and Technology Ground Maneuver Portfolio. Ground Maneuver Portfolio investments are greatly improving logistics throughput and surge capability supporting maneuver forces (Leader Follower technology) and allow experimentation with manned and unmanned teams to develop the advantages that inform/protect the maneuver force (Robotic Wingman JCTD).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

Title: Unmanned Ground Systems Technology:	FY 2019	FY 2020	FY 2021
	8.955	-	-
Description: This effort matures, integrates, and demonstrates advanced robotic and autonomous technologies for the tactical and combat vehicle fleets. Unmanned ground systems technologies can be employed to overcome critical Army challenges to include automated resupply and sustainment, and reduced physical and cognitive burden. Challenges can be met by utilizing relevant technologies such as behavior algorithms, autonomy kits, sensor integration, advanced navigation and planning, object and local environment manipulation, local situational awareness, advanced perception, vehicle and pedestrian safety, and robotic command and control.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 515 / <i>Robotic Ground Systems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Title: Autonomous Ground Vehicle Architecture Integration and Demonstration Description: This effort matures, integrates, and demonstrates advanced robotic and autonomous foundational architecture and the technologies to enable tactically relevant unmanned ground systems. Technologies focused on creating an open Autonomous Ground Vehicle Reference Architecture for all future unmanned platforms, improved tactical and maneuver intelligence and behavior algorithms based off the architecture, sensor integration and advanced perception for off road, manned and unmanned teaming for the tactical environment, and enabling the integration of weapons and vehicle self-protection capabilities.	16.001	-	-
Accomplishments/Planned Programs Subtotals	24.956	-	-

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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>				Project (Number/Name) 533 / <i>Ground Vehicle Demonstrations (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
533: <i>Ground Vehicle Demonstrations (CA)</i>	-	57.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	57.000

A. Mission Description and Budget Item Justification

These are Congressional Interest Items

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

	FY 2019	FY 2020
Congressional Add: Program increase - lightweight technology for ground combat and tactical vehicles	10.000	-
FY 2019 Accomplishments: Program increase - lightweight technology for ground combat and tactical vehicles		
Congressional Add: Program increase - advanced water harvesting technology	5.000	-
FY 2019 Accomplishments: Program increase - advanced water harvesting technology		
Congressional Add: Program increase - fuel cell research	5.000	-
FY 2019 Accomplishments: Program increase - fuel cell research		
Congressional Add: Program increase - airless tire technology demonstration	4.000	-
FY 2019 Accomplishments: Program increase - airless tire technology demonstration		
Congressional Add: Program increase - HMMWV automotive enhancements	10.000	-
FY 2019 Accomplishments: Program increase - HMMWV automotive enhancements		
Congressional Add: Program increase - HMMWV autonomy	3.000	-
FY 2019 Accomplishments: Program increase - HMMWV autonomy		
Congressional Add: Program increase - HMMWV power system	2.000	-
FY 2019 Accomplishments: Program increase - HMMWV power system		
Congressional Add: Program increase - HMMWV torque monitoring	3.000	-
FY 2019 Accomplishments: Program increase - HMMWV torque monitoring		
Congressional Add: Program increase - multi-sensor augmented reality system	5.000	-
FY 2019 Accomplishments: Program increase - multi-sensor augmented reality system		
Congressional Add: Program increase - combat vehicle weight reduction initiative	10.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603005A / <i>Combat Vehicle and Automotive Advanced Technology</i>	Project (Number/Name) 533 / <i>Ground Vehicle Demonstrations (CA)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2019 Accomplishments:</i> Program increase - combat vehicle weight reduction initiative		
Congressional Adds Subtotals	57.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603006A / <i>Space Application Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	48.542	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	48.542
257: <i>DIGITAL BATTLEFLD COMM (CA)</i>	-	36.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.000
592: <i>Space Application Tech</i>	-	12.542	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.542

Note
In Fiscal Year (FY) 2020 this Program Element (PE) is realigned to the following PE:
* 0603463A Network C3I Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates advanced space technologies that 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 space policies. This PE provides applications for enhanced intelligence, reconnaissance, surveillance, target acquisition, position/navigation/timing, missile warning, ground-to-space surveillance, and command and control capabilities. Project 592 matures and demonstrates networked and integrated surveillance, communications, and command and control capabilities for high altitude and tactically responsive space payloads to enable information superiority, enhanced situational awareness, and support global assured access enabling distributed tactical operations.

Work in this PE complements the work in PE 0602120A (Sensors and Electronic Survivability), and PE 0603794A (C3 Advanced Technology).

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 in this PE is performed by the United States Army Space and Missile Defense Command/Army Forces Strategic Command (USASMDC/ARSTRAT) Technical Center in Huntsville, AL.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603006A / <i>Space Application Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	48.985	0.000	0.000	-	0.000
Current President's Budget	48.542	0.000	0.000	-	0.000
Total Adjustments	-0.443	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.443	-			

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

Project: 257: DIGITAL BATTLEFLD COMM (CA)

Congressional Add: *Tactical Small Launch*

Congressional Add: *Global Communications Research*

Congressional Add: *Assured Positioning, Navigation and Timing for Space and Missile Defense Assets*

Congressional Add Subtotals for Project: 257

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	20.000	-
	10.000	-
	6.000	-
Congressional Add Subtotals for Project: 257	36.000	-
Congressional Add Totals for all Projects	36.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603006A / <i>Space Application Advanced Technology</i>	Project (Number/Name) 257 / <i>DIGITAL BATTLEFLD COMM (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
257: <i>DIGITAL BATTLEFLD COMM (CA)</i>	-	36.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Space Application Advanced Technology as specified in Appropriations Act Conference Reports.

Congressional adds fund efforts to: adapt and mature Conventional Prompt Strike technologies in both the payload delivery vehicle and the payload to meet the Army's emerging long range fires requirements; mature design of glide body, optimize flight-proven navigation, guidance, and control system, and exploit internal layout and design of current vehicle to meet required range, payload, and lethality capabilities; mature and demonstrate Space and High Altitude based global communications technologies and multi-payload/platform communication and prioritization protocols in order to demonstrate commanders guaranteed access to critical communications and position and timing to ensure mission command.

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

	FY 2019	FY 2020
<i>Congressional Add:</i> Tactical Small Launch	20.000	-
<i>FY 2019 Accomplishments:</i> Tactical Small Launch		
<i>Congressional Add:</i> Global Communications Research	10.000	-
<i>FY 2019 Accomplishments:</i> Global Communications Research		
<i>Congressional Add:</i> Assured Positioning, Navigation and Timing for Space and Missile Defense Assets	6.000	-
<i>FY 2019 Accomplishments:</i> Assured Positioning, Navigation and Timing for Space and Missile Defense Assets		
Congressional Adds Subtotals	36.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603006A / <i>Space Application Advanced Technology</i>	Project (Number/Name) 592 / <i>Space Application Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>592: Space Application Tech</i>	-	12.542	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.542

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology
 * Project A06 Tag Track and Locate Small Satellites Adv Tech
 * Project AV2 LEO Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates payloads, sensors, and data down link systems for tactically responsive space and high altitude platforms supporting Army ground forces. This Project matures, demonstrates, and integrates lightweight materials, hardware components with reduced power consumption, and advanced data collection, processing, and dissemination capabilities. This Project also develops algorithms that process space and near space sensor data in real and near real time for integration into battlefield operating systems. 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 space policies.

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, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy.

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

	FY 2019	FY 2020	FY 2021
Title: Payload Technology Development	12.542	-	-
Description: This effort matures technologies for smaller, Warfighter-responsive sensor and communication small satellite constellations. Work related to standard Army networks is done in coordination with the Communications-Electronics Research Development and Engineering Center (CERDEC) and the Army Cyber Center of Excellence.			
Accomplishments/Planned Programs Subtotals	12.542	-	-

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603006A / <i>Space Application Advanced Technology</i>	Project (Number/Name) 592 / <i>Space Application Tech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	6.270	11.038	11.659	-	11.659	14.919	15.908	17.039	18.701	0.000	95.534
792: <i>Personnel Performance & Training</i>	-	6.270	11.038	11.659	-	11.659	14.919	15.908	17.039	18.701	0.000	95.534

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	8.038	11.038	11.189	-	11.189
Current President's Budget	6.270	11.038	11.659	-	11.659
Total Adjustments	-1.768	0.000	0.470	-	0.470
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.567	-			
• SBIR/STTR Transfer	-0.201	-			
• Adjustments to Budget Years	-	-	0.470	-	0.470

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army Date: February 2020

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

FY19 decrease related to funds reprogrammed out for higher priority Army requirements.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
792: <i>Personnel Performance & Training</i>	-	6.270	11.038	11.659	-	11.659	14.919	15.908	17.039	18.701	0.000	95.534

A. Mission Description and Budget Item Justification

This Project matures and evaluates 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 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 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 2019	FY 2020	FY 2021
Title: Talent Assessment and Development	5.885	10.667	11.659
Description: This effort refines and assesses innovative talent management approaches to provide the Army the flexibility to adapt to changes in force structure and recruiting environments. This effort evaluates 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 evaluates methods to develop and model Soldier talents/competencies longitudinally across a career.			
FY 2020 Plans: Validating expanded screening tools to more comprehensively identify high-potential and high-risk individuals; validating Leader and advisor competency-assessment methods; conducting research to develop methods to rapidly generate test content for knowledge tests; conducting research to validate assessments to predict effective teamwork behaviors and performance.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will conduct research to validate personnel assessment measures to improve selection and assignment; will conduct research to mature and validate methods to develop critical leader competencies for Non-Commissioned Officer (NCOs); will conduct research to demonstrate psychometric validity of small unit performance measurement tools. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort				
Title: Unit Performance and Cohesion Description: This effort will mature and refine measures and methods to ensure cohesive, high performing teams for future operational environments. This effort will also mature and assess to optimize team composition to enhance unit performance; methods to rapidly build and sustain team cohesion; and metrics and assessments of unit performance, command climate, unit resilience, and cohesion.		0.385	-	-
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.371	-
Accomplishments/Planned Programs Subtotals		6.270	11.038	11.659
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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603009A / <i>TRACTOR HIKE</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	22.631	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	22.631
B18: <i>DB18</i>	-	8.704	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.704
FH1: <i>Tractor Hike</i>	-	13.927	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.927

Note

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

A. Mission Description and Budget Item Justification

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

B. Program Change Summary (\$ in Millions)

	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021 Base</u>	<u>FY 2021 OCO</u>	<u>FY 2021 Total</u>
Previous President's Budget	22.631	0.000	0.000	-	0.000
Current President's Budget	22.631	0.000	0.000	-	0.000
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

Change Summary Explanation

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603009A / <i>TRACTOR HIKE</i>				Project (Number/Name) B18 / <i>DB18</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
B18: <i>DB18</i>	-	8.704	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.704

A. Mission Description and Budget Item Justification

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603009A / TRACTOR HIKE				Project (Number/Name) FH1 / Tractor Hike			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
FH1: <i>Tractor Hike</i>	-	13.927	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.927

A. Mission Description and Budget Item Justification

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	27.711	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.711
S28: <i>Immersive Learning Environments</i>	-	3.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.000
S29: <i>Modeling & Simulation - Adv Tech Dev</i>	-	16.495	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.495
S31: <i>Modeling And Simulation Infrastructure Technology</i>	-	8.216	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.216

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PE:
? 0603118A Soldier Lethality Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates tools to enable effective training capability for the Warfighter. Project S28 matures and demonstrates simulation technologies developed by the Institute for Creative Technologies (ICT) at the University of Southern California. Project S29 incorporates advanced modeling and simulation (M&S), training, and leader development technology into immersive training demonstrations as well as demonstrates a framework for future embedded training and simulation systems for future force combat and tactical vehicles, and dismounted Soldier systems. Project S31 develops, integrates and demonstrates an overarching M&S architecture that incorporates multi-resolution, entity-based models, simulations, and tools to enable Network-Centric Warfare M&S capability.

Work in this PE complements and is fully coordinated with efforts in PE 0602308A (Advanced Concepts and Simulation), PE 0602785A (Manpower/Personnel/Training Technology), PE 0602787A (Medical Technology) and PE 0603007A (Manpower, Personnel and Training Advanced 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. FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work is performed by the United States Army Futures Command.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	28.650	0.000	0.000	-	0.000
Current President's Budget	27.711	0.000	0.000	-	0.000
Total Adjustments	-0.939	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.939	-			

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

Project: S28: *Immersive Learning Environments*

Congressional Add: *Program increase - Immersive Learning Environments*

	FY 2019	FY 2020
	3.000	-
Congressional Add Subtotals for Project: S28	3.000	-
Congressional Add Totals for all Projects	3.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>				Project (Number/Name) S28 / <i>Immersive Learning Environments</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>S28: Immersive Learning Environments</i>	-	3.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.000

A. Mission Description and Budget Item Justification

This Project matures and demonstrates immersive technologies that include the application of photorealistic synthetic environments, multi-sensory interfaces, virtual humans, and training applications on low-cost game platforms for Soldier training applications using simulation technologies. This Project uses advanced modeling, simulation, and leadership development techniques to leverage the emerging immersive technologies that are created at the Institute for Creative Technologies (ICT) University Affiliated Research Center (UARC) at the University of Southern California to develop training demonstrators. These demonstrators focus on urban operations, asymmetric warfare, resilience and rehabilitation to support Warfighting units and Army Institutions (Army Training and Doctrine Command (TRADOC) and Army Medical Command (MEDCOM)). Resilience and rehabilitation research will focus on Post Traumatic Stress Disorder (PTSD). The ICT's collaboration with its entertainment partners creates a true synthesis of creativity and technology that harnesses the capabilities of industry, and the research and development community to advance the Army's capabilities.

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

In Fiscal Year 2019 (FY19), this Project received a congressional add (\$3.0 Million). There are no planned efforts beyond FY19 for this Project.

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

	FY 2019	FY 2020
Congressional Add: Program increase - Immersive Learning Environments	3.000	-
FY 2019 Accomplishments: Program increase - Immersive Learning Environments		
Congressional Adds Subtotals	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 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>				Project (Number/Name) S29 / <i>Modeling & Simulation - Adv Tech Dev</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>S29: Modeling & Simulation - Adv Tech Dev</i>	-	16.495	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.495

Note
 In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 *Project BC8 Training Advanced Technology (Other than Synthetic Training Environment (STE))
 *Project BE9 Synthetic Training Environment (STE) technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates next generation training and simulation systems that integrate virtual threats, asymmetric warfare concepts, network-centric operations, and embedding training capabilities as well as technologies into operational go-to-war future force systems to include dismounted warrior systems. The synergy between these embedded training capabilities and the immersive training advanced technology development in Project S28 (Immersive Learning Environments) provides Army units with a set of complementary embedded as well as deploy-on-demand systems that provide just-in-time, dynamic, realistic training, and mission rehearsal capabilities. Demonstrations include technologies that form a framework for future training applications for the range of future force operations such as robotic control and other sensor operations; mission planning and rehearsal; maneuver; Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) network analysis to support distributed simulations; and vehicle system interface requirements. This Project creates a joint environment by synchronizing virtual and constructive simulated forces with the next generation and current training systems from the Army, Navy, Air Force, and Marine Corps forces.

The cited work is consistent with the science and technology (S&T) priorities of the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Training Effectiveness	1.300	-	-
Description: This research addresses the effectiveness of training Soldiers and teams in immersive environments. This effort will research and develop simulations to determine the interaction of realism, immersion, acceptance, and training effectiveness. A baseline of the key dimensions of realism and immersion for current training systems will be developed and will be extended to generate guidelines for the development of future training technologies. Cost effectiveness of these training components will also be considered.			
Title: Mixed and Augmented Reality	4.151	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>	Project (Number/Name) S29 / <i>Modeling & Simulation - Adv Tech Dev</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Description: This effort matures and demonstrates mixed and augmented reality technologies that seamlessly blend synthetic and real environments to provide a more realistic training environment for Soldiers. Efforts matured by this effort transition to Program Executive Office Simulation, Training and Instrumentation (PEO-STRI).</p> <p>Title: Mixed and Augmented Reality for Complex Environments</p> <p>Description: This effort matures and demonstrates the models and simulations that enable immersive training in future complex operational environments involving megacity terrain and unmanned autonomous systems. These technologies support the Army capability needs for the soldier to have better asymmetric vision and decide faster for dismounted soldiers in a complex urban environment.</p>	1.144	-	-
<p>Title: Synthetic Training Environment Acceleration</p> <p>Description: This effort matures and demonstrates technologies to enable a Synthetic Training Environment which is a single, interconnected training system in which units from squad through ASCC can train in the most appropriate domain - live, virtual, constructive, and gaming, or in all four simultaneously.</p>	9.894	-	-
<p>Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p> <p>Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p>	0.006	-	-
Accomplishments/Planned Programs Subtotals	16.495	-	-

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>				Project (Number/Name) S31 / <i>Modeling And Simulation Infrastructure Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>S31: Modeling And Simulation Infrastructure Technology</i>	-	8.216	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.216

Note
 In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 *Project BC4 Soldier Decision Making & Comms Performance Advanced Technology
 *Project BC8 Training Advanced Technology (Other than Synthetic Training Environment (STE))
 *Project BE9 STE Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a distributed modeling and simulation (M&S) environment that integrates a collection of multi-fidelity models and simulations and tools that map to an evolving architecture and M&S activities to support decisions throughout the acquisition life-cycle. This provides a unifying M&S architecture that synchronizes and integrates multi-resolution modeling applications such as Live, Virtual, and Constructive (LVC) experimentation. This effort focuses on researching cutting-edge M&S methods to enable the Army and the Department of Defense (DoD) to perform critical System of Systems (SoS) analysis, experimentation, technology tradeoffs, capability assessments, concept development, and training that saves time and resources while increasing the effectiveness of acquisition and training activities.

Efforts in this Project support the Under Secretary of Defense for Research and Engineering science and technology (S&T) priorities and the Army Modernization Strategy.

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
Title: Simulation Tools and Models	6.216	-	-
Description: This effort matures and demonstrates M&S technologies and techniques that support training and experimentation to assess and support system acquisition and military planning decision-making and System of Systems architecture, technology tradeoffs, etc. This research transitions to the United States Army Program Executive Office for Simulation, Training and Instrumentation (PEO STRI).			
Title: Early Human Systems Integration Demonstrations	2.000	-	-
Description: This effort will mature and demonstrate state of the art methods, tools and techniques to integrate human systems integration (HSI) early in the S&T and requirements analysis process to ensure effective and efficient design and development of			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603015A / <i>Next Generation Training & Simulation Systems</i>	Project (Number/Name) S31 / <i>Modeling And Simulation Infrastructure Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
future Soldier systems. The goal of this effort is to demonstrate the effect early HSI can have on developing the most effective, efficient, and affordable design and on predicting and improving total system performance. This effort is coordinated with the United States Army Human Systems Integration Directorate, G1.			
Accomplishments/Planned Programs Subtotals	8.216	-	-

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.000	27.723	-	27.723	26.849	27.386	27.934	28.482	0.000	138.374
EB3: <i>HIV Medical Development</i>	-	0.000	0.000	27.723	-	27.723	26.849	27.386	27.934	28.482	0.000	138.374

Note

This is a new start in FY2021.

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

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 their 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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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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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 Materiel Command (USAMRMC), Fort Detrick, Maryland.

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

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	27.723	-	27.723
Total Adjustments	0.000	0.000	27.723	-	27.723
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	27.723	-	27.723

Change Summary Explanation

In FY21, funding transferred to the Army from the Defense Health Program (DHP) research, development, test, and evaluation (RDTE) Program Elements 0603115DHA (Projects 504, 431A, 448A, and 830A), 0605013DHA (Projects 283C, 283L, and 283P), and 0605145DHA (Project 432A).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
EB3: <i>HIV Medical Development</i>	-	0.000	0.000	27.723	-	27.723	26.849	27.386	27.934	28.482	0.000	138.374

Note

This is a new start in FY2021.

In Fiscal Year 2021 (FY21) this is a New Start.

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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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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.

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 Materiel Command (USAMRMC), Fort Detrick, Maryland.

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

	FY 2019	FY 2020	FY 2021
<p>Title: HIV Medical Development</p> <p>Description: The Military HIV Research Program aims to develop candidate HIV vaccines, to assess 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 down selects one or more vaccine candidates that are optimized through pre-clinical studies in non-human primates 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 will continue 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 2020 to FY 2021 Increase/Decrease Statement:</p>	-	-	8.035

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0603115DHA Project 448A.				
<p>Title: WRAIR Vaccine Production Facility Research</p> <p>Description: The WRAIR Vaccine Pilot Bioproduction Facility will focus on the manufacture of early phase clinical materials for vaccine production from varied platforms, such as live virus, conjugates, recombinant proteins, DNA, and monoclonal antibody 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.</p> <p>FY 2021 Plans: The WRAIR PBF program will continue vaccine and biologic production efforts for use in early phase clinical trials to assess safety and effectiveness of candidate vaccines.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0603115DHA Project 504.</p>		-	-	8.315
<p>Title: Underbody Blast Testing</p> <p>Description: The UBB Testing will provide an understanding of the biomechanics of skeletal injuries that occur in a combat vehicle UBB event involving a landmine or 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.</p> <p>FY 2021 Plans: The Underbody Blast Testing program will prepare final reports and complete contract closeouts to support completion of program efforts.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0603115DHA Projects 431A.</p>		-	-	1.400
<p>Title: Deployed Warfighter Protection</p> <p>Description: The Deployed Warfighter Protection project will develop new or improved protection for ground forces from disease carrying insects.</p> <p>FY 2021 Plans: The Deployed Warfighter Protection research project will continue 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,</p>		-	-	6.473

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>primarily mosquitoes and sand flies, which transmit force degrading diseases. The AFPMB Vector Control Capabilities Gap Analysis (completed in FY 2016) will continue to be used to inform the development of functional and performance requirements for future acquisition programs. In addition, the AFPMB will continue to develop the necessary test and evaluation plans to determine a candidate product's ability to meet its stated requirements.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0603115DHA Project 830A.</p>				
<p>Title: Medical Operational Data System</p> <p>Description: The Medical Operational Data System information management system will provide responsive and reliable human resource and medical readiness data for all categories of military and civilian medical and support personnel.</p> <p>FY 2021 Plans: Medical Operational Data System will respond 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 for system engineering and acquisition effectiveness services. These technology upgrades will 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 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0605013DHA Project 283C.</p>		-	-	1.994
<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 will implement the testing of the drug surveillance and data visualization capabilities that were developed during previous fiscal years.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0605013DHA Project 283L.</p>		-	-	0.350
<p>Title: Mobile Health Care Environment</p> <p>Description: The Mobile HealthCare Environment is the capability of secure, bidirectional messaging and data exchange between patients, providers and clinics using any electronic device.</p> <p>FY 2021 Plans:</p>		-	-	0.364

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>The Mobile HealthCare Environment program will finalize 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 system enhancements will support 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 2020 to FY 2021 Increase/Decrease Statement: Funding transferred from the Defense Health Program (DHP) RDTE Program Element 0605013DHA Project 283P.</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: Will fund authorized civilian salaries and associated expenses (supplies, equipment, travel, etc.) at USAMRDC and United States Army Medical Research Acquisition Activity. Funding will also provide regulatory, clinical monitoring and data support for the Special Immunization Program. This program will provide non-licensed vaccines under FDA oversight to personnel at risk of exposure to selected infectious diseases.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding was realigned from Program Element 0605801A Project M02.</p>	-	-	0.792
Accomplishments/Planned Programs Subtotals	-	-	27.723

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	66.338	62.663	-	62.663	63.334	62.685	63.734	64.317	0.000	383.071
BS2: <i>Army Advanced Technology Development</i>	-	0.000	66.338	62.663	-	62.663	63.334	62.685	63.734	64.317	0.000	383.071

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	63.338	68.043	-	68.043
Current President's Budget	0.000	66.338	62.663	-	62.663
Total Adjustments	0.000	3.000	-5.380	-	-5.380
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	3.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-5.380	-	-5.380

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	135.968	109.608	-	109.608	112.771	113.357	114.417	147.151	0.000	733.272
AY5: Soldier Squad Small Arms Armaments Advanced Tech	-	0.000	8.000	10.110	-	10.110	11.589	6.368	9.123	12.121	0.000	57.311
AY7: Small Arms Fire Control Advanced Technology	-	0.000	12.880	13.954	-	13.954	13.520	3.497	2.997	0.000	0.000	46.848
AY9: Body Armor & Integrated Headborne Advanced Tech	-	0.000	14.809	10.002	-	10.002	7.812	7.928	7.994	38.393	0.000	86.938
AZ6: Soldier Signature Management Advanced Technology	-	0.000	1.711	1.743	-	1.743	1.778	1.814	1.834	1.852	0.000	10.732
AZ8: Soldier Squad Small Arms Armaments Adv Tech	-	0.000	2.175	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.175
BB3: Dismounted Soldier Survivability Equip/Tech Integ	-	0.000	1.466	1.319	-	1.319	4.064	4.379	4.428	4.428	0.000	20.084
BB6: Physical Augmentation: Adv Tech for Field Demo	-	0.000	4.000	2.997	-	2.997	0.000	0.000	0.000	0.000	0.000	6.997
BB8: Soldier Centric Advanced Technology	-	0.000	7.797	6.091	-	6.091	5.358	2.609	2.627	8.573	0.000	33.055
BC1: Human Performance AdvTech for Mobility & Lethality	-	0.000	4.832	11.805	-	11.805	12.079	8.405	5.946	2.085	0.000	45.152
BC4: Soldier Decision Making&Comms Performance AdvTech	-	0.000	2.000	1.998	-	1.998	2.038	2.079	2.103	2.124	0.000	12.342
BC8: Training Advanced Technology (Other than STE)	-	0.000	1.335	4.470	-	4.470	4.501	2.635	2.621	2.571	0.000	18.133
BC9: Adv Soldier Sensors/ Displays AdvTech for Dismounts	-	0.000	13.659	10.999	-	10.999	16.838	33.619	33.961	33.964	0.000	143.040
BD7: Soldier Sys Interfaces/ Integration-Sensor AdvTech	-	0.000	9.671	9.060	-	9.060	8.478	8.645	8.983	9.074	0.000	53.911

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army										Date: February 2020		
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>							
BD9: <i>Soldier & Sm Unit Tactical Energy AdvTech</i>	-	0.000	3.101	3.160	-	3.160	3.223	4.296	4.358	4.402	0.000	22.540
BE2: <i>Joint Service Combat Feeding Advanced Technology</i>	-	0.000	1.782	2.417	-	2.417	2.454	2.046	2.069	2.069	0.000	12.837
BE5: <i>Personnel & Airdrop Safety Advanced Technology</i>	-	0.000	6.770	6.293	-	6.293	6.964	6.954	7.046	7.117	0.000	41.144
BE9: <i>STE Advanced Technology</i>	-	0.000	22.480	13.190	-	13.190	12.075	18.083	18.327	18.378	0.000	102.533
BS8: <i>Soldier Lethality Advanced Technology</i>	-	0.000	17.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.500

Note

In Fiscal Year (FY) 2020 this Program Element (PE) was previously funded, with continuity of effort realigned from the following PEs:

- * 0603001A Warfighter Advanced Technology
- * 0603004A Weapons and Munitions Advanced Technology
- * 0603015A Next Generation Training & Simulation Systems
- * 0603606A Landmine Warfare and Barrier Advanced Technology
- * 0603607A Joint Service Small Arms Program
- * 0603710A Night Vision Advanced Technology

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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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.

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

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	118.468	109.968	-	109.968
Current President's Budget	0.000	135.968	109.608	-	109.608
Total Adjustments	0.000	17.500	-0.360	-	-0.360
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	17.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-0.360	-	-0.360

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 Subtotals for Project: BS8

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	1.500
	-	6.000
	-	5.000
	-	5.000
Congressional Add Subtotals for Project: BS8	-	17.500
Congressional Add Totals for all Projects	-	17.500

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army Date: February 2020

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*

Change Summary Explanation
FY20 increase related to FY20 Congressional Adds.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AY5: <i>Soldier Squad Small Arms Armaments Advanced Tech</i>	-	0.000	8.000	10.110	-	10.110	11.589	6.368	9.123	12.121	0.000	57.311

Note

In Fiscal Year (FY) 2020 this Project is being realigned from:
 Program Element (PE) 0603607A Joint Service Small Arms Program:
 * Project 627 Joint Service Small Arms Program (JSSAP)

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 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)

Title: Small Arms Technology Demonstration	FY 2019	FY 2020	FY 2021
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.	-	7.637	2.895
FY 2020 Plans: Mature the technologies for the Next Generation Family of Ammunition (NGFoA) Advanced Armor Piercing (ADVAP) round to technology readiness level (TRL) 6, System/subsystem model or prototype demonstration in a relevant environment, to ensure optimal performance against hard and soft targets; mature and demonstrate Joint Remote Weapon Station technologies and optimize Advanced Weapon Operating Technologies for Technology Insertions into emerging systems.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to the Next Generation Family of Ammo effort within this Project.</p>				
<p>Title: Next Generation Family of Ammo</p> <p>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.</p> <p>FY 2021 Plans: Will 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).</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding in this effort was realigned from Small Arms Technology Demonstration within this Project and PE 0602143A (Soldier Lethality Technology) / AY6 (Soldier Squad Small Arms Armaments Technology).</p>		-	-	7.215
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.363	-
Accomplishments/Planned Programs Subtotals		-	8.000	10.110
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AY7: Small Arms Fire Control Advanced Technology</i>	-	0.000	12.880	13.954	-	13.954	13.520	3.497	2.997	0.000	0.000	46.848

Note

In Fiscal Year (FY) 2020 this Project is being realigned from:
 Program Element (PE) 0603710A Night Vision Advanced Technology:
 *Project K70 Night Vision Advanced Technology
 PE 0603004A Weapons and Munitions Advanced Technology:
 *Project 232 Advanced Lethality & Survivability Demonstration

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

Title: Soldier Squad Small Arms Armaments Advanced Technology	FY 2019	FY 2020	FY 2021
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).	-	12.296	13.954
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Mature and configure modular, multispectral, digital weapon sensor technologies and modalities; optimize identification range and integrate with lighter weight payload; optimize design of multifunction sensor system for fire support and dismounted Scout Operations; optimize illuminator and designator laser source; and mature image processing approaches.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Increase in funding from PE 0603318A (Soldier Lethality Advanced Technology) / AY5 (Soldier Squad Small Arms Armaments Advanced Tech) to support development of demonstrator for Soldier assessment.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.584	-
Accomplishments/Planned Programs Subtotals		-	12.880	13.954
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AY9: Body Armor & Integrated Headborne Advanced Tech</i>	-	0.000	14.809	10.002	-	10.002	7.812	7.928	7.994	38.393	0.000	86.938

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project FF6 Individual Protection

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)

Title: Body Armor & Integrated Headborne Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	14.137	10.002
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Mature combat helmet forming processes to enhance protective performance by integrating state of the art, high performance polyethylene materials; exploit hybridized material configurations and architectures to demonstrate a combat helmet with lower weight small arms protective capability; demonstrate a real time ballistic helmet test methodology to improve behind-helmet blunt trauma measurement capabilities and provide performance data for correlation to emerging head/brain injury criteria to inform future combat helmets requirements; integrate hearing and eyewear protection findings onto optimized platforms to enhance individual Soldier hearing protection and maximize operational situational awareness; optimize and mature head-borne shock tube test methodology as a means to improve blast-over pressure profiles that can be correlated to operational blast environment conditions; exploit existing and developmental ballistic resistant materials in new system architectures to provide vital torso region protection against emerging, near peer, small arms threats to provide near term performance trade space analysis.</p> <p>FY 2021 Plans: Will 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 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 2020 to FY 2021 Increase/Decrease Statement: Lower funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.672	-
Accomplishments/Planned Programs Subtotals		-	14.809	10.002
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AZ6: Soldier Signature Management Advanced Technology</i>	-	0.000	1.711	1.743	-	1.743	1.778	1.814	1.834	1.852	0.000	10.732

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project FF6 Individual Protection

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 to 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 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) B12 (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)

Title: Soldier Camouflage, Concealment and Decoys Demonstration	FY 2019	FY 2020	FY 2021
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, 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 in	-	1.634	1.743

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
closing the capability gap between current camouflage, concealment, and deception technologies and defeating enemy sensorial capabilities in future operating environments.				
<p>FY 2020 Plans: Improve coatings and overgarment clothing for Soldier clothing and individual equipment that reduces the probability of Soldier detection from thermal sensors; mature topical applications to conceal exposed skin (i.e. face, hands) from thermal sensors; demonstrate performance of advanced textile printing that imparts multiple functionalities to include durable camouflage patterns to clothing and individual equipment from visual and thermal sensors.</p> <p>FY 2021 Plans: Will demonstrate 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; optimize the balance between detection, protection, comfort and durability of clothing systems; mature and demonstrate 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>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.077	-
Accomplishments/Planned Programs Subtotals		-	1.711	1.743
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AZ8: Soldier Squad Small Arms Armaments Adv Tech</i>	-	0.000	2.175	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.175

Note

In Fiscal Year 2020 (FY20) this Project was being realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project FF6 Individual Protection

In FY21 this Project is realigned to:
 PE 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, provide effective deception capabilities, 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 and increased protection of high-valued assets. Demonstrations conducted under this project will support S&T efforts in Soldier Lethality protection/survivability projects to 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 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)

Title: High-Value Asset Camouflage, Concealment and Decoys Demonstration	FY 2019	FY 2020	FY 2021
	-	2.076	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>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 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 2020 Plans: Mature the performance of advanced camouflage laminate and textile systems and decoy technology on high value assets (i.e. mission command platforms, battle management centers); mature and demonstrate integrated signature management technologies for high-valued assets to improve effectiveness against visual and thermal sensors to enable expeditionary maneuver and mission command during multi-domain operations and to increase survivability of friendly forces while retaining combat power and resilient formations.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support PE 0603463A (Network C3I Advanced Technology) / AQ1 (Spectrum Obfuscation Advanced Technology).</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.099	-
Accomplishments/Planned Programs Subtotals	-	2.175	-

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BB3: <i>Dismounted Soldier Survivability Equip/Tech Integ</i>	-	0.000	1.466	1.319	-	1.319	4.064	4.379	4.428	4.428	0.000	20.084

Note

In Fiscal Year 2020 (FY2) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project FF6 Individual Protection

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)

Title: Dismounted Soldier Survivability Equipment and Technology Integration	FY 2019	FY 2020	FY 2021
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.	-	1.400	1.319
FY 2020 Plans: Optimize integration opportunities of Soldier individual protective and loadbearing equipment to realize near term system level weight reduction; demonstrate 3-dimensional (3D) woven and knit garments for cold weather applications to reduce the bulk and weight of the extreme climate protective ensemble; demonstrate operational benefit of advanced textile printing capabilities at the			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>sub-system and system level for individual equipment that can impart multiple functionalities (e.g. signature management, vector protection, flame resistance, etc.) in a single, more cost-effective process and more durable capability.</p> <p>FY 2021 Plans: Will mature cold weather clothing technologies to provide weight reduction while improving protection to increase maneuverability of the Soldier in extreme climates; optimize 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; integrate and demonstrate a water filtration capability designed to remove toxic chemical 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 2020 to FY 2021 Increase/Decrease Statement: Lower funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.066	-
Accomplishments/Planned Programs Subtotals		-	1.466	1.319
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BB6: Physical Augmentation: Adv Tech for Field Demo</i>	-	0.000	4.000	2.997	-	2.997	0.000	0.000	0.000	0.000	0.000	6.997

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project J50 Future Warrior Technology Integration

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 PEs 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 2019	FY 2020	FY 2021
Title: Wearable Assistive Devices Advanced Technology for Feld Demo	-	3.819	2.997
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			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
benefit from leveraging industry investments and determine if these systems enhance Soldier mobility and lethality in operational environments. FY 2020 Plans: Conduct representative operational field demonstrations and augmentation/assist devices integration with Soldier CIE to measure operational and physical impacts of augmentation systems and the applicability in military environments; conduct manufacturing and industrial design analyses to measure key augmentation metrics (e.g. power usage and duration, system weight, performance in military relevant environment, and integration with CIE) and physiological impacts to Soldiers using established human performance methodologies. FY 2021 Plans: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Funding decreased to support PE 0602143A (Soldier Lethality Technology) / AY8 (Advanced Fire Control Tech) to address fire control acceleration.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.181	-
Accomplishments/Planned Programs Subtotals		-	4.000	2.997
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BB8: <i>Soldier Centric Advanced Technology</i>	-	0.000	7.797	6.091	-	6.091	5.358	2.609	2.627	8.573	0.000	33.055

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project J50 Future Warrior Technology Integration

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)

Title:	FY 2019	FY 2020	FY 2021
Operational Unit Partnership and Soldier Touch Point	-	7.443	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<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 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> <p>FY 2020 Plans: Conduct operational user group field demonstration to validate the integration of technologies/methods that maximize the Warfighter's physical and cognitive performance; conduct large scale field studies in coordination with operational units on mission essential tasks in a realistic, constructive tactical environment employing a cross-assessment of variables such as lightweight equipment, situational awareness tools, sleep, nutrition, human augmentation for load carriage, etc. These assessments will inform multiple training/education and materiel solutions designed to maximize the tactical performance to overcome Soldier limitations in order to achieve overmatch.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to PE 0603118A (Soldier Lethality Advanced Technology) / BC1 (Human Performance AdvTech for Mobility & Lethality).</p>			
<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: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0603118A (Soldier Lethality Advanced Technology) / BE9 (STE Advanced Technology).</p>	-	-	6.091
<p>Title: FY 2020 SBIR/STTR Transfer</p>	-	0.354	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	7.797	6.091

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BC1: Human Performance AdvTech for Mobility & Lethality</i>	-	0.000	4.832	11.805	-	11.805	12.079	8.405	5.946	2.085	0.000	45.152

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project J50 Future Warrior Technology Integration

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) joint Science and Technology program supported by the Office of the Secretary of Defense Close Combat Lethality Task Force.

This work is directly supported by and fully coordinated across 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 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)

Title: Soldier/Squad Performance Metrics for Lethality	FY 2019	FY 2020	FY 2021
	-	4.612	4.475

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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 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 2020 Plans: Demonstrate the performance impacts of biometric Soldier readiness information portrayed to small units via dismounted mission command platforms; demonstrate an enhanced small unit tactical decision making process with measurable and actionable information to maximize physical and cognitive readiness levels; mature and demonstrate assessment tools and methodologies for operational test and evaluation.</p> <p>FY 2021 Plans: Will mature technologies, methodologies, and human performance models for demonstrating increased mobility & 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 2020 to FY 2021 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: Will 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>		-	-	7.330

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
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.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0602143A (Soldier Lethality Technology) / BB8 (Soldier Centric Advanced Technology).				
Title: FY 2020 SBIR/STTR Transfer		-	0.220	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	4.832	11.805
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BC4: <i>Soldier Decision Making&Comms Performance AdvTech</i>	-	0.000	2.000	1.998	-	1.998	2.038	2.079	2.103	2.124	0.000	12.342

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603015A Next Generation Training & Simulation Systems:
 * Project S31 Modeling And Simulation Infrastructure Technology

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)

Title: Human System Integration Demonstration	FY 2019	FY 2020	FY 2021
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-	-	2.000	1.998

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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 2020 Plans: Provide a technical framework, knowledge products that identify candidate technologies for degraded visual environments (DVE) mitigation, and summaries of HSI work to support the Future Vertical Lift material solution analysis and Milestone A, as well as recommendations to the Fires Center of Excellence for mobile short-range air defense system (M-SHORAD) and the Integrated Air and Missile Defense (IAMD) program.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
Accomplishments/Planned Programs Subtotals		-	2.000	1.998
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BC8: <i>Training Advanced Technology (Other than STE)</i>	-	0.000	1.335	4.470	-	4.470	4.501	2.635	2.621	2.571	0.000	18.133

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603115A Next Generation Training & Simulation Systems:
 * Project S29 Modeling & Simulation - Advanced Technology Development
 * Project S31 Modeling And Simulation Infrastructure Technology

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 2019	FY 2020	FY 2021
Title: Live Training Technology Applications	-	1.335	-
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.			
FY 2020 Plans: Mature and demonstrate integrated software and hardware components such as artificial intelligence algorithms to aid in target recognition, weapon modeling, next generation magnetometers, high resolution three dimensional terrain, and weapon orientation sensors to enhance live training technology.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
The funding in this effort was realigned to support PE 0603118A (Soldier Advanced Lethality Technology) / BE9 (STE Advanced Technology) to accelerate live training technology.				
Title: Synthetic Training Environment (STE): Reconfigurable Virtual Trainer		-	-	3.360
Description: This effort provides combined arms collective training for military platforms through the modernization and performance improvement of current training systems to be reconfigurable, transportable, and immersive. It exploits relevant mixed reality physical and functional fidelity cues informing maturation and demonstration activities for reconfigurable collective training capabilities. The results of this effort will improve crew performance through transfer of skills learned in reconfigurable training system to the real world.				
FY 2021 Plans: Will provide a standardized evaluation method for rapid, repeatable, validated simulated environment comparisons enabling concrete determination of simulated environment capability to meet learning objectives.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0603118A (Soldier Lethality Advanced Technology) / BE9 (STE Adv Technology).				
Title: STE: Live Training Applications		-	-	1.110
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: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0603118A (Soldier Lethality Advanced Technology) / BE9 (STE Adv Technology).				
Accomplishments/Planned Programs Subtotals		-	1.335	4.470
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BC9: <i>Adv Soldier Sensors/Displays AdvTech for Dismounts</i>	-	0.000	13.659	10.999	-	10.999	16.838	33.619	33.961	33.964	0.000	143.040

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603606A Landmine Warfare and Barrier Advanced Technology:
 * Project 608 Countermines & Bar Development
 PE 0603710A Night Vision Advanced Technology:
 * Project K70 Night Vision Advanced Technology

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 2019	FY 2020	FY 2021
Title: Advanced Soldier Sensors/Displays Advanced Technology for Dismounts	-	13.659	10.999
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 mature automated algorithms to increase probability of recognition/identification and tracking of threats in all environments.			
FY 2020 Plans: Mature augmented reality situational understanding and visual three dimensional (3D) information capabilities for mounted and dismounted Soldiers; provide an overlay and display of 3D point cloud information to Soldiers for increased scene context in near peer environments; mature explosive and hazard detection components for integration with adaptable target detection algorithms			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
to create a baseline capability that increases Soldiers situational understanding of threats in near-peer environments; validate sensor designs. FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Decrease represents adjustments to accelerate Advanced Low Light Level Sensors in PE 0602143 (Soldier Lethality Technology) / BD1 (Advanced Soldier Sensors/Displays Technologies for Dismounts).			
Accomplishments/Planned Programs Subtotals	-	13.659	10.999

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BD7: <i>Soldier Sys Interfaces/Integration-Sensor AdvTech</i>	-	0.000	9.671	9.060	-	9.060	8.478	8.645	8.983	9.074	0.000	53.911

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project J50 Future Warrior Technology Integration

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 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)

Title: Soldier System Interfaces & Integration (Sensor Advanced Technology)	FY 2019	FY 2020	FY 2021
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.	-	9.671	9.060
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Integrate battlefield and Soldier worn sensors with body area networks and the Nett Warrior architecture; mature and integrate sensor fusion algorithms and user interfaces to provide actionable and timely information to the dismounted Soldier and small unit; demonstrate integrated sensor capabilities in lab and virtual environments; mature and integrate algorithms for dismounted Small Unmanned Aerial Systems (SUAS) to enable autonomous operations; mature soldier-robotic user interfaces to minimize Soldier dedicated control of robotic assets; mature and demonstrate modular robotics architectures to allow for rapid integration and demonstration of advanced capabilities; integrate dismounted robotic systems with Nett Warrior to enable sharing of tactical data between Small Units.</p> <p>FY 2021 Plans: Will continue to integrate battlefield and Soldier worn sensors with body area networks and the Nett Warrior architecture; mature and integrate advanced algorithms and user interfaces for Small Unit mission planning, human performance sensing, Soldier worn equipment sensing, and remote sensing; conduct field demonstrations of integrated battlefield and Soldier worn sensor systems to validate performance and operation; mature algorithms, user interfaces, and architectures to enable autonomous tactical SUAS and conduct field demonstrations to validate the performance and operation of the system; integrate 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
Accomplishments/Planned Programs Subtotals		-	9.671	9.060
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BD9: <i>Soldier & Sm Unit Tactical Energy AdvTech</i>	-	0.000	3.101	3.160	-	3.160	3.223	4.296	4.358	4.402	0.000	22.540

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project J50 Future Warrior Technology Integration

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)

Title: Dismounted Soldier Power and Energy	FY 2019	FY 2020	FY 2021
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.	-	3.101	3.160
FY 2020 Plans: Mature, integrate, and demonstrate advanced dismounted Soldier power and energy technologies, including lightweight, energy dense power sources and efficient power generation technologies to reduce the Soldier's physical burden and increase the run-time of electronics; demonstrate Soldier power management and distribution technologies to efficiently manage the transfer			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>of power on the Soldier; analyze and assess dismounted Soldier power and energy technologies during laboratory and field experiments to characterize their performance and validate their operation.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
Accomplishments/Planned Programs Subtotals		-	3.101	3.160
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BE2: Joint Service Combat Feeding Advanced Technology</i>	-	0.000	1.782	2.417	-	2.417	2.454	2.046	2.069	2.069	0.000	12.837

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project C07 Joint Service Combat Feeding Tech Demo

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 2019	FY 2020	FY 2021
Title: Joint Service Combat Feeding Advanced Technology Demonstration	-	1.701	2.417
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 2020 Plans: Mature alternative packaging configurations to reduce weight/logistics burden and provide flexibility in rations processing applications to enable semi-independent operations; mature novel food processing and nutritional intervention strategies to validate Close Combat Assault Ration concept for reduced Soldier/squad reliance on ration resupply during extended operations; demonstrate densification technologies that maximize nutrient value while minimizing ration weight; demonstrate portable, rapid			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>biosensor platforms to improve food safety and reduce risk of food-borne illness on the battlefield; transition demonstrated refrigeration technology that reduces reliance on hydrofluorocarbons to Product Manager ? Force Sustainment Systems.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding increase from PE 0602143A (Soldier Lethality Technology) / BE3 (Joint Service Combat Feeding Technology) to support demonstrations in FY21.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.081	-
Accomplishments/Planned Programs Subtotals		-	1.782	2.417
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BE5: Personnel & Airdrop Safety Advanced Technology</i>	-	0.000	6.770	6.293	-	6.293	6.964	6.954	7.046	7.117	0.000	41.144

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603001A Warfighter Advanced Technology:
 * Project 242 Airdrop Equipment
 * Project XW6 Small Unit Expeditionary Maneuver

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)

Title: Personnel & Airdrop Safety Advanced Technology	FY 2019	FY 2020	FY 2021
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-	-	6.462	6.293

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Access/Area Denial (A2/ AD) and manned-unmanned teaming (MUM-T) operational concepts by demonstrating airdrop from non-traditional platforms.</p> <p>FY 2020 Plans: Demonstrate precision aerial delivery software and hardware components in a GPS denied/degraded environment as well as in Dense, Urban, and Complex Terrain. Efforts will provide high precision resupply in austere environments and expand the operational footprint of the Soldier/Squad without significant impact to existing logistics requirements.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.308	-
Accomplishments/Planned Programs Subtotals	-	6.770	6.293

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BE9: <i>STE Advanced Technology</i>	-	0.000	22.480	13.190	-	13.190	12.075	18.083	18.327	18.378	0.000	102.533

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603115A Next Generation Training & Simulation Systems:
 * Project S29 Modeling & Simulation - Advanced Technology Development
 * Project S31 Modeling And Simulation Infrastructure Technology

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)

Title: STE Soldier/Squad Virtual Trainer	FY 2019	FY 2020	FY 2021
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.	-	5.887	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>FY 2020 Plans: Demonstrate advancements based on STE accelerated tasks to include dynamic occlusion algorithms for complex urban environments and advanced position tracking for spatialization.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned to PE 0603118A (Soldier Lethality Advanced Technology) / BB8 (Soldier Centric Advanced Technology).</p>				
<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> <p>FY 2020 Plans: Mature and demonstrate an authoring tool for individual training scenarios; demonstrate ways to automatically tailor training based on existing learner records; and demonstrate models that predict individual competencies and tailor training to target deficiencies; demonstrate large-scale, mixed reality Common Operating Picture visualization and interaction of emerging STE technologies.</p> <p>FY 2021 Plans: Will 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>FY 2020 to FY 2021 Increase/Decrease Statement: Funding increase from PE 0602143A (Soldier Lethality Technology) / BC7 (Training Technology (Other than STE)) to support AI methods for self-optimizing systems.</p>		-	1.118	3.371
<p>Title: STE One World Terrain</p> <p>Description: 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>FY 2020 Plans:</p>		-	5.702	2.814

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Demonstrate applications that enhance environmental representations commonly found in urban areas including Megacities and underground environments; exploit and modify non-traditional data sources such as Open Street Maps, crowd-sourced information, and other available data from which geo-specific information can guide placement; enhance the environment with procedural placement of appropriate urban feature models; exploit and modify a common terrain engine representation for use across game engines (i.e. consumed without modification); mature the commonality and differences between candidate game engines to derive common representations for environment elements (terrain surface, feature meshes, textures/materials, etc.); optimize terrain reasoning data needs, especially those not typically represented in game engines; exploit a proposed common representation that is flexible and compatible with multiple game engines; validate the tradeoffs between compiled/derived formats versus close-to-source formats and articulate how engines with specialized internal formats would leverage the proposed representation; and demonstrate the viability of the proposed representation in at least three different game engines.</p> <p>FY 2021 Plans: Will 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>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: STE Training Simulation Software</p> <p>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).</p> <p>FY 2020 Plans: Mature models of Multi-Domain Operations to include cyber effects and patterns of life, demonstrating state-of-the-art simulated entities and concurrent role-players in a relevant collective training exercise. In addition, mature methods to create simulation agnostic behavior algorithms from authoritative sources to show broad applicability to multi-echelon collective training; demonstrate hybrid scalability and Point of Need technologies.</p> <p>FY 2021 Plans:</p>	-	8.782	6.127

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Weapons Effects for STE</p> <p>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 weapons (such as small arms, projectiles, indirect fire, and improvised explosives device attacks) and display of realistic vulnerabilities in the battlespace.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding was realigned from PE 0603119A (Ground Advanced Technology) / BL6 (Expedient Passive Protection Advanced Technology) to support demonstration of weapons effects directly related to STE.</p>		-	-	0.878
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.991	-
Accomplishments/Planned Programs Subtotals		-	22.480	13.190

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BS8: <i>Soldier Lethality Advanced Technology</i>	-	0.000	17.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.500

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 2019	FY 2020
Congressional Add: Subterranean Warfighter Advanced Technology	-	1.500
FY 2020 Plans: Subterranean Warfighter Advanced Technology		
Congressional Add: Rapid Safe Advanced Materials	-	6.000
FY 2020 Plans: Rapid Safe Advanced Materials		
Congressional Add: Multi-Spectral Sensor Mitigation	-	5.000
FY 2020 Plans: Multi-Spectral Sensor Mitigation		
Congressional Add: Helmet Pad Suspension Systems	-	5.000
FY 2020 Plans: Helmet Pad Suspension Systems		
Congressional Adds Subtotals	-	17.500

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603119A / Ground Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	136.793	14.795	-	14.795	19.583	28.471	29.479	29.367	0.000	258.488
BK8: Robotics for Engineer Operations Adv Tech	-	0.000	1.923	4.353	-	4.353	9.298	9.171	9.032	4.806	0.000	38.583
BK9: Ground System Fluids and Fuels Adv Tech	-	0.000	2.118	1.748	-	1.748	1.812	1.806	1.999	2.063	0.000	11.546
BL3: Explosives Forensics Advanced Technology	-	0.000	2.038	2.077	-	2.077	2.121	2.163	2.187	2.209	0.000	12.795
BL6: Expedient Passive Protection Advanced Technology	-	0.000	3.703	3.166	-	3.166	0.400	2.531	4.839	5.938	0.000	20.577
BL8: Power Projection in A2AD Environments Adv Tech	-	0.000	0.892	1.267	-	1.267	3.007	4.836	3.215	6.087	0.000	19.304
BM1: Protection from Advanced Weapon Effects Adv Tech	-	0.000	1.919	2.184	-	2.184	2.945	6.218	5.350	5.350	0.000	23.966
BO3: MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)	-	0.000	124.200	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	124.200
CC1: Predictive Maintenance Advanced Technology*	-	0.000	0.000	0.000	-	0.000	0.000	1.746	2.857	2.914	0.000	7.517

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2021

Note

In Fiscal Year (FY) 2019, this Program Element (PE) was previously funded, with continuity of effort realigned from the following PEs:
 * 0603004A Weapons and Munitions Advanced Technology
 * 0603005A Combat Vehicle and Automotive Advanced Technology
 * 0603728A Environmental Quality Technology Demonstrations
 * 0603734A Military Engineering Advanced Technology

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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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.

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	12.593	15.511	-	15.511
Current President's Budget	0.000	136.793	14.795	-	14.795
Total Adjustments	0.000	124.200	-0.716	-	-0.716
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	124.200			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-0.716	-	-0.716

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*

	FY 2019	FY 2020
	-	5.000
	-	5.000
	-	5.000
	-	10.000
	-	3.000
	-	3.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army		Date: February 2020	
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>	
Congressional Add Details (\$ in Millions, and Includes General Reductions)		FY 2019	FY 2020
Congressional Add: <i>Composite Flywheel Technology</i>		-	5.000
Congressional Add: <i>Lead-Acid Battery Life Extension</i>		-	10.000
Congressional Add: <i>Robotic Construction Equipment</i>		-	9.700
Congressional Add: <i>Terrain Conditions Forecasting</i>		-	3.000
Congressional Add: <i>Environmental Sensors for Explosives</i>		-	3.000
Congressional Add: <i>Robotic 4-D Printing of Geopolymer-Based Composites</i>		-	2.000
Congressional Add: <i>Waste to Energy Disposal</i>		-	3.000
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
Congressional Add: <i>Energy Technology Research in Cold and Arctic Regions</i>		-	4.000
Congressional Add: <i>Research Facility Modernization</i>		-	4.000
Congressional Add Subtotals for Project: BO3		-	124.200
Congressional Add Totals for all Projects		-	124.200
Change Summary Explanation			
FY20 increase related to \$124.200 million of Congressional Add funding.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BK8: Robotics for Engineer Operations Adv Tech</i>	-	0.000	1.923	4.353	-	4.353	9.298	9.171	9.032	4.806	0.000	38.583

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603728A Environmental Quality Technology Demonstrations
 * Project 002 Environmental Compliance Technology

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).

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)

Title: Robotic Integrated Engineer Operations (RIENO)	FY 2019	FY 2020	FY 2021
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.	-	1.922	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Demonstrate and assess remote control and semi-autonomous characterization of the environment to include geologic, hydrologic, and man-made features. Such information is crucial for many autonomous construction related behaviors. FY 2020 to FY 2021 Increase/Decrease Statement: Work under RIENO continues in the Beyond-Visual-Line-of-Sight (BVLOS) effort in FY21.			
Title: Beyond-Visual-Line-of-Sight Tele-operated Engineer Operations Demonstration 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. FY 2021 Plans: Will mature tele-operated construction equipment in Global Positioning System (GPS) denied environments; will demonstrate semi-autonomous site characterization; will demonstrate capabilities to remove or emplace obstacles and manipulate the environment; and will mature and demonstrate interface for handheld or mobile devices for construction equipment mission planning and execution. FY 2020 to FY 2021 Increase/Decrease Statement: The BVLOS Tele-Operated Engineer Operations Demonstration was previously conducted under the RIENO effort in this Project.	-	-	4.353
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.001	-
Accomplishments/Planned Programs Subtotals	-	1.923	4.353

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

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BK9: <i>Ground System Fluids and Fuels Adv Tech</i>	-	0.000	2.118	1.748	-	1.748	1.812	1.806	1.999	2.063	0.000	11.546

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603005A Combat Vehicle and Automotive Advanced Technology
 * Project 441 Combat Vehicle Mobility

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 2019	FY 2020	FY 2021
Title: Alternative Fuels and Petroleum, Oil & Lubricants	-	2.022	-
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.			
FY 2020 Plans: Will begin assessing additional candidate synthetic fuel blends to determine their suitability for military ground systems. Candidate fuel efficient gear oils that maintain and improve vehicle axle durability and provide extended performance time over current gear oil will be qualified for military use. Performance requirements will be developed for a new military brake fluid that			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>is compatible with ABS brake systems and candidate fluid technologies will be investigated. Smart fuel metering technology will be integrated into self-correcting devices that will automatically report fuel quantity and fuel filter effectiveness testing will be conducted to establish fuel particle contamination limits for new fuel monitoring technology.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding has been realigned in FY21 to the effort Ground System Fluids and Fuels in this Project due to decreased research in alternate fuels.</p>				
<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> <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>FY 2021 Plans: Will assess the lubrication capacity of fuel additive using improved methods and component test rigs to optimize wear reduction of fuel delivery system components. Will complete assessment and demonstrate anti-lock brake system compatible brake fluid in selected ground systems. Will establish optimized post filter fuel particle contamination limits for new fuel monitoring technology based on fuel filter effectiveness. Will validate performance of current military coolant against candidate extended performance coolants.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding has been realigned in FY21 from the Alternative Fuels and Petroleum, Oil & Lubricants effort in this Project.</p>		-	-	1.748
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans:</p>		-	0.096	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC ?638				
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i>				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	2.118	1.748
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BL3: <i>Explosives Forensics Advanced Technology</i>	-	0.000	2.038	2.077	-	2.077	2.121	2.163	2.187	2.209	0.000	12.795

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology
 * Project L97 Smoke and Obscurants Advanced Technology

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 2019	FY 2020	FY 2021
Title: Detection Mechanisms for Contaminants	-	1.946	2.077
Description: This effort demonstrates improved point and standoff detection of military and homemade explosives and their precursors, and other chemicals and hazardous materials.			
FY 2020 Plans: Will integrate ultra violet laser, spectrometer and algorithm technology improvements for trace explosive detection. Will assess technology improvements for trace explosives sensors against homemade and military explosives, as well as narcotics.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will 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. Will demonstrate a photonic integrated circuit sensor based on waveguide enhanced Raman spectroscopy and determine detection limits for select explosives and narcotics materials.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY 2020 SBIR/STTR Transfer		-	0.092	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	2.038	2.077
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BL6: <i>Expedient Passive Protection Advanced Technology</i>	-	0.000	3.703	3.166	-	3.166	0.400	2.531	4.839	5.938	0.000	20.577

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology
 * Project T08 Combat Eng Systems

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).

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

	FY 2019	FY 2020	FY 2021
Title: Force Protection in the Urban Environment Demonstrations	-	3.636	3.166
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 2020 Plans: Demonstrate an expedient retrofit kit for existing buildings and a rapidly deployable force protection barrier; will demonstrate applications for quickly calculating small arms protection levels and wall vulnerability to blast.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will demonstrate an expedient system to increase levels of protection for existing buildings against blast and indirect fire; will validate a rapidly deployable force protection barrier tailored for small units operating in contested environments; will provide a rapidly deployable vehicle barrier optimized for heavy vehicle threats; and will demonstrate wall blast vulnerability and overhead cover design applications for existing structures.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.067	-
Accomplishments/Planned Programs Subtotals		-	3.703	3.166
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BL8: Power Projection in A2AD Environments Adv Tech</i>	-	0.000	0.892	1.267	-	1.267	3.007	4.836	3.215	6.087	0.000	19.304

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology
 * Project T08 Combat Eng Systems

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).

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

	FY 2019	FY 2020	FY 2021
Title: Entry and Sustainment in Complex Contested Environments Demonstrations	-	0.881	1.267
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 2020 Plans: Expand, mature, and automate site selection algorithms for geospatial planning tools, allowing aviation mission planning cells to select region of interest and rapidly identify best suited terrain for air assault missions and forward arming and refueling needs.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will demonstrate site selection algorithms for rapidly identifying landing zones during air assault missions and forward arming and refueling needs; will mature and demonstrate capabilities to predict off-road mobility in arctic regions. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.011	-
Accomplishments/Planned Programs Subtotals		-	0.892	1.267
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BM1: <i>Protection from Advanced Weapon Effects Adv Tech</i>	-	0.000	1.919	2.184	-	2.184	2.945	6.218	5.350	5.350	0.000	23.966

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology
 * Project T08 Combat Eng Systems
 PE 0603728A Environmental Quality Technology Demonstrations
 * Project 03E Robotics for Engineer Operations

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 coordinated with PE 0602144A (Ground Technology).

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

	FY 2019	FY 2020	FY 2021
Title: Applications of Environmentally-Inspired Unconventional Countermeasures	-	0.238	-
Description: This effort will demonstrate rapidly-deployable, eco-friendly materials with spectral signatures that alter or obscure underlying target spectral signatures.			
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Demonstrate living tone-down formulas at larger scale outdoor level; demonstrations will include application of select formulations on Army relevant structural material. Deliver algorithms to detect and compare spectral features essential for the performance of unconventional countermeasures.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: In FY21, work in this effort is realigned to PE 0603466A (Air and Missile Defense Advanced Technology) / Project AE3 (Unconventional Countermeasures-Survivability ATech).</p>				
<p>Title: Defeat of Complex Attack Demonstrations</p> <p>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.</p> <p>FY 2020 Plans: Demonstrate baseline protection of current structural hardening solutions against fragmentation effects and scaled high velocity penetrator effects from precision strike weapons.</p> <p>FY 2021 Plans: Will optimize subscale hardening solutions against emerging complex weapon attack scenarios; will validate enhanced or layered subscale systems for reduced structural thickness with improved performance.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	1.673	2.184
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.008	-
Accomplishments/Planned Programs Subtotals		-	1.919	2.184
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BO3: <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	-	0.000	124.200	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	124.200

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 2019	FY 2020
Congressional Add: Electrical System Safety and Reliability	-	5.000
FY 2020 Plans: Electrical System Safety and Reliability		
Congressional Add: Cold Regions Research	-	5.000
FY 2020 Plans: Cold Regions Research		
Congressional Add: High-Performance Concrete Technology	-	5.000
FY 2020 Plans: High-Performance Concrete Technology		
Congressional Add: Lightweight Airfield Matting	-	10.000
FY 2020 Plans: Lightweight Airfield Matting		
Congressional Add: Secure Management of Energy Generation and Storage	-	3.000
FY 2020 Plans: Secure Management of Energy Generation and Storage		
Congressional Add: Rapid Low Energy Mobile Manufacturing	-	3.000
FY 2020 Plans: Rapid Low Energy Mobile Manufacturing		
Congressional Add: Composite Flywheel Technology	-	5.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020
<i>FY 2020 Plans:</i> Composite Flywheel Technology		
<i>Congressional Add:</i> Lead-Acid Battery Life Extension	-	10.000
<i>FY 2020 Plans:</i> Lead-Acid Battery Life Extension		
<i>Congressional Add:</i> Robotic Construction Equipment	-	9.700
<i>FY 2020 Plans:</i> Robotic Construction Equipment		
<i>Congressional Add:</i> Terrain Conditions Forecasting	-	3.000
<i>FY 2020 Plans:</i> Terrain Conditions Forecasting		
<i>Congressional Add:</i> Environmental Sensors for Explosives	-	3.000
<i>FY 2020 Plans:</i> Environmental Sensors for Explosives		
<i>Congressional Add:</i> Robotic 4-D Printing of Geopolymer-Based Composites	-	2.000
<i>FY 2020 Plans:</i> Robotic 4-D Printing of Geopolymer-Based Composites		
<i>Congressional Add:</i> Waste to Energy Disposal	-	3.000
<i>FY 2020 Plans:</i> Waste to Energy Disposal		
<i>Congressional Add:</i> Advanced Polymer Development for Force Protection	-	4.500
<i>FY 2020 Plans:</i> Advanced Polymer Development for Force Protection		
<i>Congressional Add:</i> Micrometeorological-Soil Synthetic Test Environment	-	1.000
<i>FY 2020 Plans:</i> Micrometeorological-Soil Synthetic Test Environment		
<i>Congressional Add:</i> Partnership and Technology Transfer	-	4.000
<i>FY 2020 Plans:</i> Partnership and Technology Transfer		
<i>Congressional Add:</i> Sensor Systems for Underground Detection	-	3.000
<i>FY 2020 Plans:</i> Sensor Systems for Underground Detection		
<i>Congressional Add:</i> UAS Mounted Hostile Threat Detection	-	5.000
<i>FY 2020 Plans:</i> UAS Mounted Hostile Threat Detection		
<i>Congressional Add:</i> Heavy Load Simulator	-	6.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020
<i>FY 2020 Plans:</i> Heavy Load Simulator		
Congressional Add: Measurement and Control of Frozen Surface Properties	-	4.000
<i>FY 2020 Plans:</i> Measurement and Control of Frozen Surface Properties		
Congressional Add: Resilient Energy Systems	-	2.500
<i>FY 2020 Plans:</i> Resilient Energy Systems		
Congressional Add: Operations in Permafrost Environment	-	4.000
<i>FY 2020 Plans:</i> Operations in Permafrost Environment		
Congressional Add: Power Generation Technologies in Cold Regions	-	5.000
<i>FY 2020 Plans:</i> Power Generation Technologies in Cold Regions		
Congressional Add: Sensing and Prediction of Arctic Maritime Coastal Ice Conditions	-	5.000
<i>FY 2020 Plans:</i> Sensing and Prediction of Arctic Maritime Coastal Ice Conditions		
Congressional Add: Thermosyphons	-	2.000
<i>FY 2020 Plans:</i> Thermosyphons		
Congressional Add: Materials and Manufacturing Technology for Cold Environments	-	3.500
<i>FY 2020 Plans:</i> Materials and Manufacturing Technology for Cold Environments		
Congressional Add: Energy Technology Research in Cold and Arctic Regions	-	4.000
<i>FY 2020 Plans:</i> Energy Technology Research in Cold and Arctic Regions		
Congressional Add: Research Facility Modernization	-	4.000
<i>FY 2020 Plans:</i> Research Facility Modernization		
Congressional Adds Subtotals	-	124.200

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy
N/A

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603125A / <i>Combating Terrorism - Technology Development</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	43.910	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	43.910
DF5: <i>Agile Integration & Demonstration</i>	-	10.910	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.910
DW4: <i>Energy Technologies (Congressional Adds (CAs))</i>	-	33.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	33.000

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PE:

* 0602145A Next Generation Combat Vehicle Technology

A. Mission Description and Budget Item Justification

This PE demonstrates and evaluates emerging technologies and systems with high payoff potential to address current technology shortfalls or future capability gaps. Efforts include hybrid electric power technologies to reduce use of fossil fuel in tactical generators; collaboration with the United States (U.S.) Department of Energy (DOE) to demonstrate technologies that provide significant gains in ground vehicle energy efficiency; demonstration of ground platform power management, generation, and distribution technologies that increase energy efficiencies and support the integration of advanced future capabilities; and field demonstrations to stress and assess emerging technologies earlier in the systems development life cycle, thus reducing potential vulnerabilities and providing an improved understanding of employment risks against potential threats.

Work in this Project is complementary to and is fully coordinated with PE 0602618A (Ballistics Technology) / Project H80 (Survivability and Lethality Technology), PE 0602601A (Combat Vehicle and Automotive Technology), and PE 0603005A (Combat Vehicle and Automotive Advanced Technology).

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

This work is performed by the U.S. Army Futures Command.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603125A / <i>Combating Terrorism - Technology Development</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	36.757	0.000	0.000	-	0.000
Current President's Budget	43.910	0.000	0.000	-	0.000
Total Adjustments	7.153	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	7.274	-			
• SBIR/STTR Transfer	-0.121	-			

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

Project: DW4: *Energy Technologies (Congressional Adds (CAs))*

- Congressional Add: *Artificial Intelligence Enabled Sensor Networks*
- Congressional Add: *Enhanced Propulsion Systems for UAS*
- Congressional Add: *Lightweight Low Power Radar System*
- Congressional Add: *Long Endurance UAV Research*
- Congressional Add: *Open Source ISR Research*
- Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun*

Congressional Add Subtotals for Project: DW4

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	8.000	-
	6.000	-
	8.000	-
	7.965	-
	3.000	-
	0.035	-
Congressional Add Subtotals for Project: DW4	33.000	-
Congressional Add Totals for all Projects	33.000	-

Change Summary Explanation

FY2019 reprogramming of \$7.274M supports Army Capability Accelerator effort under Project DF5.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603125A / <i>Combating Terrorism - Technology Development</i>				Project (Number/Name) DF5 / <i>Agile Integration & Demonstration</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
DF5: <i>Agile Integration & Demonstration</i>	-	10.910	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.910

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 PE 0602145A Next Generation Combat Vehicle Technology:
 * Project BH5 Platform Electrification and Mobility Tech
 * Project BI4 Materials Application and Integration Technology

A. Mission Description and Budget Item Justification

This Project demonstrates and evaluates emerging technologies and systems with high payoff potential to address current technology shortfalls or future capability gaps. Efforts include hybrid electric power technologies to reduce use of fossil fuel in tactical generators; collaboration with the United States Department of Energy (DOE) to demonstrate technologies that provide significant gains in ground vehicle energy efficiency; demonstration of ground platform power management, generation, and distribution technologies that increase energy efficiencies and support the integration of advanced future capabilities; and field demonstrations to stress and assess emerging technologies earlier in the systems development life cycle, thus reducing potential vulnerabilities and providing an improved understanding of employment risks against potential threats.

Work in this Project is complementary to and is fully coordinated with PE 0602618A (Ballistics Technology) / Project H80 (Survivability and Lethality Technology), PE 0602601A (Combat Vehicle and Automotive Technology), and PE 0603005A (Combat Vehicle and Automotive Advanced Technology).

The cited work is consistent with the Under Secretary of Defense, Research and Engineering Science and Technology priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

This work is performed by the United States Army Futures Command.

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

Title: Ground Platform Subsystem Demonstrations	FY 2019	FY 2020	FY 2021
Description: This effort contributes to the Army's ground platform risk reduction efforts which seek to address technical and integration challenges in the areas of mobility, survivability, vehicle architecture, and systems integration. Specifically, this effort focuses on maturing and demonstrating integrated vehicle power management, generation and distribution technologies to increase ground vehicle energy efficiencies and ensure ground platforms have enough power to enable future capabilities such as electromagnetic armor, active protection systems, improvised explosive device detect and defeat technologies, advanced	1.073	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603125A / <i>Combating Terrorism - Technology Development</i>	Project (Number/Name) DF5 / <i>Agile Integration & Demonstration</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
situational awareness and future network integration technologies. This effort is coordinated with PE 0603005A (Combat Vehicle and Automotive Advanced Technology).			
Title: Ground Vehicle Power and Energy Description: This effort matures and demonstrates advanced technologies that enable military ground vehicles to become significantly more energy efficient. It collaborates with the DOE to demonstrate technologies in: advanced combustion engines and transmissions; lightweight structures and materials; energy recovery and thermal management; alternative fuels and lubricants; hybrid propulsion systems; batteries and energy storage; and analytical tools (e.g., modeling and simulation). This effort is coordinated with PE 0602601A (Combat Vehicle and Automotive Technology).	2.563	-	-
Title: Army Capability Accelerator Description: Effort focuses on applied research where teams of combat soldiers, entrepreneurs, researchers and defense industry veterans collaborate to produce an actual working prototype that real troops can field-test in realistic conditions.	7.274	-	-
Accomplishments/Planned Programs Subtotals	10.910	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603125A / <i>Combating Terrorism - Technology Development</i>	Project (Number/Name) DW4 / <i>Energy Technologies (Congressional Adds (CAs))</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
DW4: <i>Energy Technologies (Congressional Adds (CAs))</i>	-	33.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	33.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for technology development and demonstration.

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

	FY 2019	FY 2020
<i>Congressional Add:</i> Artificial Intelligence Enabled Sensor Networks	8.000	-
<i>FY 2019 Accomplishments:</i> Artificial Intelligence Enabled Sensor Networks		
<i>Congressional Add:</i> Enhanced Propulsion Systems for UAS	6.000	-
<i>FY 2019 Accomplishments:</i> Enhanced Propulsion Systems for UAS		
<i>Congressional Add:</i> Lightweight Low Power Radar System	8.000	-
<i>FY 2019 Accomplishments:</i> Lightweight Low Power Radar System		
<i>Congressional Add:</i> Long Endurance UAV Research	7.965	-
<i>FY 2019 Accomplishments:</i> Long Endurance UAV Research		
<i>Congressional Add:</i> Open Source ISR Research	3.000	-
<i>FY 2019 Accomplishments:</i> Open Source ISR Research		
<i>Congressional Add:</i> FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.035	-
<i>FY 2019 Accomplishments:</i> FY 2018 NDAA SEC 825 MDAP Cost Overrun		
Congressional Adds Subtotals	33.000	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603130A / <i>TRACTOR NAIL</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	4.896	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.896
DS8: <i>Tractor Nail</i>	-	4.896	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.896

Note
 The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

A. Mission Description and Budget Item Justification
 The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1)

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	4.896	0.000	0.000	-	0.000
Current President's Budget	4.896	0.000	0.000	-	0.000
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

Change Summary Explanation
 The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603131A / <i>TRACTOR EGGS</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	6.041	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.041
DS9: <i>Tractor Eggs</i>	-	6.041	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.041

Note

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

A. Mission Description and Budget Item Justification

This program is reported in accordance with Title 10, United States Code, Section 119(a)(1).

B. Program Change Summary (\$ in Millions)

	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021 Base</u>	<u>FY 2021 OCO</u>	<u>FY 2021 Total</u>
Previous President's Budget	6.041	0.000	0.000	-	0.000
Current President's Budget	6.041	0.000	0.000	-	0.000
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

Change Summary Explanation

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
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>							
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.000	25.000	-	25.000	25.000	25.000	25.000	25.000	0.000	125.000
CD3: <i>Counter Improvised-Threat Simulation</i>	-	0.000	0.000	25.000	-	25.000	25.000	25.000	25.000	25.000	0.000	125.000

Note

This is a new start in FY2021.

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)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	25.000	-	25.000
Total Adjustments	0.000	0.000	25.000	-	25.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	25.000	-	25.000

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,

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army		Date: February 2020
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>	
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 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CD3: Counter Improvised-Threat Simulation	-	0.000	0.000	25.000	-	25.000	25.000	25.000	25.000	25.000	0.000	125.000

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 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 2019	FY 2020	FY 2021
Title: Standoff Detection of IED Threats in All Environments	-	-	9.870
Description: This effort develops technology to detect IED threats at standoff distances. Technologies include electro-optical, radar, light range and distance (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.			
FY 2021 Plans: Will mature and demonstrate sensor technologies including: electro-optical, radar, light range and distance (LIDAR), atomic magnetometer and other technologies applicable to detecting IEDs and their components. Will evaluate sensing technologies on their ability to detect IEDs and their components through materials such as walls and garments. Will integrate sensor technologies on dismounted Soldiers, ground, water based and aerial systems or at fixed sites to evaluate detection performance. Will			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>evaluate detection of radio controlled IEDs using advanced network techniques. Will demonstrate detection of IEDs on or under ground, in littoral environments, and attached to vehicles or personnel in all environments.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is a realignment 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.</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: Will mature and demonstrate high power microwave IED neutralization technology previously matured by the Defense Threat Reduction Agency. Will develop novel encasement technologies to prevent IED function. Will develop energetic and kinetic effector technologies to neutralize IEDs or mitigate IED effects. Will develop protection technologies to mitigate the effects of IEDs to Soldiers, materiel and bases. Will develop techniques to robotically manipulate IEDs.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is a realignment 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.</p>		-	-	5.432
<p>Title: Enabling C-IED Technologies</p> <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: Will advance sensor processing techniques to detect IED threats. Will analyze data from multiple sensor systems to determine the ability to detect, attribute and predict emplacement of IED threats. Will apply autonomous system maneuver for small air and</p>		-	-	9.698

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
ground platforms to improve detection of IED threats. Will use modeling and simulation to support IED detection and forecasting data analytics.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> This effort is a realignment 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.			
Accomplishments/Planned Programs Subtotals	-	-	25.000

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	40.461	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	40.461
CY3: <i>Offensive Cyber Operations Mirror Adv Tech</i>	-	6.238	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.238
K12: <i>EW Demonstrations (CA)</i>	-	10.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000
K15: <i>Advanced Comm Ecm Demo</i>	-	2.439	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.439
K16: <i>Non-Commo Ecm Tech Dem</i>	-	21.784	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.784

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned to the following PEs:

- * 0603463A Network C3I Advanced Technology
- * 0603465A Future Vertical Lift Advanced Technology Project:
- * 0603462A Next Generation Combat Vehicle Advanced Technology
- * 0603457A C3I Cyber Advanced Development

A. Mission Description and Budget Item Justification

This PE matures and demonstrates electronic warfare (EW) sensors and software intended to deny, disrupt, locate or destroy the enemy's command, control and communications (C3) systems and intelligence, surveillance and reconnaissance assets. This PE matures both countermeasures (CM) and counter-countermeasures (CCM) to deny the enemy the use of their systems while protecting United States (U.S.) assets from enemy deception and jamming. Project CY3 matures and demonstrates architecture, sensor and software techniques to provide operationally relevant capabilities for cyber support at Corps level and below and enables cyber situational awareness, command and control, mission rehearsal, observable reporting, and framework to incrementally advance cyber tool development. Project K15 matures and demonstrates capabilities to locate and exploit enemy communication systems including computer networks. Project K16 matures and demonstrates multifunctional EW capabilities (jamming) to enhance platform survivability and provide near real-time situational awareness to the Commander through the detection, identification and geo-location of emitters of interest.

Work in this PE complements PE 0602120A (Sensors and Electronic Survivability), PE 0602782A (Command, Control, Communications Technology), PE 0602270A (Electronic Warfare Technology), PE 0603772A (Advanced Tactical Computer Science) and PE 0603794A (Command, Control and Communications Advanced Technology), and is coordinated with PE 0602601A (Combat Vehicle and Automotive Technology), PE 0602618A (Ballistics Technology), PE 0603003A (Aviation Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), PE 0603313A (Missile and Rocket Advanced Technology) and PE 0603794A (Command, Control and Communications Advanced Technology).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>
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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. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	41.458	0.000	0.000	-	0.000
Current President's Budget	40.461	0.000	0.000	-	0.000
Total Adjustments	-0.997	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.997	-			

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

Project: K12: *EW Demonstrations (CA)*

Congressional Add: *Tactical Cyber-Electronic Warfare Readiness*

Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun*

	FY 2019	FY 2020
	9.998	-
	0.002	-
Congressional Add Subtotals for Project: K12	10.000	-
Congressional Add Totals for all Projects	10.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) CY3 / <i>Offensive Cyber Operations Mirror Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CY3: <i>Offensive Cyber Operations Mirror Adv Tech</i>	-	6.238	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.238

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603457 C3I Cyber Advanced Development:
 * Project 9CY Network Access and Effects
 * Project CB4 Offensive Cyber Operations (OCO) Mirror Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates architecture, sensor and software techniques to provide operationally relevant capabilities for cyber support at Corps and Below. This Project enables cyber situational awareness, command and control, mission rehearsal, observable reporting, and framework to incrementally advance cyber tool development to realize the desired intent against any threat, to perform Cyber/EW/SIGINT operations and to assist in answering the commanders understanding of the battlespace in a hostile electromagnetic and cyber environment.

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 in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Offensive Operations	6.237	-	-
Description: This effort matures and demonstrates integrated electronic attack (EA) and cyberspace electromagnetic activities (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. This results in the capability to engage a multitude of diverse multi-node, multi-waveform, multi-platform and cyber (internetworked computers) targets while maximizing overall network efficiency and effectiveness, and preserving Blue Force and non-combatant communications.			
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.001	-	-
Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun			
Accomplishments/Planned Programs Subtotals	6.238	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) CY3 / <i>Offensive Cyber Operations Mirror 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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) K12 / <i>EW Demonstrations (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
K12: <i>EW Demonstrations (CA)</i>	-	10.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Electronic Warfare Technology and Demonstrations.

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

	FY 2019	FY 2020
<i>Congressional Add:</i> Tactical Cyber-Electronic Warfare Readiness	9.998	-
<i>FY 2019 Accomplishments:</i> Tactical Cyber-Electronic Warfare Readiness		
<i>Congressional Add:</i> FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.002	-
<i>FY 2019 Accomplishments:</i> FY 2018 NDAA SEC 825 MDAP Cost Overrun		
Congressional Adds Subtotals	10.000	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) K15 / <i>Advanced Comm Ecm Demo</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>K15: Advanced Comm Ecm Demo</i>	-	2.439	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.439

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology:
 * Project AN8 COE - Every Receiver is a Sensor Advanced Tech
 * Project AO7 EW for Maneuver Operations (EMO) Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates sensor and software technologies to locate and identify modern tactical enemy and blue force (friendly) radio frequency (RF) communications, radars, signals of interest (SOI) and computer networks/nodes. This Project enables uninterrupted air and ground based intelligence collection and long range targeting operations in a hostile electromagnetic and cyber environment, and enables communications countermeasures (CM) and counter-countermeasures (CCM) to first intercept, identify and locate tactical communications; then degrade threat-computer networks and their components.

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 in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Stand-off Non-Cooperative Multi-Intelligence (Multi-INT) Technologies	2.438	-	-
Description: This effort matures and demonstrates hardware and software to conduct standoff electronic warfare (EW) intelligence, surveillance reconnaissance, planning and effects in a three dimensional urban battlespace.			
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.001	-	-
Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun			
Accomplishments/Planned Programs Subtotals	2.439	-	-

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) K15 / <i>Advanced Comm Ecm Demo</i>

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

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>				Project (Number/Name) K16 / <i>Non-Commo Ecm Tech Dem</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
K16: <i>Non-Commo Ecm Tech Dem</i>	-	21.784	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.784

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology:
 * Project AK3 Aviation Survivability Advanced Technology
 PE 0603462A Next Generation Combat Vehicle Advanced Technology:
 * Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates non-communication, multi-functional electronic warfare (EW) capabilities that enhance the survivability of Army air and ground platforms and dismounted Soldiers. This Project matures and demonstrates radio frequency (RF), infrared (IR) and electro-optical (EO) sensors and jamming sources to detect, locate, deceive, and neutralize (jam) booby traps, radar-directed target acquisition systems, target-tracking sensors, surface-to-air missiles (SAMs), air-to-air missiles (AAMs), and top-attack and electronically-fuzed munitions. This Project also enables electronic support (ES) hardware and software to detect, identify and geolocate emitters of interest from an effective standoff distance to provide near real-time situational awareness.

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

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

	FY 2019	FY 2020	FY 2021
Title: Multispectral Threat Detection and Countermeasure Technologies	6.269	-	-
Description: This effort matures and demonstrates countermeasure technologies that provide platform protection and integrated cueing against EO, IR, and RF guided threats.			
Title: Advanced Tactical EW Countermeasure Technologies	4.922	-	-
Description: This effort matures and demonstrates integrated EW direction finding technologies that provide protection of ground and dismounts from emerging RF threats at standoff distances.			
Title: EW Counter Countermeasures	3.382	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603270A / <i>Electronic Warfare Technology</i>	Project (Number/Name) K16 / <i>Non-Commo Ecm Tech Dem</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Description: This effort matures and demonstrates hardware and software to counter emerging EW threats to command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) platforms.				
Title: Active Protection System (APS) Soft Kill (SK)/Hard Kill (HK) Sensors (formerly titled Active Protection System (APS) Soft Kill)		3.345	-	-
Description: This effort matures and demonstrates hardware, software and techniques to provide an EW soft kill, and cueing/tracking capability to the APS suite. This effort supports the Army's APS program to mature and demonstrate technologies to reduce vehicle weight by reducing reliance on armor through the use of other means such as sensing, warning, hostile fire detection, and active countermeasures to achieve increased protection against current and emerging threats.				
Title: Modeling Simulation and Technique Maturation for Integrated RF Operations (formerly titled Integrated RF Operations)		1.207	-	-
Description: This effort matures and demonstrates a capability to perform modeling and simulation (M&S) of geographically dispersed RF systems to provide a coordinated, collaborative and interoperable suite of EW capabilities. A modular software architecture will allow for rapid, cost effective technique development and integration of new EW capabilities, arget signals of interest and environmental simulations.				
Title: Intelligence Processing and Architecture Modernization		2.654	-	-
Description: This effort will leverage Intelligence Community investments in software frameworks and exploits against threat SOIs to develop a library of open, modular, and scalable software solutions to 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.				
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun		0.005	-	-
Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun				
Accomplishments/Planned Programs Subtotals		21.784	-	-
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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	92.404	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	92.404
206: <i>Missile Simulation</i>	-	2.412	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.412
263: <i>Future Msl Tech Integr(FMTI)</i>	-	36.269	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.269
704: <i>Advanced Missile Demo</i>	-	18.723	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.723
NA6: <i>Missile and Rocket Initiatives (CA)</i>	-	35.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:

- ? 0603462A Next Generation Combat Vehicle Advanced Technology
- ? 0603464A Long Range Precision Fires Advanced Technology
- ? 0603465A Future Vertical Lift Advanced Technology
- ? 0603466A Air and Missile Defense Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures, fabricates, and demonstrates advanced rocket, missile, interceptor, and guided munition technologies to enhance weapon system lethality, survivability, agility, deployability, and affordability. Project 206 develops high fidelity simulations for advanced tactical missiles and interceptors. Project 263 demonstrates missile and interceptor systems with capabilities to provide protection against rockets, artillery, and mortars; provide precision weapons for small units in close combat; provide precision long-range fires; and provide minimum smoke propulsion for aviation missiles. Project 704 demonstrates the capability to detect and track rocket, artillery, mortar, and unmanned air vehicles threats. Project NA6 is a congressional increase Project.

Work in this PE is complimentary to PE 0602303A (Missile Technology) and is fully coordinated with PE 0602618A (Ballistics Technology), PE 0602624A (Weapons and Munitions Technology), PE 0603003A (Aviation Advanced Technology), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), PE 0603125A (Combating Terrorism Technology Development), PE 0603270A (Electronic Warfare Technology), PE 0603734A (Military Engineering Advanced Technology), and PE 0708045A (End Item Industrial Preparedness Activities).

In FY20 this PE is being eliminated, with continuity of effort realigned to other PEs as part of a strategic financial restructuring of the Science and Technology (S&T) portfolio. All FY20 adjustments align program requirements with 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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>
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The work in this PE is performed by the United States Army Futures Command.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	94.561	0.000	0.000	-	0.000
Current President's Budget	92.404	0.000	0.000	-	0.000
Total Adjustments	-2.157	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.157	-			

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

Project: NA6: *Missile and Rocket Initiatives (CA)*

Congressional Add: *Program increase - cybersecurity and supply chain risk management*

Congressional Add: *Program increase - cyber security*

Congressional Add: *Program increase - tactically mobile, shoot-on-the-move SHORAD demonstration*

Congressional Add Subtotals for Project: NA6

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	10.000	-
	15.000	-
	10.000	-
Congressional Add Subtotals for Project: NA6	35.000	-
Congressional Add Totals for all Projects	35.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>	Project (Number/Name) 206 / <i>Missile Simulation</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>206: Missile Simulation</i>	-	2.412	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.412

Note
 In Fiscal Year 2020 (FY20 this Project was being realigned to:
 Program Element (PE) 0603464A Long Range Precision Fires Advanced Technology:
 * Project AF4 Missile Simulation Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced modeling and simulation technologies for missile design and analysis. Evaluation of missile technology by means of modeling and simulation provides a cost-effective method that supports missile maturation throughout the weapon system life cycle. This Project permits a reduction in the number of flight tests required for programs of record as well as improves the confidence of flight test readiness and probability of flight test success.

This Project support efforts in the Army Science and Technology Lethality portfolio.

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

Title: Missile Simulation	FY 2019	FY 2020	FY 2021
Description: This effort matures and demonstrates advanced analysis and high fidelity modeling and simulation technologies for advanced missiles and interceptor design and analysis. Evaluation of missile technology through modeling and simulation provides a cost-effective method to support missile maturation throughout the weapon system life cycle. This effort shortens component design timelines, reduces integration activities, enables a reduction of flight tests required for programs of record and improves the confidence of flight test readiness and the probability of flight test success.	2.412	-	-
Accomplishments/Planned Programs Subtotals	2.412	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>	Project (Number/Name) 263 / <i>Future Msl Tech Integr(FMTI)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
263: <i>Future Msl Tech Integr(FMTI)</i>	-	36.269	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.269

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 PE 0603462A Next Generation Combat Vehicle Advanced Technology:
 * Project BG7 Ground System Active Defense (GSAD) Advanced Tech
 Program Element (PE) 0603464A Long Range Precision Fires Advanced Technology:
 * Project AE8 Land-Based Anti-Ship Missile (LBASM) Advanced Tech
 * Project AE9 Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech
 * Project AH3 Single Multi-Mission Attack Missile Adv Tech

A. Mission Description and Budget Item Justification

This Project matures, fabricates, and demonstrates advanced missile and interceptor technologies, such as seekers, guidance and controls, propulsion, and airframes. The project goal is to reduce the life-cycle costs and cost per kill of precision guided missiles and interceptors.

This Project support efforts in the Army Science and Technology Lethality and Ground Maneuver portfolios.

This Project matures technologies from Program Element (PE) 0602303A (Missile Technology) and directly supports systems managed by the Program Executive Officer for Missiles and Space. Work in this Project is in collaboration with PE 0602618A (Ballistics Technology), PE 0602624A (Weapons and Munitions Technologies), PE 0603004A (Weapons and Munitions Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology) and PE 0708045A (End Item Industrial Preparedness Activities).

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 2019	FY 2020	FY 2021
Title: Low Cost Tactical Extended Range Missile	9.470	-	-
Description: This effort focuses on maturation, fabrication, and demonstration of technologies for low-cost precision fires missile capable of deep strike engagements. The aim is to provide extended range and expanded target set capability through advanced propulsion, new payload technology, and maintain effectiveness in Global Positioning System (GPS) challenged environments through new and novel navigation technologies. This effort supports the Army need for developing capability enablers in the area of Extended Range Precision Fires.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3		R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>		Project (Number/Name) 263 / <i>Future Msl Tech Integr(FMTI)</i>
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Title: Active Protection System Interceptor Demonstration Description: This effort matures, integrates and demonstrates modular hard-kill Active Protection System (APS) technologies with the Hit Avoidance Architecture and APS Common Controller and matures modeling and simulation for system integration and demonstration. Specifically the hard-kill APS portion and modeling and simulation efforts will be addressed by the United States (U.S.) Army Aviation and Missile Research, Development and Engineering Center (AMRDEC). This effort supports the Army's APS program to mature and demonstrate APS technologies to reduce vehicle weight while reducing reliance on armor through the use of other means such as sensing, warning, hostile fire detection, and active countermeasures to achieve increased protection against current and emerging threats. This effort supports the development of an APS Common Architecture enabling adaptable APS solutions that can be integrated across Army vehicle platforms as required.		3.516	-	-
Title: Affordable Extended Range Precision Missile Demonstration Description: This effort focuses on the maturation, fabrication, integration, hardware-in-the-loop (HWIL) test, and flight demonstration of technology for an affordable discriminate extended range precision missile to include critical component technologies such as advanced propulsion, seekers, fire control, datalink, guidance and controls, and maneuverable airframes.		7.700	-	-
Title: Close Combat Weapons Technology Description: This effort addresses close combat weapon systems trade studies, and technology maturation and demonstration for a next generation close combat precision missile system for dismounted and mounted maneuver.		5.572	-	-
Title: Multi-Domain Lethality Demonstration Description: This effort focuses on the maturation, fabrication, integration, HWIL development and test, and flight demonstration of critical missile technology that supports Multi-Domain Battle Concept/Cross-Domain Fires and Manned-Unmanned Teaming (MUM-T) System of Systems. The objective is to develop capability for missile systems to destroy enemy air defenses in the land and the maritime domains. This effort will develop and demonstrate appropriate sensor and payload component technologies for engaging and destroying maritime- and land-based air defense systems; integrate these component technologies into prototype missile hardware; and demonstrate hardware in a relevant flight environment.		9.977	-	-
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun		0.034	-	-
Accomplishments/Planned Programs Subtotals		36.269	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>	Project (Number/Name) 263 / <i>Future Msl Tech Integr(FMTI)</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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>	Project (Number/Name) 704 / <i>Advanced Missile Demo</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>704: Advanced Missile Demo</i>	-	18.723	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	18.723

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology:
 * Project AK5 Multi-Role Small Guided Missile Advanced Tech
 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 matures advanced missile system concepts and related hardware to enhance weapon system lethality, survivability, agility, versatility, deployability, and affordability for defense against future air and ground, armored and non-armored threats.

This Project support efforts in the Army Science and Technology Lethality portfolio.

Work in this Project is in collaboration with PE 0602624A (Weapons and Munitions Technologies).

The cited work is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas and the Army Modernization Strategy. FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

	FY 2019	FY 2020	FY 2021
<p>Title: Counter Rockets, Artillery, Mortars (RAM), Unmanned Aerial Systems (UAS), and Cruise Missile Tracking and Fire Control</p> <p>Description: This effort matures and demonstrates system technology to provide 360 degree, near hemispherical coverage for tracking and intercept of UAS and/or Cruise Missile threats. This effort matures fire control methodology for engagement of threat UAS and/or Cruise Missile to generate firing solutions and determine interceptors available for an air defense mission. These efforts will be evaluated through Hardware-in-the-Loop (HWIL) experiments and multiple interceptor flights. Effort will also mature tactical launcher configurations and designs for alternative mission profiles. The technologies demonstrated will be applicable to the Indirect Fire Protection Capability (IFPC) and other Air and Missile Defense programs.</p>	2.273	-	-
<p>Title: Low-cost Extended Range Air Defense</p> <p>Description: This effort matures key technologies of a lower-cost interceptor system with a low- to medium-altitude, medium- to long-range capability. This effort will enable lower cost interceptor integration into a net-enabled Air and Missile Defense Task Force for the protection of high value assets. Technologies will address the defeat of air defense threats such as Unmanned Aerial</p>	7.991	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>	Project (Number/Name) 704 / <i>Advanced Missile Demo</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
System (UAS) and Cruise Missile threats with secondary capabilities against Large Caliber Rockets (LCR), Short Range Ballistic Missiles (SRBM), and Tactical Air-to-Surface Missiles (TASMS).				
Title: Seeker and Guidance Technology for Air Defense Description: This effort focuses on the maturation, integration, and fabrication of seeker and guidance technologies supporting air defense missile systems. Technologies addressed enable the defeat of multiple air defense threats such as Rockets, Artillery, and Mortars, UAS, and Cruise Missile threats with secondary capabilities against LCRs, SRBMs, and TASMs.		6.537	-	-
Title: Multi-Role Missile Demonstration Description: This effort focuses on the maturation, fabrication, integration, hardware-in-the-loop (HWIL) development and test, and flight demonstration of critical technology that supports an open systems architecture to enable modular designs of guided and unguided missiles for smaller and lighter missile options with multi-role engagement capabilities reducing the life cycle cost for missiles. Critical component technologies include advanced propulsion, payload (lethal and non-lethal), seekers, fire control, datalink, guidance and controls, and maneuverable airframes. This effort matures and demonstrates technology from PE 0602303A (Missile Technology).		1.922	-	-
Accomplishments/Planned Programs Subtotals		18.723	-	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603313A / <i>Missile and Rocket Advanced Technology</i>				Project (Number/Name) NA6 / <i>Missile and Rocket Initiatives (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
NA6: <i>Missile and Rocket Initiatives (CA)</i>	-	35.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Missile and Rocket advanced technology development.

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

	FY 2019	FY 2020
<i>Congressional Add:</i> Program increase - cybersecurity and supply chain risk management	10.000	-
<i>FY 2019 Accomplishments:</i> Program increase - cybersecurity and supply chain risk management		
<i>Congressional Add:</i> Program increase - cyber security	15.000	-
<i>FY 2019 Accomplishments:</i> Program increase - cyber security		
<i>Congressional Add:</i> Program increase - tactically mobile, shoot-on-the-move SHORAD demonstration	10.000	-
<i>FY 2019 Accomplishments:</i> Program increase - tactically mobile, shoot-on-the-move SHORAD demonstration		
Congressional Adds Subtotals	35.000	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603322A / TRACTOR CAGE
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	16.845	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.845
B92: DB92	-	16.845	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.845

Note

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

A. Mission Description and Budget Item Justification

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	16.845	0.000	0.000	-	0.000
Current President's Budget	16.845	0.000	0.000	-	0.000
Total Adjustments	0.000	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			

Change Summary Explanation

The details of this program are reported in accordance with Title 10, United States Code, Section 119(a)(1).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	23.769	23.357	-	23.357	28.773	31.113	17.039	12.373	0.000	136.424
6CY: Autonomous Cyber Advanced Technology	-	0.000	6.000	5.995	-	5.995	7.993	8.451	5.106	5.391	0.000	38.936
7CY: Decoy and Deterrence Advanced Technology	-	0.000	2.135	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.135
8CY: Information Trust Advanced Technology	-	0.000	2.203	10.900	-	10.900	14.269	15.593	4.951	0.000	0.000	47.916
9CY: Network Access and Effects Advanced Technology	-	0.000	1.431	4.464	-	4.464	4.513	5.071	4.962	4.962	0.000	25.403
CB4: Offensive Cyber Operations (OCO) Mirror Adv Tech	-	0.000	2.000	1.998	-	1.998	1.998	1.998	2.020	2.020	0.000	12.034
CB6: C3I Cyber Advanced Development (CA)	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

Note

In Fiscal Year (FY) 2020 this Program Element (PE) was previously funded, with continuity of effort realigned from the following PEs:

* 0603270A Electronic Warfare Technology

* 0603794A C3 Advanced Technology

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.

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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	13.769	18.795	-	18.795
Current President's Budget	0.000	23.769	23.357	-	23.357
Total Adjustments	0.000	10.000	4.562	-	4.562
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	10.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	4.562	-	4.562

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

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

Congressional Add: *Program Increase*

	FY 2019	FY 2020
	-	10.000
Congressional Add Subtotals for Project: CB6	-	10.000
Congressional Add Totals for all Projects	-	10.000

Change Summary Explanation

FY20 increase related to FY20 Congressional Add.

FY21 increase due to Science & Technology portfolio restructure.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
6CY: Autonomous Cyber Advanced Technology	-	0.000	6.000	5.995	-	5.995	7.993	8.451	5.106	5.391	0.000	38.936

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 06030794A C3 Advanced Technology:
 * Project EL5 Secure Tactical Information Integration

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.

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

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

Title: Autonomous Cyber	FY 2019	FY 2020		FY 2021
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.	-	6.000		5.995
FY 2020 Plans: Will develop proof-of-concept sensors that can adapt to and autonomously react to adversary cyber-attack; 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: Will 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				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
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.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	6.000	5.995

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 7CY I Decoy and Deterrence Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>7CY: Decoy and Deterrence Advanced Technology</i>	-	0.000	2.135	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.135

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology:
 * Project EL5 Secure Tactical Information Integration

In FY21 this Project is Eliminated.

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. Work in this Project complements PE 0602213A C3I Applied Cyber, Project CY9 Decoy and Deterrence Technology.

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

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

Title: Decoy and Deterrence Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	2.135	-
FY 2020 Plans: Develop additional techniques incorporating application diversity to control and vary the network attack surface to inhibit the cyber attacker's ability to detect and exploit pre-placed cyber decoys.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
This Project is eliminated in FY21.			
Accomplishments/Planned Programs Subtotals	-	2.135	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
8CY: <i>Information Trust Advanced Technology</i>	-	0.000	2.203	10.900	-	10.900	14.269	15.593	4.951	0.000	0.000	47.916

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology:
 * Project EL5 Secure Tactical Information Integration

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.

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

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

Title: Information Trust Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	2.203	3.500
FY 2020 Plans: Develop a suitable trust score architecture that can provide real time analytics of the data through distributed processing and minimization of network traffic.			
FY 2021 Plans: Will mature and demonstrate the authentication service that helps determine and track user trust values within a block chain architecture.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Planned increase for demonstration of the authentication service.				
Title: Agile Virtual Enclave		-	-	7.400
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: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding increased to mature and demonstrate technology to develop a MLS Access Guard for data sharing in a mission partner environment with a reduced hardware footprint.				
Accomplishments/Planned Programs Subtotals		-	2.203	10.900
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
9CY: Network Access and Effects Advanced Technology	-	0.000	1.431	4.464	-	4.464	4.513	5.071	4.962	4.962	0.000	25.403

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 060270A C3 Advanced Technology:
 * Project CY3 Offensive Cyber Operations Mirror Adv Tech

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.

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

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

Title: Offensive Cyber Enabling Mission Support	FY 2019	FY 2020	FY 2021
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.	-	1.431	4.464
FY 2020 Plans: Will mature and demonstrate protocol-based access and Deny, Degrade, and Disrupt, Destroy, and manipulate (D4M) off-net techniques from tactical Radio Frequency (RF) enabled platforms against emerging hybrid commercial/military technologies used for Adversary Command, Control, Communication, Computers, and Intelligence (AC4I); mature decision aid tools for selection and optimization of RF enabled techniques in support of the Commander's desired intent.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603457A / C3I Cyber Advanced Development	Project (Number/Name) 9CY I Network Access and Effects Advanced Technology		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 an suitable environment				
FY 2020 to FY 2021 Increase/Decrease Statement: Increased funding supports high priority offensive cyber operations research, accelerates time to deployment for cyber effects, and begins the process of automatic vulnerability discovery via the decision aid tools.				
Accomplishments/Planned Programs Subtotals		-	1.431	4.464
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CB4: <i>Offensive Cyber Operations (OCO) Mirror Adv Tech</i>	-	0.000	2.000	1.998	-	1.998	1.998	1.998	2.020	2.020	0.000	12.034

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603270A Electronic Warfare Technology:
 * Project CY3 Offensive Cyber Operations Mirror Adv Tech

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.

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

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

	FY 2019	FY 2020	FY 2021
Title: Offensive Cyber Operations Mirror	-	2.000	1.998
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 2020 Plans: Mature and demonstrate technologies and real world behavioral models of sufficient fidelity to replicate Offensive Cyber Operations environments (for cyber development, deployment, exercises, and mission rehearsal) to reduce risk for critical offensive cyber mission functions.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Accomplishments/Planned Programs Subtotals		-	2.000	1.998
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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)
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CB6: C3I Cyber Advanced Development (CA)	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

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 2019	FY 2020
Congressional Add: Program Increase	-	10.000
FY 2020 Plans: Program Increase		
Congressional Adds Subtotals	-	10.000

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	211.457	224.755	188.024	-	188.024	191.463	197.623	198.323	201.064	0.000	1,412.709
DS7: High Performance Computing Modernization Program	-	176.457	224.755	188.024	-	188.024	191.463	197.623	198.323	201.064	0.000	1,377.709
DW5: HIGH PERF COMP MODERN (HPCM) (CA)	-	35.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	218.098	184.755	188.205	-	188.205
Current President's Budget	211.457	224.755	188.024	-	188.024
Total Adjustments	-6.641	40.000	-0.181	-	-0.181
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	40.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-6.641	-			
• Adjustments to Budget Years	-	-	-0.181	-	-0.181

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: *Congressional Increase*

Congressional Add Subtotals for Project: DW5

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	37.967
	-	37.967
	35.000	-
	35.000	-
	35.000	37.967

Change Summary Explanation

FY20 increase related to FY20 Congressional Adds.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
DS7: High Performance Computing Modernization Program	-	176.457	224.755	188.024	-	188.024	191.463	197.623	198.323	201.064	0.000	1,377.709

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) community; 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 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 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 community, 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 2019	FY 2020	FY 2021
Title: Department of Defense Supercomputing Resource Centers	93.484	95.848	99.611
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 community to effectively and efficiently investigate, demonstrate, and mature a broad range of technologies through advanced computational methods.			
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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. Refine and exploit the advanced capabilities of previously demonstrated supercomputers (utilize the existing capability to complete 54,000 trillion floating point operations per second) 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 (i.e. 2020) processor, memory, disk input/output (I/O), interconnect, and operating system (OS) capabilities. Demonstrate enhanced access solutions to supercomputers ? solutions that do not require software to be added to the client machine to allow scientists and engineers located at sites with prohibitive security practices to access supercomputers. 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>FY 2021 Plans: Will 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. Will 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. Will 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. Will demonstrate new mechanisms to access and reduce barriers to supercomputers. Will leverage data-intensive supercomputing architectures for DoD use cases in machine learning, artificial intelligence, and data sciences.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Defense Research and Engineering Network</p> <p>Description: 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 community, 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>FY 2020 Plans: Continue to refine and exploit DREN III (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 requirements of the Test & Evaluation (T&E) and Acquisition Engineering communities. Formalize the strategic technical</p>		30.946	30.367	32.973

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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 final configuration and fine tune the Identity Aware Proxy (IAP) Security Gateway Enhancement Project to enhance HPCMP's Defense Information Systems Agency (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. Continue to demonstrate hardware architecture and software stack enhancements for network sensors to simultaneously allow; (1) active support for the HPCMP's DISA-accredited Tier 2 cybersecurity service provider capabilities; and (2) active experimentation for novel, adaptive cybersecurity detection and intervention methods; Implement the ability to employ SDNs to allow traditional IP and experimental protocol networks to coexist within a common DoD networking infrastructure. Implement a prototype ISCM and cyber situational awareness capability to ingest robust, diverse, host-based and network-based near-real-time information by harnessing HPC resources for advanced mission essential task elements.</p> <p>FY 2021 Plans: Will 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 requirements of the T&E and Acquisition Engineering communities. Will 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; will complete source selection for DREN IV. Will 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. Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects 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 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</p>		52.027	52.442	55.440

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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 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 2020 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 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 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, will a) incorporate new generation of high order accuracy solvers; b) implement hypersonic terminal maneuvers; and c) begin incorporation of 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. These capabilities will be deployed in support of the Future Vertical Lift (FVL) Program, as well as for sustainment of existing rotorcraft-based programs and associated upgrades. RF antenna design and analysis is maturing computational electromagnetics capabilities to assist in design and evaluation of next generation radar for aircraft, ships, and ground-based platforms; demonstrate 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. Conclude 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. Begin efforts to incorporate 6-DOF submarine maneuvering. For Ground Vehicles a) complete advanced model interfacing standards; b) complete incorporation of sensing and autonomy capabilities; and c) expand autonomy capabilities.</p> <p>FY 2021 Plans:</p>				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will 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 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 analysis of cost implications. Will 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) 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, 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 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 (X-Band 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 submarine maneuvering. For Ground Vehicles will continue to expand autonomy capabilities.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	8.131	-
Accomplishments/Planned Programs Subtotals		176.457	186.788	188.024
		FY 2019	FY 2020	
Congressional Add: Program Increase		-	37.967	

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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	FY 2019	FY 2020
FY 2020 Plans: Program Increase		
Congressional Adds Subtotals	-	37.967

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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)
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
DW5: HIGH PERF COMP MODERN (HPCM) (CA)	-	35.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

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 2019	FY 2020
Congressional Add: Congressional Increase	35.000	-
FY 2019 Accomplishments: Congressional Increase		
Congressional Adds Subtotals	35.000	-

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 2021 Army											Date: February 2020	
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	260.535	199.358	-	199.358	196.039	208.501	219.054	210.850	0.000	1,294.337
BF2: Autonomous Ground Resupply (AGR) Adv Tech	-	0.000	18.772	19.278	-	19.278	0.000	0.000	0.000	0.000	0.000	38.050
BF4: Combat Vehicle Robotics Adv Tech	-	0.000	10.308	8.820	-	8.820	27.803	33.274	37.976	39.233	0.000	157.414
BF5: Adv Lethality & Accuracy Sys for Med Cal Adv Tech	-	0.000	2.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.000
BF7: Crew Augmentation and Optimization Adv Tech	-	0.000	3.871	4.411	-	4.411	4.412	4.337	4.288	4.331	0.000	25.650
BG1: Sensors for Auto Oper and Survivability Adv Tech	-	0.000	10.128	14.213	-	14.213	11.262	12.696	12.835	12.837	0.000	73.971
BG3: Modeling and Simulation for MUMT Advanced Tech	-	0.000	3.530	3.364	-	3.364	0.999	1.019	4.586	4.586	0.000	18.084
BG4: Adv Mobility Experimental Prototype Adv Tech Demo	-	0.000	9.658	3.903	-	3.903	2.927	0.000	0.000	0.000	0.000	16.488
BG5: Extended Line of Sight (ELOS) Advanced Technology	-	0.000	12.000	1.449	-	1.449	0.000	0.000	0.000	0.000	0.000	13.449
BG7: Ground Systems Active Defense (GSAD) Advanced Tech	-	0.000	23.387	49.073	-	49.073	51.743	50.801	49.038	44.760	0.000	268.802
BG9: Obscuration Advanced Technology	-	0.000	3.085	10.145	-	10.145	2.708	2.772	2.809	2.809	0.000	24.328
BH1: Survivability Systems Controls Advanced Technology	-	0.000	13.022	13.680	-	13.680	14.094	14.009	13.772	13.912	0.000	82.489
BH3: C4ISR Modular Autonomy Advanced Technology	-	0.000	3.926	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.926
BH4: Ground Vehicle Holistic Defense Adv Tech*	-	0.000	0.000	0.000	-	0.000	14.145	15.794	15.810	15.969	0.000	61.718
BH6: Platform Electrification and Mobility Adv Tech	-	0.000	5.198	24.701	-	24.701	31.077	34.717	36.008	20.944	0.000	152.645

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army										Date: February 2020			
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								
BH8: Enhanced VETRONICS Advanced Technology	-	0.000	12.960	12.397	-	12.397	10.113	10.758	10.146	10.250	0.000	66.624	
BI1: Protection for Autonomous Systems Adv Tech	-	0.000	4.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.100	
BI3: Sensor Protection Advanced Technology	-	0.000	1.500	1.798	-	1.798	1.798	1.798	1.818	1.818	0.000	10.530	
BI5: Materials Application and Integration Adv Tech	-	0.000	3.625	5.487	-	5.487	5.628	5.741	5.800	4.577	0.000	30.858	
BI8: All-Electric Combat Powertrain Advanced Technology*	-	0.000	0.000	0.000	-	0.000	0.000	1.249	4.596	15.794	0.000	21.639	
BJ1: Vehicle System Security Advanced Technology	-	0.000	1.250	1.499	-	1.499	2.843	4.502	4.948	3.502	0.000	18.544	
BJ6: Hydrogen Based Combat System Advanced Technology	-	0.000	4.485	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.485	
BJ8: Detection of Explosive Hazards Advanced Technology	-	0.000	5.130	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.130	
BK1: Autonomous Mobility Adv Tech	-	0.000	7.140	8.791	-	8.791	6.894	6.794	5.736	5.736	0.000	41.091	
BK4: Next Gen Intelligent Fire Control(NG-IFC) Adv Tech	-	0.000	0.450	9.241	-	9.241	1.998	2.398	2.498	3.158	0.000	19.743	
BK6: Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech	-	0.000	0.510	3.140	-	3.140	1.499	1.499	1.998	2.242	0.000	10.888	
BP6: Ground Vehicle Advanced Technology(CA)	-	0.000	100.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	100.500	
BZ9: Smart Targeting Environment for Lower Level Assets	-	0.000	0.000	3.968	-	3.968	4.096	4.343	4.392	4.392	0.000	21.191	
*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2021													

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army		Date: February 2020
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>	
Note All efforts in this Program Element (PE) were previously funded, with continuity of effort realigned from the following PEs: * 0603004A (Weapons and Munitions Advanced Technology) * 0603005A (Combat Vehicle and Automotive Advanced Technology) * 0603270A (EW Technology) * 0603313A (Missile and Rocket Advanced Technology) * 0603606A (Landmine Warfare and Barrier Advanced Technology) * 0603710A (Night Vision Advanced Technology) * 0603734A (Military Engineering Advanced Technology) * 0603772A (Advanced Tactical Computer Science & Sensor Technology)		
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, 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.		

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	160.035	174.428	-	174.428
Current President's Budget	0.000	260.535	199.358	-	199.358
Total Adjustments	0.000	100.500	24.930	-	24.930
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	100.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	24.930	-	24.930

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*
- Congressional Add: *ATE5.2 Engine Development*
- Congressional Add: *Additive Manufacturing of Critical Components*
- Congressional Add: *Advanced Water Harvesting Technology*
- Congressional Add: *Advanced High Strength and Lightweight Steels*
- Congressional Add: *Combat Vehicle Weight Reduction Initiative*
- Congressional Add: *Virtual and Physical Prototyping*
- Congressional Add: *HMMWV Augmented Reality System*
- Congressional Add: *Health Usage Monitoring for HMMWV*
- Congressional Add: *HMMWV Autonomy*
- Congressional Add: *HMMWV Torque Monitoring*
- Congressional Add: *HMMWV Automotive Enhancements*
- Congressional Add: *Additive Manufacturing*

	FY 2019	FY 2020
	-	20.000
	-	10.000
	-	10.000
	-	5.000
	-	5.000
	-	5.000
	-	3.000
	-	8.000
	-	8.000
	-	5.000
	-	3.000
	-	5.000
	-	2.000
	-	7.500
	-	4.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2019	FY 2020
Congressional Add Subtotals for Project: BP6	-	100.500
Congressional Add Totals for all Projects	-	100.500

Change Summary Explanation

FY2020 funding change due to \$100.500 M in Congressional adds

FY2021 funding change due to administrative 6.2 to 6.3 shift from 0602145A/BG6/Advanced Concepts for Active Defense, to 0603462A/BG7/Ground Systems Active Defense, and increase in \$8.0M due to Office of Management and Budget (OMB) Passback Transfer

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BF2: Autonomous Ground Resupply (AGR) Adv Tech	-	0.000	18.772	19.278	-	19.278	0.000	0.000	0.000	0.000	0.000	38.050

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603005A (Combat Vehicle and Automotive Advanced Technology) / 515 (Robotic Ground Systems)
 PE 0603734A Military Engineering Advanced Technology Development / T08 (Combat Eng Systems)

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 2019	FY 2020	FY 2021
Title: Architecture and Standards	-	7.097	7.510

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>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 and sustainable lifecycle management model. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p>FY 2020 Plans: Will improve the fail-safe architecture with common interfaces, software and algorithms for increased robotic capability, increased reliability, and autonomous testing methodologies and procedures. Will work within and make recommendations for improvements to the government-controlled interoperability profile (IOP) standard. Will validate that standardized interfaces are enforced between unmanned platforms, payloads, controllers, and wireless communication devices.</p> <p>FY 2021 Plans: Will 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. Will 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. Will 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>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: Hardware and Hardware-in-the-loop/Software-in-the-loop (HIL/SIL)</p> <p>Description: 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>FY 2020 Plans: Will evaluate new hardware and software configurations to optimize AGR solutions throughout the full range of environmental conditions that are controllable and repeatable to optimize performance. Will utilize HIL SIL capability to improve and validate</p>	-	5.999	4.690

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
hardware and software configurations in the laboratory before field experimentation, reducing costs, saving time and improving overall system performance. FY 2021 Plans: Will 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. Will use HIL and SIL capability to rapidly integrate and simulate advanced software behaviors prior to conducting field testing. Will 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. Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Soldier Experimentation Description: 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 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). FY 2020 Plans: Will utilize soldier feedback to optimize utility and reliability within all AGR efforts. Will improve training and maintenance packages to enable expedient transition to the soldier. Will identify high risk and vulnerabilities of the system to increase survivability of the system from enemies to inform the Program of Record (PoR). FY 2021 Plans: Will 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. Will collaborate with TRADOC and ATEC to obtain a safety release to enable Soldiers and Marines to utilize AGR equipment in relevant operational environments. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		-	4.537	6.578
Title: Simulation Tools for Autonomous Ground Resupply		-	0.287	0.500

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<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 2020 Plans: Will demonstrate simulation environment performance and impact to autonomous deployment cost and timeline; will support Autonomous Ground Resupply capstone demonstrations via simulation-enabled analyses methods; and will integrate additional sensors and algorithms into simulation tools.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: N/A</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.852	-
Accomplishments/Planned Programs Subtotals	-	18.772	19.278

<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 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BF4: <i>Combat Vehicle Robotics Adv Tech</i>	-	0.000	10.308	8.820	-	8.820	27.803	33.274	37.976	39.233	0.000	157.414

Note
 In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603005A Combat Vehicle and Automotive Advanced Technology
 * Project 515 Robotic Ground Systems

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 2019	FY 2020	FY 2021
<p>Title: Platform Electronic Control</p> <p>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.</p> <p>FY 2020 Plans: Will optimize sensors and software algorithms that provide for robotic vehicle perception to be continuously effective across adverse operational conditions. Will mature the interface technologies that allow for field changes to vehicle payload configurations that self-align with native vehicle control scheme and mission taskings.</p> <p>FY 2021 Plans:</p>	-	7.346	4.500

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will demonstrate the smart payload-agnostic interfaces and control mechanisms into the autonomous control systems to provide robust mobility characteristics and standard inputs. Will develop a robust platform with system health intelligence for monitoring the critical component state and control data streams.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding from this effort is realigned the Unmanned Maneuver and Soldier-Robotic Interface Integration efforts within this Project.</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> <p>FY 2020 Plans: Will develop the RAS Safety Standard utilizing the newly formed RAS Safety Review Board (Army) that exploits the published guidelines on best practices for isolation of safety critical software from other RAS behaviors. Will optimize process for obtaining a useable Safety Confirmation for robotic systems and reduce the overall time for developmental safety testing.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort completed in FY20 with funding from this effort being realigned the Unmanned Maneuver and Soldier-Robotic Interface Integration efforts within this Project. .</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: Will integrate advanced autonomous behaviors for the robotic combat vehicle in a manned/unmanned team mission demonstrating the off-road capability and commanded formation. Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding in this effort is realigned from the Unmanned Maneuver and Soldier-Robotic Interface Integration efforts within this Project.</p>		-	-	3.000
<p>Title: Soldier-Robotic Interface Integration</p>		-	-	1.320

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<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: Will develop enhanced multi-vehicle, assisted autonomous control to include dynamically reconfigurable interfaces for the mission systems to increase standoff and enable force multiplication. Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding in this effort is realigned from the Unmanned Maneuver and Soldier-Robotic Interface Integration efforts within this Project.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.468	-
Accomplishments/Planned Programs Subtotals	-	10.308	8.820

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>				Project (Number/Name) BF5 / <i>Adv Lethality & Accuracy Sys for Med Cal Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BF5: <i>Adv Lethality & Accuracy Sys for Med Cal Adv Tech</i>	-	0.000	2.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology
 * Project 232 Advanced Lethality & Survivability Demo

In FY21 this Project is Eliminated.

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 2019	FY 2020	FY 2021
Title: Advanced Lethality and Accuracy System for Medium Caliber Advanced Technology	-	1.909	-
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.			
FY 2020 Plans: Will validate weapon system integration with demonstration of AHS and will complete system level performance optimization efforts of programmable air burst munition and armor piercing munition fire control solutions for stationary on stationary			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BF5 / <i>Adv Lethality & Accuracy Sys for Med Cal Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>engagements against personnel and materiel targets. The maturation and demonstrations that will be conducted through FY20 will inform technical updates to the level 2 technical data package that will be finalized for transition to Program Executive Office (PEO) Ground Combat Systems and PEO Ammunition.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort completes in FY20.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.091	-
Accomplishments/Planned Programs Subtotals	-	2.000	-

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

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BF7: <i>Crew Augmentation and Optimization Adv Tech</i>	-	0.000	3.871	4.411	-	4.411	4.412	4.337	4.288	4.331	0.000	25.650

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
Program Element (PE) 0603005A (Combat Vehicle and Automotive Advanced Technology) / 441 (Combat Vehicle Mobility)

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 2019	FY 2020	FY 2021
Title: Crew Augmentation & Optimization Advanced Technology	-	3.696	4.411
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 2020 Plans: Will mature crew station technologies by increasing crew performance over existing baseline capabilities. Will integrate and demonstrate advancements in multimodal hardware, displays and controls and task augmentation to provide greater situational awareness and faster decision timelines. Will validate effectiveness in relevant field demonstration utilizing Soldier subjects.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Will mature and demonstrate vehicle and crew task management and re-tasking to enhance team performance. Will demonstrate effectiveness of individual vehicle operators without increasing levels of manpower for specific mission sub-sets. Will demonstrate baseline teaming of crew and robotic operator configurations to permit reconfiguration of roles, improve ease of use and increase overall productivity. Will validate effectiveness in an operationally-relevant, motion-based simulation environment with Soldiers. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.175	-
Accomplishments/Planned Programs Subtotals	-	3.871	4.411

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

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BG1: <i>Sensors for Auto Oper and Survivability Adv Tech</i>	-	0.000	10.128	14.213	-	14.213	11.262	12.696	12.835	12.837	0.000	73.971

Note

In FY 2020 this Project is realigned from:
 PE 0603606A (Landmine Warfare and Barrier Advanced Technology) / Project 683 (Area Denial Sensors)
 PE 0603710A (Night Vision Advanced Technology) / Project K70 (Night Vision Advanced Technology)

A. Mission Description and Budget Item Justification

This Project matures, optimizes, and demonstrates automated, advanced multi-function sensors and algorithms enabling autonomous man-unmanned combined arms maneuver 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)

Title: Sensors for Autonomous Operations and Survivability Advanced Technology	FY 2019	FY 2020	FY 2021
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).	-	9.668	-
FY 2020 Plans: Will validate performance of AiTD and AiTR algorithms against ground targets in cluttered environments with situational awareness and targeting sensors. Will mature sensors with multi-spectral response and increased dynamic range to enable innovative AiTR behaviors and tasking in moderately complex environments, and against asymmetric targets. Will improve			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>embedded processing techniques to provide real-time performance on space-constrained platforms. Will mature and optimize threat optics detection with targeting sensors.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned to Advanced Sensors with Embedded Processing and Multi-Mission Payload efforts in this Project.</p>				
<p>Title: Advanced Sensors with Embedded Processing</p> <p>Description: Matures and demonstrates advanced, automated 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 to enable combined arms maneuvers in complex environments for Next Generation Combat Vehicle via manned, optionally manned, and robotic platform applications.</p> <p>FY 2021 Plans: Will mature sensor payloads with embedded Aided Target Detection and Recognition (AiTD and AiTR) algorithms for situational awareness and targeting sensors. Will demonstrate sensors with multi-spectral response and embedded processing to provide real-time performance on space-constrained platforms. Will continue to mature threat optics detection with targeting sensors by combining pre-shot and thirdgeneration forward looking infrared capability.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned from the Sensors for Autonomous Operations and Survivability Advanced Technology effort in FY21.</p>		-	-	8.740
<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: Will 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. Will demonstrate sensor payloads on-the-move at low altitudes for rotary and fixed wing platforms in close combat open terrain scenarios. Will mature threat cueing algorithms based on the integrated sensor payload architecture and multi-look flight paths.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned from the Sensors for Autonomous Operations and Survivability Advanced Technology effort in FY21.</p>		-	-	5.473
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.460	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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 2019	FY 2020	FY 2021
<i>FY 2020 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	10.128	14.213

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

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BG3: Modeling and Simulation for MUMT Advanced Tech	-	0.000	3.530	3.364	-	3.364	0.999	1.019	4.586	4.586	0.000	18.084

Note

In FY 2020 this Project was realigned from PE 0603734A (Military Engineering Advanced Technology) / Project T08 (Combat Eng Systems).

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

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

	FY 2019	FY 2020	FY 2021
<p>Title: Mobility in Complex Urban Environments Demonstrations</p> <p>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. This effort is coordinated with PE 0602145A (Next Generation Combat Vehicle Technology).</p> <p>FY 2020 Plans: Mature a fully integrated real-time hardware-in-the-loop simulator to validate autonomous vehicle maneuver configurations; conduct field demonstrations to assess performance; demonstrate mobility obstacle detection software to support real-time mobility decisions in urban environments; integrate further sensor modalities into the simulator.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort was realigned to the Simulation Tools for CoVeR Demonstrations Effort within this same Project</p>	-	3.496	-
<p>Title: Simulation Tools for CoVeR Demonstrations</p>	-	-	3.364

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Description: This effort matures and demonstrates high-fidelity M&S tools to support the development and optimization of autonomous vehicle platforms and components to support autonomous maneuver in unstructured environments.</p> <p>FY 2021 Plans: Will 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; will optimize and improve M&S tools to support autonomous vehicle platforms and component development; and will optimize adaptive learning models and analytical tools for predicting impacts to maneuver in unstructured environments.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort was realigned from the Mobility in Complex Urban Environments Demonstrations effort within this Project.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.034	-
Accomplishments/Planned Programs Subtotals		-	3.530	3.364
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BG4: <i>Adv Mobility Experimental Prototype Adv Tech Demo</i>	-	0.000	9.658	3.903	-	3.903	2.927	0.000	0.000	0.000	0.000	16.488

Note

In FY 2020 this Project is realigned from PE 0603005A (Combat Vehicle and Automotive Advanced Technology) / Project 441 (Combat Vehicle Mobility).

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 2019	FY 2020	FY 2021
Title: Advanced Mobility Experimental Prototype (AMEP) Advanced Technology	-	9.219	3.903
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 2020 Plans: Will mature powertrain, power generation and running gear components for integration into surrogate ground vehicle system. Will develop powertrain controls architecture and algorithms to improve powertrain component efficiencies.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.439	-
Accomplishments/Planned Programs Subtotals		-	9.658	3.903
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BG5: <i>Extended Line of Sight (ELOS) Advanced Technology</i>	-	0.000	12.000	1.449	-	1.449	0.000	0.000	0.000	0.000	0.000	13.449

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology, Project:
 * 232 Advanced Lethality & Survivability Demo

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)

Title: Extended Line Of Sight (ELOS) Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	11.455	1.449
FY 2020 Plans: Will optimize an ELOS Munition Air Frame (projectile) design to include fin stabilization element, Seeker Unit, Guidance Electronics Unit (GEU), Canard Actuation System (CAS), Warhead, GNC (Guidance, Navigation and Control) Software, Target Acquisition and Tracking (TA&T) Software, Propulsion system; will integrate these components to validate their performance through preprogram maneuver cannon fired experiments. Finalize Seeker Unit design, initiate Processor in the Loop (PIL) and Hardware in the Loop (HIL) analysis/testing.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 demonstrated advanced technologies including: fin stabilization; next generation seeker components; electronic guidance, navigation and control (GNC) software; and other advanced component technology. FY 2020 to FY 2021 Increase/Decrease Statement: Funding in this effort is realigned in FY21 to support higher priority Army Modernization needs.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.545	-
Accomplishments/Planned Programs Subtotals		-	12.000	1.449
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BG7: Ground Systems Active Defense (GSAD) Advanced Tech</i>	-	0.000	23.387	49.073	-	49.073	51.743	50.801	49.038	44.760	0.000	268.802

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603004A (Weapons and Munitions Advanced Technology) / L97 (Smoke and Obscurants Advanced Technology)
 PE 0603005A (Combat Vehicle and Automotive Advanced Technology) / 221 (Combat Veh Survivability)
 PE 0603270A (EW Technology) / K16 (Non-Commo ECM Tech Demo)
 PE 0603313A (Missile and Rocket Advanced Technology) / 263 (Future MSL Tech Integr)

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)

Title: Ground Systems Active Defense Development	FY 2019	FY 2020	FY 2021
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	-	8.989	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
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.				
<p>FY 2020 Plans: Will further develop and mature sensor and effector technologies for inclusion in suite of threat defeat capability. Will validate compliance with SSC architecture, perform environmental and durability testing of developed components to mature the technology, and provide demonstration of pacing threat defeat in representative environment. Will optimize and mature subsystem packaging and integration methods for both active protection components as well as base vehicle armor protection for the defeat of residual fragments that result from countermeasure engagements.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Work in this effort is realigned in FY21 to the Soft Kill System Development, Top/Bottom Attack Protection, Survivability Capability Characterization and Experimentation, Sensors for Adaptive Armor, and Active Blast Mitigation Environmental and Durability Validation efforts within this Project.</p>				
<p>Title: Obscuration Technologies for Active Protection Systems</p> <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 2020 Plans: Will conduct prototype field experiments and characterization of the Improved Rapid Obscuration System that provides short range coverage for indirect defeat (obscuring the gunner?s view).</p> <p>FY 2021 Plans: Will optimize payloads and demonstrate dissemination of obscurant materials for the Extended Range Obscuration System (EROS).</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	0.584	2.340
<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 2020 Plans:</p>		-	3.304	7.135

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will continue maturation and adaptation of a hard-kill countermeasure and fire control sensor to provide protection for Next Generation Combat Vehicles from guided missile, recoilless rifle, and rocket propelled grenade attacks. Will validate the lethal mechanism design through laboratory testing. Design and develop countermeasure and fire control subsystems that are MAPS compliant.</p> <p>FY 2021 Plans: Will conduct component experiments with radar, propulsion/thruster and warhead mechanisms hardware and software to verify performance meets design intent and is repeatable; will begin design and development of integrated testbed for demonstration and evaluation of integrated protection system.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<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 2020 Plans: For Combat Operations Battlefield Radar: Will conduct capability/tradeoff analysis based on demonstrated technology to mature active protection systems for 360 degree situational awareness. Will improve resource management and processing algorithms that supports multi-mission capabilities. Improve radar simulation models to support HWIL evaluation of emerging threats and future sensor improvements and technologies.</p> <p>For Advanced Soft Kill Countermeasures (ASKCM): Will mature the soft-kill countermeasure system and hardware components and integrate techniques to address multiple types of anti-tank threats by optimizing hardware performance. Begin demonstrations of ASKCM capabilities to validate system performance against multiple threat classes, launch profiles and distances. Soft Kill Techniques and Effects: Will mature methodologies for countermeasure sources to be characterized, assessed and optimized against the priority threats of interest. Will demonstrate countermeasure capabilities against a variety of threats and guidance types.</p> <p>FY 2021 Plans: For Combat Operations Battlefield Radar: Will 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-</p>		-	9.448	9.974

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>loop evaluation of emerging threats and future sensor improvements and technologies; and provide analysis to ensure operation in cluttered radio frequency environments.</p> <p>For Advanced Soft Kill Countermeasures (ASKCM): Will 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: Will execute 2nd & 3rd iterations of validation of threat hardware successfully integrated in the lab without countermeasure in the loop (dry shot demonstration). Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</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: Will 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. Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort is added to support Army Modernization needs for countering existing and future enemy threat systems targeting combat vehicles.</p>		-	-	7.036
<p>Title: Soft-Kill System Development</p> <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.</p>		-	-	9.140

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Technologies will be optimized and integrated on combat vehicles using the MAPS Framework and Controller, and demonstrated in a relevant environment.				
<p>FY 2021 Plans: Will 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. Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Ground Systems Active Defense Development effort in this Project and increased to support Army Modernization priorities.</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: Will mature test methods to evaluate Soldier protection technologies from both top and bottom attack emerging threats. Will leverage modelling and simulation to evaluate protection technologies from current and future top and bottom attack threats. Will demonstrate underbody technologies that provide full-spectrum protection against bottom attack threats at a reduced weight from current technology. Will demonstrate top attack armor solutions and evaluate whether they interfere with vehicle operation. Will validate compliance with combat vehicle architectures, perform environmental and durability testing, and demonstrate capabilities against pacing threats in a representative environment.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Ground Systems Active Defense Development effort in this Project.</p>		-	-	6.294
<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: Will 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</p>		-	-	2.944

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
technologies in FY21 to characterize enhanced vehicle protection. Characterization data will be used to inform technology development and transition to PdM VPS. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned from the Ground Systems Active Defense Development effort and increased to support Army Modernization priorities in FY21.				
Title: Sensors for Adaptive Armor 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. FY 2021 Plans: Will 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. Will perform analysis and maturation of adaptive armor countermeasure concepts. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Ground Systems Active Defense Development effort in this project.		-	-	2.714
Title: Active Blast Mitigation Environmental and Durability Validation 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. FY 2021 Plans: Will optimize MAPS-compliant ABMS technology using improved countermeasure design for safety and manufacturing. Will develop a more effective countermeasure and improve upon the performance of prior ABMS designs. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Ground Systems Active Defense Development effort in this project.		-	-	1.496
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638		-	1.062	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<i>FY 2020 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	23.387	49.073

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BG9: <i>Obscuration Advanced Technology</i>	-	0.000	3.085	10.145	-	10.145	2.708	2.772	2.809	2.809	0.000	24.328

Note

In FY 2020 this Project is realigned from PE 0603004A (Weapons and Munitions Advanced Technology) / Project L97 (Smoke and Obscurants Advanced Technology).

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 2019	FY 2020	FY 2021
Title: Advanced Obscuration	-	2.945	2.145
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 2020 Plans: Will continue to mature particulate infrared and bispectral obscurant dissemination in the screening obscuration module. Investigate obscurant cloud interaction for vehicle protection applications.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will validate and demonstrate dissemination materials compatible with the screening obscuration module. Will demonstrate dissemination materials for the Improved Rapid Obscuration System (IROS). Will optimize multi-spectral payloads to perform as obscurant countermeasures for effective vehicle protection. FY 2020 to FY 2021 Increase/Decrease Statement: In FY21, this task was decreased to support Army modernization priorities.				
Title: Synthetic Biology Bioprocessing Facility 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. FY 2021 Plans: Will modernize bio-manufacturing facility's fermentation and downstream purification capabilities. FY 2020 to FY 2021 Increase/Decrease Statement: Funding increase in FY21 due to Office of Management and Budget (OMB) Passback Transfer of \$8.0M		-	-	8.000
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.140	-
Accomplishments/Planned Programs Subtotals		-	3.085	10.145
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BH1: <i>Survivability Systems Controls Advanced Technology</i>	-	0.000	13.022	13.680	-	13.680	14.094	14.009	13.772	13.912	0.000	82.489

Note

In Fiscal Year (FY) 2020 this Project is realigned from PE 0603005A (Combat Vehicle and Automotive Advanced Technology) / 221 (Combat Veh Survivability).

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)

Title: Survivability System Control	FY 2019	FY 2020	FY 2021
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 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.	-	12.431	13.680
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will build upon foundation of the MAPS controller and artifacts by analyzing latest stakeholder requirements and conducting functional analysis in preparation for an update to the MAF. Will optimize and enhance the Modular APS (MAPS) controller subsystem to begin accepting new technologies identified through design analysis activities. Will continue to advance modeling and simulation (M&S) and verification capabilities in the system integration lab. Will maintain configuration management of delivered MAPS-compliant systems. Will certify and demonstrate survivability components for MAPS-compliant active defense subsystems through use of hardware-in-the-loop and M&S. Will assess available artificial intelligence algorithms and technology that can synthesize sensor input data to paint contextual threat picture for optimized response. Will explore adaptability for tactical fleet integration with focus on SWAP constraints and affordability.</p> <p>FY 2021 Plans: Will 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. Will implement and demonstrate an expanded MAPS base kit derived from studies conducted in FY20. Will 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. Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.591	-
Accomplishments/Planned Programs Subtotals		-	13.022	13.680
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / Next Generation Combat Vehicle Advanced Technology	Project (Number/Name) BH1 / Survivability Systems Controls Advanced Technology

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BH3: C4ISR Modular Autonomy Advanced Technology	-	0.000	3.926	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.926

Note
 In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science & Sensor Technology
 * Project 101 Tactical Command and Control

In FY21 this Project is realigned to:
 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)

Title: Command of Autonomous Teams (COAT)	FY 2019	FY 2020	FY 2021
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.	-	3.747	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will implement the computational situation awareness engine, which consumes the data feeds from RAS and produces a model of the mission to display to the user; will complete interfaces to the mission model that allows soldiers to create alerts based on mission data and priority; will complete implementation of tactical service language that allows Soldiers to define behaviors for RAS platforms in the mission model.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned to the PE 0603462A (NGCV Advanced Technology) Project BZ9 (Smart Targeting Environment for Lower Level Assets) effort to support Army Modernization needs.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.179	-
Accomplishments/Planned Programs Subtotals		-	3.926	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BH6: Platform Electrification and Mobility Adv Tech	-	0.000	5.198	24.701	-	24.701	31.077	34.717	36.008	20.944	0.000	152.645

Note

This Project is a new start in FY 2020.

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)

Title: NGCV Platform Electrification & Mobility Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	4.962	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will develop electrified mobility demonstrator design. Will develop composite rubber track and hydro strut suspension with track tensioner required to lower power demands for the electrified mobility demonstrator.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Work in the NGCV Platform Electrification & Mobility Advanced Technology effort is realigned to the Platform Electrification Technologies, Advanced Mobility Technologies and System/Vehicle Integration and Test efforts in this Project in FY 2021.</p>				
<p>Title: Platform Electrification Technologies</p> <p>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.</p> <p>FY 2021 Plans: Will develop scaleable, modular combat vehicle electrification architecture. Will develop electric sprocket drive motors, diesel-electric power system and thermal management system for electrification architecture. Will develop combat vehicle electrification software architecture. Will develop electric fan and demonstrate cooling architecture. Will demonstrate combat vehicle electrification software architecture. Will demonstrate architecture and components for a modular high voltage, high energy storage system. Will demonstrate architecture for a tactical battlefield recharge capability.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Work in Platform Electrification Technology was previously conducted in the NGCV Platform Electrification & Mobility Advanced Technology effort in this Project .</p>		-	-	15.072
<p>Title: Advanced Mobility Technologies</p> <p>Description: 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>FY 2021 Plans: Will demonstrate and validate performance of solid composite track and external suspension systems.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Work in Advanced Mobility Technologies was previously conducted in the NGCV Platform Electrification & Mobility Advanced Technology effort in this Project.</p>		-	-	3.744
<p>Title: Advanced Vehicle Power Technology Alliance (AVPTA) - Electrification Technology</p> <p>Description: 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

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
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.				
FY 2021 Plans: Will demonstrate commercial battery chemistry and packaging technologies applicable to military hybrid and all-electric drive combat and tactical platforms.				
FY 2020 to FY 2021 Increase/Decrease Statement: This activity transitioned from PE0602145A (Next Generation Combat Vehicle Technology), Project BH5 (Platform Electrification and Mobility Technology) in FY 2021.				
Title: System/Vehicle Integration and Test		-	-	3.044
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.				
FY 2021 Plans: Will integrate the sub-system models of the modular electrification architecture and components into surrogate hull models to maximize available volume.				
FY 2020 to FY 2021 Increase/Decrease Statement: Work in System/Vehicle Integration and Test was previously conducted in the NGCV Platform Electrification & Mobility Advanced Technology effort in this Project.				
Title: FY 2020 SBIR/STTR Transfer		-	0.236	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	5.198	24.701

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BH8: <i>Enhanced VETRONICS Advanced Technology</i>	-	0.000	12.960	12.397	-	12.397	10.113	10.758	10.146	10.250	0.000	66.624

Note

In Fiscal Year (FY) 2020 this Project is realigned from Program Element (PE) 0603005A (Combat Vehicle and Automotive Advanced Technology) / Project 497 (Combat Vehicle Electro).

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)

Title: Enhanced - Vehicle Electronics (E-Vetronics)	FY 2019	FY 2020	FY 2021
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 /	-	12.371	12.397

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>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 efforts will enable future vehicle capabilities, reduce dependencies on proprietary solutions, and support increased market competition through open architecture components and software.</p> <p>FY 2020 Plans: Will mature open systems architecture defining capabilities for flexible computing, I/O, advanced video network distribution, advancements in slip ring technology, tactical SA, cooperative engagement. Will define the standards and performance for flexible computing and I/O component. Defines the open system standards for integrating tactical SA capabilities into ground vehicles.</p> <p>FY 2021 Plans: Will begin development of a shared processor to support addition of new functionality without requiring additional processing hardware to the vehicle. Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.589	-
Accomplishments/Planned Programs Subtotals		-	12.960	12.397
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
B11: <i>Protection for Autonomous Systems Adv Tech</i>	-	0.000	4.100	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.100

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology
 * Project 232 Advanced Lethality & Survivability Demo
 PE 0603005A Combat Vehicle and Automotive Advanced Technology
 * Project 221 Combat Veh Survivability

In FY21, this Project is realigned to:
 PE 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BG7 Ground Systems Active Defense (GSAD) Advanced Tech

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).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Protection for Autonomous Systems</p> <p>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.</p> <p>FY 2020 Plans: Will determine potential vulnerabilities to an autonomous ground combat vehicle through modeling and simulation using physics-based tools. Will develop capabilities to validate vulnerabilities in a laboratory environment. Will matures protection technologies for autonomous sensors.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher modernization priority areas.</p>		-	2.707	-
<p>Title: Vehicle Anti-Personnel Protection Armament System</p> <p>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.</p> <p>FY 2020 Plans: Will optimize and improve developmental technologies such as kinetic energy weapons/munitions and millimeter Wave energy sources for employment on unmanned platforms to deliver effects (repel, suppress, move) that enable freedom of platform movement and maneuver.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher modernization priority areas.</p>		-	1.207	-
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.186	-
Accomplishments/Planned Programs Subtotals		-	4.100	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

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

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BI3: <i>Sensor Protection Advanced Technology</i>	-	0.000	1.500	1.798	-	1.798	1.798	1.798	1.818	1.818	0.000	10.530

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
Program Element (PE) 0603710A (Night Vision Advanced Technology) / K70 (Night Vision Advanced Technology)

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 2019	FY 2020	FY 2021
Title: Sensor Protection Advanced Technology	-	1.432	1.798
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 2020 Plans: Will mature novel approaches for protecting optics from energetic threats on multiple types of vehicle platforms and soldier sensors.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) B13 / <i>Sensor Protection Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will mature and demonstrate technologies to protect emerging high sensitivity uncooled longwave infrared sensors.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: FY 2020 SBIR/STTR Transfer		-	0.068	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	1.500	1.798
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>B15: Materials Application and Integration Adv Tech</i>	-	0.000	3.625	5.487	-	5.487	5.628	5.741	5.800	4.577	0.000	30.858

Note

In FY 2020 this Project is realigned from PE 0603005A (Combat Vehicle and Automotive Advanced Technology) / Project 221 (Combat Veh Survivability).

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)

Title: System Design Optimization for Lightweighting	FY 2019	FY 2020	FY 2021
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).	-	3.460	4.793
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will mature and demonstrate advanced materials for weight optimization. Will demonstrate an optimization design which will result in meeting/exceeding required performance while reducing weight and increasing system robustness. Will validate the operational metrics on a combat platform established for light weighting to include freedom of movement, freedom and maneuver, and enhanced transportability and supportability. Will demonstrate the integration of a hybrid joint design of dissimilar materials. Exploit the capabilities of Additive Manufacturing by demonstrating performance requirements on a combat platform that are enabled by the unique geometries and design options that are not possible with traditional manufacturing techniques.</p> <p>FY 2021 Plans: Will mature and demonstrate advanced/lightweight material technologies for design/weight optimization and advanced manufacturing, to include additive manufacturing. Will 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. Will validate material and component manufacturability, blast/ballistic performance, machinability, weldability, corrosion resistance, and stiffness characteristics.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0602145A (Next Generation Combat Vehicle Technology) / BI4 (Materials Application and Integration Technology) to better support the Army Modernization Priorities.</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: Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned from PE 0602145A (Next Generation Combat Vehicle Technology) / BI4 (Materials Application and Integration Tech).</p>		-	-	0.694
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.165	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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) B15 / <i>Materials Application and Integration Adv Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<i>FY 2020 Plans:</i> Funding transferred in accordance with Title 15 USC ?638			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	3.625	5.487

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BJ1: Vehicle System Security Advanced Technology	-	0.000	1.250	1.499	-	1.499	2.843	4.502	4.948	3.502	0.000	18.544

Note

In Fiscal Year 2020 (FY20) this Project is realigned from;
 Program Element (PE) 0603005A Combat Vehicle and Automotive Technology
 * Project 441 Combat Vehicle Mobility

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 2019	FY 2020	FY 2021
Title: Vehicle System Security Advanced Technology	-	1.193	1.499
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 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will demonstrate quantifiable security & resiliency metrics to inform digital protection requirements for future capabilities. Will develop and mature embedded cyber-resilient technologies to protect against offensive and malicious attacks. Will mature and demonstrate resilient runtime technologies for real-time threat detection and operation in near-peer cyber-contested environments.</p> <p>FY 2021 Plans: Will 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. Will also 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding re-aligned to more foundational efforts in PE 622145 (Next Generation Combat Vehicle Technology) / BI9 (Vehicle System Security Technology), which coordinates with this Project.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.057	-
Accomplishments/Planned Programs Subtotals		-	1.250	1.499
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BJ6: Hydrogen Based Combat System Advanced Technology	-	0.000	4.485	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.485

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603005A Combat Vehicle and Automotive Advanced Technology
 * Project 441 Combat Vehicle Mobility

In FY21 this Project is realigned to:
 PE 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BH6 Platform Electrification and Mobility Adv Tech

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)

Title: Hydrogen Based Combat System Advanced Technology	FY 2019	FY 2020	FY 2021
Description: This effort matures, integrates and demonstrates the technologies required to enable combat systems to be powered by fuel cells.	-	4.281	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603462A / <i>Next Generation Combat Vehicle Advanced Technology</i>	Project (Number/Name) BJ6 / <i>Hydrogen Based Combat System Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Will conduct performance evaluation of both reusable solid hydrogen storage tanks and liquid hydrogen for battlefield operations. Will demonstrate the physical integration of multiple fuel cell stacks into a larger module to reduce volume and increase power density.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 to BH6 (Platform Electrification and Mobility Adv Tech) to support Army Modernization Priorities.</p> <p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>				
		-	0.204	-
Accomplishments/Planned Programs Subtotals		-	4.485	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BJ8: <i>Detection of Explosive Hazards Advanced Technology</i>	-	0.000	5.130	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.130

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
 Program Element (PE) 0603606A Landmine Warfare and Barrier Advanced Technology
 * Project 608 Countermines & Bar Dev

In Fiscal Year 21 (FY21) this Project will realign to:
 PE 0602145A Next Generation Combat Vehicle Technology
 * Project BF9 Sensors for Autonomous Operations and Surv Tech

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 2019	FY 2020	FY 2021
Title: Detection of Explosive Hazards Advanced Technology	-	4.897	-
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).			
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will mature an EH detection payload for a manned or unmanned ground vehicle and validate performance in multiple environments. Will mature EH threat detection payload for small fixed wing and rotary wing UASs. FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher Army Modernization priorities.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.233	-
Accomplishments/Planned Programs Subtotals		-	5.130	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BK1: <i>Autonomous Mobility Adv Tech</i>	-	0.000	7.140	8.791	-	8.791	6.894	6.794	5.736	5.736	0.000	41.091

Note

This project transitions technologies from 0602145A/BJ9, Autonomous Mobility Tech, for additional maturation and demonstration.

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)

Title: Machine Learning Data Collection	FY 2019	FY 2020	FY 2021
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.	-	2.777	5.195
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will mature data collection system to include multiple sensing modalities and proper computation requirements. Will develop and conduct collection plans leveraging both simulation and live data collection across multiple vehicles. Will develop and conduct test and validation plans to understand proper data to collect from training exercises. Will develop collection, analysis, and validation tools.</p> <p>FY 2021 Plans: Will optimize data collection system created in FY20. Will design the data pipeline and infrastructure to support a large number of sensor platforms, petabytes (quadrillion bytes) of data, and many concurrent users. Will mature and demonstrate overall data collection approach with surrogate and actual vehicles using training and simulated operational events.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is increased in FY21 to design the data pipeline and infrastructure for a large number of support platforms, and underlying data and users.</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> <p>FY 2020 Plans: Will develop and mature simulation tools that will be used to research coordination and collaboration between vehicles and show usability of collected data from above. Will develop algorithms to determine position/orientation of vehicle within formation utilizing AI/ML that has been trained with Army relevant platform data.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort was realigned to shift focus to UAS Mapping efforts in FY21 within this same Project.</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:</p>		-	-	3.596

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Will 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. Will optimize the UAS's ability to identify enemies and terrain to be used for future UAS/UGV coordination. FY 2020 to FY 2021 Increase/Decrease Statement: This effort was realigned from Formation Control within this Project to support UAS and UGV coordination.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.325	-
Accomplishments/Planned Programs Subtotals	-	7.140	8.791

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BK4: <i>Next Gen Intelligent Fire Control(NG-IFC) Adv Tech</i>	-	0.000	0.450	9.241	-	9.241	1.998	2.398	2.498	3.158	0.000	19.743

Note

This project transitions technologies from 0602145A/BK3, Next Gen Intelligent Fire Control (NG-IFC) Tech, for additional maturation and demonstration.

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 2019	FY 2020	FY 2021
Title: Next Generation Intelligent Fire Control	-	0.430	9.241
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 2020 Plans: Will optimize the fire control auto-tracking algorithms capability for advanced weapons systems.			
FY 2021 Plans: Will demonstrate sensor interoperability in a fire control System Integration Lab (SIL) environment. Will optimize and integrate hardware and software for beyond line of sight targeting with a forward sensor platform/system. Will 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 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Funding increased to conduct demonstration of hardware and software in support of Army Modernization priorities.			
Title: FY 2020 SBIR/STTR Transfer	-	0.020	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	0.450	9.241

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

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BK6: <i>Adv Direct InDirect Armament Sys (ADIDAS) Adv Tech</i>	-	0.000	0.510	3.140	-	3.140	1.499	1.499	1.998	2.242	0.000	10.888

Note

This project transitions technologies from 0602145A/BK5, Adv Direct In-Direct Armament Sys (ADIDAS) Tech, for additional maturation and demonstration.

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)

Title: Advanced Direct In-Direct Armament System (ADIDAS)	FY 2019	FY 2020	FY 2021
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.	-	0.487	-
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will optimize the armament system configurations for high elevations and advanced recoil mitigation to reduce impulse. Will mature system level designs through modeling and simulation. FY 2020 to FY 2021 Increase/Decrease Statement: This effort transitions in FY21 to the Large Caliber Armament System (LCAS) effort in this Project.				
Title: Large Caliber Armament System (LCAS) 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: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: This Project and effort is increased to demonstrate large caliber armament technologies for light and medium weight optionally manned platforms in support of the Army Modernization priorities.		-	-	3.140
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.023	-
Accomplishments/Planned Programs Subtotals		-	0.510	3.140
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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)			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BP6: Ground Vehicle Advanced Technology(CA)	-	0.000	100.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	100.500

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 2019	FY 2020
Congressional Add: Additive Manufacturing for Jointless Hull FY 2020 Plans: Additive Manufacturing for Jointless Hull	-	20.000
Congressional Add: Carbon Fiber and Graphite Foam Technology FY 2020 Plans: Carbon Fiber and Graphite Foam Technology	-	10.000
Congressional Add: Hydrogen Fuel Cells FY 2020 Plans: Hydrogen Fuel Cells	-	10.000
Congressional Add: ATE5.2 Engine Development FY 2020 Plans: ATE5.2 Engine Development	-	5.000
Congressional Add: Additive Manufacturing of Critical Components FY 2020 Plans: Additive Manufacturing of Critical Components	-	5.000
Congressional Add: Advanced Water Harvesting Technology FY 2020 Plans: Advanced Water Harvesting Technology	-	5.000
Congressional Add: Advanced High Strength and Lightweight Steels FY 2020 Plans: Advanced High Strength and Lightweight Steels	-	3.000
Congressional Add: Combat Vehicle Weight Reduction Initiative	-	8.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2020 Plans:</i> Combat Vehicle Weight Reduction Initiative		
<i>Congressional Add:</i> Virtual and Physical Prototyping <i>FY 2020 Plans:</i> Virtual and Physical Prototyping	-	8.000
<i>Congressional Add:</i> HMMWV Augmented Reality System <i>FY 2020 Plans:</i> HMMWV Augmented Reality System	-	5.000
<i>Congressional Add:</i> Health Usage Monitoring for HMMWV <i>FY 2020 Plans:</i> Health Usage Monitoring for HMMWV	-	3.000
<i>Congressional Add:</i> HMMWV Autonomy <i>FY 2020 Plans:</i> HMMWV Autonomy	-	5.000
<i>Congressional Add:</i> HMMWV Torque Monitoring <i>FY 2020 Plans:</i> HMMWV Torque Monitoring	-	2.000
<i>Congressional Add:</i> HMMWV Automotive Enhancements <i>FY 2020 Plans:</i> HMMWV Automotive Enhancements	-	7.500
<i>Congressional Add:</i> Additive Manufacturing <i>FY 2020 Plans:</i> Additive Manufacturing	-	4.000
Congressional Adds Subtotals	-	100.500

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>BZ9: Smart Targeting Environment for Lower Level Assets</i>	-	0.000	0.000	3.968	-	3.968	4.096	4.343	4.392	4.392	0.000	21.191

Note

In Fiscal Year 2021 (FY21) this Project was realigned from:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology
 * Project BH3 C4ISR Modular Autonomy Advanced Technology

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)

Title: Small Targeting Environment for Lower Level Assets (STELLA)	FY 2019	FY 2020	FY 2021
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.	-	-	3.968
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will 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.				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding was realigned into this effort to support higher priority Army Modernization needs.				
Accomplishments/Planned Programs Subtotals		-	-	3.968
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 2021 Army											Date: February 2020	
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	142.899	158.608	-	158.608	163.892	164.038	136.149	137.936	0.000	903.522
AM7: Modular RF Communications Advanced Technology	-	0.000	15.376	13.913	-	13.913	8.193	8.093	0.000	0.000	0.000	45.575
AM9: Protected SATCOM Advanced Technology	-	0.000	0.000	16.639	-	16.639	27.274	31.770	12.242	0.000	0.000	87.925
AN2: Narrowband SATCOM Advanced Technology	-	0.000	0.000	4.995	-	4.995	9.991	15.985	0.000	0.000	0.000	30.971
AN4: Non Traditional Waveforms Advanced Technology	-	0.000	5.346	7.792	-	7.792	7.993	4.460	5.537	6.412	0.000	37.540
AN6: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	-	0.000	1.944	1.998	-	1.998	0.000	0.000	0.000	0.000	0.000	3.942
AN8: COE - Every Receiver is a Sensor Advanced Tech	-	0.000	5.810	2.997	-	2.997	2.997	2.997	6.430	6.430	0.000	27.661
AO1: UNT - Every Receiver is a Sensor Advanced Tech	-	0.000	6.512	2.997	-	2.997	3.057	3.118	3.152	3.152	0.000	21.988
AO3: Stand-In Advanced RF Effects (STARE) Adv Tech	-	0.000	1.944	2.997	-	2.997	2.997	3.057	3.091	3.091	0.000	17.177
AO6: Tag Track and Locate Small Satellites Adv Tech	-	0.000	13.593	16.659	-	16.659	16.939	17.485	17.680	17.859	0.000	100.215
AO7: EW for Maneuver Operations (EMO) Adv Tech	-	0.000	4.145	2.916	-	2.916	3.042	3.113	3.147	3.147	0.000	19.510
AP6: C4ISR Integrated Demonstrations Advanced Tech	-	0.000	4.414	3.740	-	3.740	3.886	4.038	4.149	4.149	0.000	24.376
AP8: Comms/Horiz Int for Army Mod Priorities Adv Tech	-	0.000	0.660	8.075	-	8.075	10.573	10.110	10.324	10.355	0.000	50.097
AP9: Next Generation HF Advanced Technology	-	0.000	5.832	6.994	-	6.994	6.923	0.000	3.309	6.452	0.000	29.510

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020		
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	-	0.000	5.832	3.885	-	3.885	3.988	3.826	3.763	1.698	0.000	22.992	
AQ5: Sensor CE-Integrated Sensor Architecture Adv Tech	-	0.000	1.466	1.998	-	1.998	2.048	1.499	2.020	2.040	0.000	11.071	
AQ8: High Tempo Data Driven Decision Tools Adv Tech	-	0.000	0.000	3.022	-	3.022	4.253	5.331	5.037	7.735	0.000	25.378	
AR2: Energy Informed Operations Advanced Technology	-	0.000	1.944	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.944	
AR4: Intelligent Env Battlefield Awareness Adv Tech	-	0.000	0.641	3.257	-	3.257	4.125	4.184	5.201	7.334	0.000	24.742	
AR6: Understanding the Environment as a Threat Adv Tech	-	0.000	2.245	2.809	-	2.809	2.555	3.301	3.656	4.636	0.000	19.202	
AR8: Sensing in Contested Environments Adv Tech	-	0.000	0.000	0.983	-	0.983	1.631	1.798	1.818	2.814	0.000	9.044	
AS9: Persistent Geophysical Sensing-Infrasound Adv Tech	-	0.000	2.511	4.774	-	4.774	2.479	2.281	2.553	2.776	0.000	17.374	
AT3: Subterranean Detection and Monitoring Adv Tech	-	0.000	1.059	3.488	-	3.488	2.245	0.000	1.233	1.384	0.000	9.409	
AT5: GeoINT - OPS Merge Advanced Technology*	-	0.000	0.000	0.000	-	0.000	0.000	0.000	4.988	6.537	0.000	11.525	
AT8: Network-Enabled GeoSpatial-GEOINT Services AdvTech	-	0.000	3.880	2.997	-	2.997	3.097	4.522	0.000	0.000	0.000	14.496	
AU1: Tactical GeoSpatial Information Capabilities ATech	-	0.000	2.012	3.740	-	3.740	4.259	5.860	0.000	0.000	0.000	15.871	
AU2: Optimization of Geospatial Data for Visualization	-	0.000	0.000	2.098	-	2.098	2.198	1.798	1.782	1.800	0.000	9.676	
AU4: Geospatially Enabled Operational Design Adv Tech	-	0.000	4.819	8.205	-	8.205	8.054	7.663	0.000	0.000	0.000	28.741	

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity	R-1 Program Element (Number/Name)											
2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	PE 0603463A / Network C3I Advanced Technology											
AU6: <i>Automated Analytics for Operational Environment AT</i>	-	0.000	1.661	0.000	-	0.000	0.000	0.000	2.278	2.278	0.000	6.217
AU8: <i>GEOInt/Ops Integration for Multi-echelon Orders*</i>	-	0.000	0.000	0.000	-	0.000	0.000	0.000	6.805	7.604	0.000	14.409
AV1: <i>GEOInt/Ops Logistics Integration-Planning Adv Tech</i>	-	0.000	0.000	3.914	-	3.914	3.915	2.897	4.948	4.948	0.000	20.622
AV2: <i>LEO Advanced Technology</i>	-	0.000	1.927	1.979	-	1.979	0.000	0.000	0.000	0.000	0.000	3.906
AV4: <i>Foundational S&T for Network C3I Advanced Tech</i>	-	0.000	0.000	2.126	-	2.126	2.646	2.859	2.949	2.949	0.000	13.529
AV8: <i>Navigation Warfare (NAVWAR) Advanced Technology</i>	-	0.000	5.118	2.535	-	2.535	2.044	1.998	5.968	5.968	0.000	23.631
AW2: <i>Autonomous Navigation Advanced Technology</i>	-	0.000	0.292	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.292
AW4: <i>DoD PNT M&S Collaborative Initiative (CI) Adv Tech</i>	-	0.000	2.916	2.997	-	2.997	0.000	0.000	0.000	0.000	0.000	5.913
AW6: <i>Modular GPS Independent Sensors Advanced Tech</i>	-	0.000	0.000	11.089	-	11.089	10.490	9.995	12.089	14.388	0.000	58.051
BP4: <i>ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)</i>	-	0.000	39.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	39.000

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2021

Note

In Fiscal Year (FY) 2020 this Program Element (PE) was previously funded, with continuity of effort realigned from the following PEs:

- * PE 0603006A Space Application Advanced Technology
- * PE 0603270A Electronic Warfare Technology
- * PE 0603710A Night Vision Advanced Technology
- * PE 0603728A Environmental Quality Technology Demonstrations
- * PE 0603734A Military Engineering Advanced Technology
- * PE 0603772A Advanced Tactical Computer Science and Sensor Technology

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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* PE 0603794A C3 Advanced Technology

A. Mission Description and Budget Item Justification

This 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.

Work in this PE complements PE 0602146A (Network C3I Technology), PE 0602782A (Command, Control, Communications Technology), PE 0602143A (Soldier Lethality Technology), PE 0602145A (Next Generation Combat Vehicle Technology), PE 0602146A (Network C3I Technology), PE 0602147A (Long Range Precision Fires Technology), PE 0602148A (Future Vertical Lift Technology), PE 0602150A (Air and Missile Defense Technology), PE 0603118A (Soldier Lethality Advanced Technology), PE 0603462A (Next Generation Combat Vehicle Advanced Technology), PE 0603464A (Long Range Precision Fires Advanced Technology), PE 0603465A (Future Vertical Lift Advanced Technology), and PE 0603466A (Air and Missile Defense Advanced Technology).

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 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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	106.899	129.790	-	129.790
Current President's Budget	0.000	142.899	158.608	-	158.608
Total Adjustments	0.000	36.000	28.818	-	28.818
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-3.000			
• Congressional Rescissions	-	-			
• Congressional Adds	-	39.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	28.818	-	28.818

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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)

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*

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*

Congressional Add: *Army Visual and Tactical Arctic Reconnaissance*

Congressional Add Subtotals for Project: BP4

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	4.000
	-	10.000
	-	9.000
	-	5.000
	-	3.000
	-	6.000
	-	2.000
Congressional Add Subtotals for Project: BP4	-	39.000
Congressional Add Totals for all Projects	-	39.000

Change Summary Explanation

Fiscal Year 2020 (FY20) increase related to \$39.000 Million of congressional add funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AM7: Modular RF Communications Advanced Technology	-	0.000	15.376	13.913	-	13.913	8.193	8.093	0.000	0.000	0.000	45.575

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

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/Project AM6 (Modular RF Communications Technology).

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 in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Modular RF Communications Advanced Technology	-	14.678	13.913
Description: 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.			
FY 2020 Plans: Optimize autonomous techniques and algorithms for network initialization, detection, and/or adaption; optimize the architecture design to enable validation of algorithms for network and networking technology initialization from initial start-up condition and/or initial contact with an autonomous networking algorithm; demonstrate multiple approaches to autonomous networking by providing algorithms to detect available networks and networking technologies available to a single node or user, initialize network technology, and/or adapt the changing environmental conditions, such as hostile electronic warfare emitters; mature shared interfaces between network technologies and an autonomous networking algorithms to enable initialization, detection, selection, and/or control of networks and demonstrate the interfaces enabling the autonomous network operation in a relevant laboratory			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AM7 / <i>Modular RF Communications Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>environment; validate initial instantiation of the network routing algorithms are able to optimally select and switch among the available networks to traverse data from originator to consumer across the overall tactical network in congested and electronic warfare contested environments; deliver initial routing and switching software code and documentation for demonstration in program of record systems; and publish the first version of an interface standard between network technologies and an autonomous network detection and adaptation algorithms.</p> <p>FY 2021 Plans: Will 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 information, and mature interface standards; and develop specifications for the next phase of capability to incorporate Artificial Intelligence/Machine Learning (AI/ML) techniques.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was decreased to support higher priority modernization efforts.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.698	-
Accomplishments/Planned Programs Subtotals		-	15.376	13.913
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AM9: <i>Protected SATCOM Advanced Technology</i>	-	0.000	0.000	16.639	-	16.639	27.274	31.770	12.242	0.000	0.000	87.925

Note

In Fiscal Year 2021 (FY21) this Project was realigned from:
 Program Element (PE) 0602146 C3 Advanced Technology
 * Project AN9 UNT - Every Receiver is a Sensor Technology
 PE 0603463A Network C3I Advanced Technology
 * Project AO1 UNT-Every Receiver is a Sensor Adv 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.

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 2019	FY 2020	FY 2021
Title: Protected SATCOM Advanced Technology and Resilient Tactical Networking and Comms	-	-	12.543
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: Will 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 contested environment; and provide tactical SATCOM advantage to the US Army by demonstrating commercial LEO technologies			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
that will validate improvements to Tactical SATCOM Network Resiliency and inform future Next Generation Tactical Terminal Development.				
FY 2020 to FY 2021 Increase/Decrease Statement: This funding was realigned from PE 0602146A Network C3I Technology, Project AN9 UNT - Every Receiver is a Sensor Technology and PE 0603463A Network C3I Advanced Technology, Project AO1 UNT - Every Receiver is a Sensor Advanced Tech in FY2021 to fund this high priority effort.				
Title: High Altitude: Wideband Global Satellite Communications (SATCOM) (WGS) Ka Band Surrogate Payload / Aerial Tier Networking		-	-	4.096
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. This work complements technology development performed on PE 0602146/BZ8 (Aerial Tier Networking).				
FY 2021 Plans: Will 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.				
FY 2020 to FY 2021 Increase/Decrease Statement: This funding was realigned from PE 0602146A Network C3I Technology, Project AN9 UNT - Every Receiver is a Sensor Technology and PE 0603463A Network C3I Advanced Technology, Project AO1 UNT - Every Receiver is a Sensor Advanced Tech in FY2021 to fund this high priority effort.				
Accomplishments/Planned Programs Subtotals		-	-	16.639
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AN2: <i>Narrowband SATCOM Advanced Technology</i>	-	0.000	0.000	4.995	-	4.995	9.991	15.985	0.000	0.000	0.000	30.971

Note

In Fiscal Year 2021 (FY21) this Project was realigned from:
 Program Element (PE) 0602143A C3 Advanced Technology
 * Project AN1 Narrowband SATCOM Technology

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.

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)

Title: Narrowband SATCOM Advanced Technology	FY 2019	FY 2020	FY 2021
Description: This project validates and demonstrates technologies to enable gateway communications across disparate Narrowband Satellite Communications (SATCOM) networks, enabling resiliency in contested environments.	-	-	4.995
FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AN2 / <i>Narrowband SATCOM Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
This funding was realigned from PE 0602143A Soldier Lethality Technology, Project AN1 Narrowband SATCOM Technology.			
Accomplishments/Planned Programs Subtotals	-	-	4.995

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AN4: <i>Non Traditional Waveforms Advanced Technology</i>	-	0.000	5.346	7.792	-	7.792	7.993	4.460	5.537	6.412	0.000	37.540

Note

In Fiscal Year (FY) 2020 this project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology Project:
 * EL4 Tactical Comms and Networking Technology Int

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 06022146A/Project AN3 (Non Traditional Waveforms Technology).

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 2019	FY 2020	FY 2021
Title: Non Traditional Waveforms Advanced Technology	-	5.103	7.792
Description: 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.			
FY 2020 Plans: Mature cooperative beamforming technology to support dismounted or mounted operations; provide increased capacity in a contested environment to dismounted and mounted communications using cooperative technology, such as the dismount distributed tactical beamforming system, to support additional number of users and data throughput; demonstrate dismounted			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>network technology providing local networking among dismounted unit in support of low probability of detection/intercept communication to distant nodes, using technology such as distributed cooperative beamforming; and demonstrate millimeter wave communications systems in a relevant field environments to validate performance characteristics of the delivered technology.</p> <p>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 using techniques such as amplitude control and advanced signal processing techniques; mature adaptive power control techniques and dismounted 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>FY 2020 to FY 2021 Increase/Decrease Statement: Funding in this effort increased from lower priority modernization areas.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.243	-
Accomplishments/Planned Programs Subtotals	-	5.346	7.792

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AN6: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	-	0.000	1.944	1.998	-	1.998	0.000	0.000	0.000	0.000	0.000	3.942

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

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/Project AN5 (Protected SATCOM-WB Global SATCOM Inter Canc Tech).

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 2019	FY 2020	FY 2021
Title: Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech	-	1.856	1.998
Description: 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.			
FY 2020 Plans: Optimize Wideband Global Satellite (WGS) Ka-band interference cancelling technology modem algorithms based on lessons learned from previous over the air demonstrations; validate the Ka-band interference cancelling technology planning tool predicted			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AN6 / <i>Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
performance matches actual field demonstration performance against Warfare (EW) threats; and provide modem enhancements to validate Ka-band interference cancelling technology for field based demonstrations. FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding increase to execute demonstrations of Ka-band interference cancelling technology.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.088	-
Accomplishments/Planned Programs Subtotals		-	1.944	1.998
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AN8: COE - Every Receiver is a Sensor Advanced Tech	-	0.000	5.810	2.997	-	2.997	2.997	2.997	6.430	6.430	0.000	27.661

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology, Project:
 * 243 Sensors and Signals Processing

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 06033463A (Network C3I Advanced Technology) \ Project AO1 (UNT - Every Receiver is a Sensor Advanced Tech).

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 2019	FY 2020	FY 2021
Title: Advanced Data Analytics for Situational Awareness	-	5.546	2.997
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. Work accomplished under Program Element (PE) 0602146A/Project AN7 complements this effort.			
FY 2020 Plans: Evaluate open source and commercial-off-the-shelf (COTS) technologies to support the creation of a converged data platform which will unify tactical data silos across the warfighting functions (such as: Intel and Operations data sets), resolve data access limitations, and prioritize critical data sharing. Integrate selected data management and information sharing technologies to create			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AN8 / <i>COE - Every Receiver is a Sensor Advanced Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>initial converged data platform and demonstrate the improvement to tactical situational awareness in both timeliness and accuracy by maturing initial analytic capabilities, leveraging these aggregated data sources, to the converged data platform.</p> <p>Evaluate and define communication pathways between current Mission Command, Fires, and Intelligence systems and scope potential deficiencies and latencies; map current Army and Joint targeting protocols to proposed data flows and identify potential for algorithmic support; mature system platforms capable of managing cross-domain, multi-INT, multi-platform data flows, and evaluate on the basis of speed, accuracy, and data integrity; develop and demonstrate initial multi-INT algorithms capable of facilitating timely creation of intelligence to support long range fires missions; and mature and demonstrate algorithms that can support distributed processing, exploitation, and dissemination (PED) workflows, increase automation, and augment analyst?s capabilities.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher modernization priority areas</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.264	-
Accomplishments/Planned Programs Subtotals	-	5.810	2.997

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

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AN8 / <i>COE - Every Receiver is a Sensor Advanced Tech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AO1: <i>UNT - Every Receiver is a Sensor Advanced Tech</i>	-	0.000	6.512	2.997	-	2.997	3.057	3.118	3.152	3.152	0.000	21.988

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int
 PE 0603772A Electronic Warfare Technology, Projects:
 * K15 Advanced Comm ECM Demo
 * K16 Non-Commo ECM Tech Dem

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 06022146A (Network C3I Technology) \ Project AN9 (UNT - Every Receiver is a Sensor Technology).

Work in this Project complements PE 06033463A (Network C3I Advanced Technology) \ Project AN8 (COE Every Receiver is a Sensor Technology).

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)

Title: Unified Network Transport (UNT) - Every Receiver is a Sensor Advanced Tech	FY 2019	FY 2020	FY 2021
Description: 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.	-	1.821	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AO1 / <i>UNT - Every Receiver is a Sensor Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Mature software algorithms on a software defined radio and demonstrate advanced radio tasking capabilities; validate performance measures for dynamic spectrum sensing/advanced tasking algorithms in a relevant laboratory environment; and optimize advanced tasking algorithms for use on legacy fielded systems to increase the number of sensors on the battlefield.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort was realigned to PE 0603463A (Network C3I Advanced Technology) / AM9 (Protected SATCOM Advanced Technology) in FY21.</p>				
<p>Title: Multi Intelligence Modernization supporting Multifunction Operations</p> <p>Description: This effort will optimize Intelligence Community investments in software frameworks and exploits against threat SOIs 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 0602146/Project AN7 complement this effort.</p> <p>FY 2020 Plans: Mature and demonstrate electronic support functions suitable for operation in a highly contested environment with enhanced techniques for geolocation; and integrate techniques to harden and protect electronic support and attack assets from enemy electronic warfare.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Nominal planned change of scope.</p>		-	2.827	2.997
<p>Title: Highly Distributable UGS</p> <p>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.</p> <p>FY 2020 Plans:</p>		-	1.568	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AO1 / <i>UNT - Every Receiver is a Sensor Advanced Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Mature and demonstrate advanced ultra-low cost disposable sensing capabilities suitable for operation in a highly contested environment and demonstrate distributed signal survey utilizing large quantities of such sensors; and demonstrate distributed sensor information feeding the larger electronic warfare framework for improved situational understanding.				
FY 2020 to FY 2021 Increase/Decrease Statement: This funding was realigned to PE 0603457A C3I Cyber Advanced Development, Project 9CY Network Access and Effects.				
Title: FY 2020 SBIR/STTR Transfer		-	0.296	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	6.512	2.997
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AO3: <i>Stand-In Advanced RF Effects (STARE) Adv Tech</i>	-	0.000	1.944	2.997	-	2.997	2.997	3.057	3.091	3.091	0.000	17.177

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int
 PE 0603270A Electronic Warfare Technology, Project:
 * K15 Advanced Comm ECM Demo

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 06022146A (Network C3I Technology) \ Project AO2 (Robust Grey C3I Technology).

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)

Title: Robust Grey C3I Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	1.856	-
FY 2020 Plans: Optimize enhancements to commercial off-the-shelf technologies, such as cellular and/or narrowband communications, to provide dismount and mounted operators with long-range connectivity in a hostile electromagnetic spectrum environment; and			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
demonstrate low probability of detection/intercept and/or anti-jam enhancements, such as radio frequency directionality and/or frequency/modulation coding, in a relevant field environment. FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher modernization priority areas				
Title: Stand-In Advanced RF Effects Advanced Technology 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. FY 2021 Plans: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort.		-	-	2.997
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.088	-
Accomplishments/Planned Programs Subtotals		-	1.944	2.997
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AO6: Tag Track and Locate Small Satellites Adv Tech	-	0.000	13.593	16.659	-	16.659	16.939	17.485	17.680	17.859	0.000	100.215

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603006A Space Application Advanced Technology, Project:
 * 592 Space Application 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.

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)

<u>Title:</u>	FY 2019	FY 2020	FY 2021
Tag, Track, and Locate Small Satellites	-	12.976	16.659

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Description: This effort matures and demonstrates technologies required for smaller, warfighter-responsive sensor and communication Low Earth Orbit small satellite constellations. Work will augment, improve, exploit and optimize existing commercial and DoD technologies and networks. Work supports the Army Modernization Priorities.</p> <p>This effort will validate 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>The work cited is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology (S&T) priority focus areas and the Army Modernization Strategy. This work is performed by the Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT) in Huntsville, AL.</p> <p>FY 2020 Plans: Optimize and demonstrate technologies, and validate software/algorithms, for tracking and locating objects of interest to improve performance of space-based signal detection, processing, and dissemination; exploit existing commercial technologies to improve warfighter capabilities.</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 2020 to FY 2021 Increase/Decrease Statement: Planned program increase to fund higher priority improvements.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans:</p>		-	0.617	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement:				
Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	13.593	16.659
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AO7: EW for Maneuver Operations (EMO) Adv Tech	-	0.000	4.145	2.916	-	2.916	3.042	3.113	3.147	3.147	0.000	19.510

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603270A Electronic Warfare Technology, Project:
 * K15 Advanced Comm Ecm Demo

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 A2/AD environments, restore network capabilities, and enable maneuver and fires.

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 2019	FY 2020	FY 2021
Title: EW for Maneuver Ops	-	2.846	1.637
Description: This effort matures and demonstrates hardware and software to conduct electronic warfare (EW) for intelligence, surveillance reconnaissance in support of Army tactical operations.			
FY 2020 Plans: Mature stand-in capabilities to find, fix, and locate adversary signals of interest that impact the Army's ability to use the Electromagnetic Spectrum; mature and demonstrate the capability for distributed platform sensing that efficiently collaborate to convey spectrum Situational Understanding (SU) to the Commander; and demonstrate and validate critical technologies for distributed Electronic Warfare Support (ES) at the Brigade and Below tactical engagement.			
FY 2021 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
simulated environments; and demonstrate these critical technologies for Electronic Warfare (EW) at the Brigade and Below tactical engagement. FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was decreased to support higher modernization priorities				
Title: Simultaneous Countermeasure for Active Reconnaissance and Surveillance (SCARS) Description: This effort matures and demonstrates Electronic Warfare capabilities leveraging hardware-in-the-loop and modeling and simulation (M&S) of threat Intelligence, Surveillance, and Reconnaissance (ISR) systems to validate coordinated and collaborative non-kinetic effects. FY 2020 Plans: Mature simultaneous Electronic Warfare (EW) techniques against adversarial Intelligence Surveillance and Reconnaissance (ISR) capabilities; and perform laboratory risk reduction experiments in modeling, simulation, and hardware-in-the-loop to validate EW techniques prior to the kinetic engagement. FY 2021 Plans: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Economic adjustment		-	1.111	1.279
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.188	-
Accomplishments/Planned Programs Subtotals		-	4.145	2.916
C. Other Program Funding Summary (\$ in Millions) N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

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 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AP6: C4ISR Integrated Demonstrations Advanced Tech	-	0.000	4.414	3.740	-	3.740	3.886	4.038	4.149	4.149	0.000	24.376

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

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 2019	FY 2020	FY 2021
Title: C4ISR Integrated Demonstrations Advanced Tech	-	4.214	3.740
Description: This project provides appropriate 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. This project provides network automation, resiliency, and situational understanding through science & technology advancements.			
FY 2020 Plans: Demonstrate commercial and government off-the-shelf and research and development advanced technologies in themed field-based risk reduction events that informs the Army's Modernization Priorities, including Network/C3I, Future Vertical Lift, Next Generation Combat Vehicle, and Soldier Lethality; provide technology assessments of science & technology efforts, such as millimeter wave communication systems and/or spectrum decoying, in a field relevant environment to demonstrate technology			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
maturation; exploit virtualization to increased venue capabilities by incrementally building a more scalable tactical network; and mature and demonstrate advancement of spectrum collection, injection, and management capabilities. FY 2021 Plans: Will demonstrate maturing and emerging commercial and government off-the-shelf research and development advanced technologies in threat-based field experimentation that will 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 scalable tactical network; and mature and demonstrate advancement of spectrum collection, injection, and management capabilities. FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort was realigned to support higher priority modernization priorities.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.200	-
Accomplishments/Planned Programs Subtotals		-	4.414	3.740
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AP8: Comms/Horiz Int for Army Mod Priorities Adv Tech	-	0.000	0.660	8.075	-	8.075	10.573	10.110	10.324	10.355	0.000	50.097

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

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).

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)

Title: Communications Support to Army Modernization Priorities/Horizontal Integration Fields Advance Technology	FY 2019	FY 2020	FY 2021
Description: 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.	-	0.630	8.075
FY 2020 Plans: Will demonstrate commercial and/or government off-the-shelf technologies which can fulfill interim network requirements for Long Range Precision Fires (LRPF), Next Generation Combat Vehicle (NGCV), Future Vertical Lift (FVL), Air and Missile Defense (AMD), and/or Soldier Lethality (SL), while other network science and technology projects develop future network capabilities.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AP8 / <i>Comms/Horiz Int for Army Mod Priorities Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will conduct demonstrations at NetModX 21 Field experiment, which is NGCV themed to align with NGCV Robotic Combat Vehicle(RCV) Phase 2 demonstration. Will also provide support to Next Generation Combat Vehicle (NGCV) Robotic Combat Vehicle phase 2 demonstration. FY 2020 to FY 2021 Increase/Decrease Statement: The funding in this effort increased to support multiple demonstrations.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.030	-
Accomplishments/Planned Programs Subtotals		-	0.660	8.075
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AP9: Next Generation HF Advanced Technology	-	0.000	5.832	6.994	-	6.994	6.923	0.000	3.309	6.452	0.000	29.510

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

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.

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 in this Project is performed by the U.S. Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Next Generation HF Advanced Technology	-	5.568	6.994
Description: 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.			
FY 2020 Plans: Optimize software code modifications to the High Frequency (HF) communications waveform to meet the Army's HF requirements, such as anti-jam and low probability of detection/intercept, and modernization goals to provide resilient long-range reach-back in satellite denied environments; demonstrate the modified software code in a waveform emulator to validate the code's functionality; demonstrate the modified HF software to validate the enhancements, such as anti-jam and low probability of			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>detection/intercept performance, against pacing threats, such as simulated enemy systems; and optimize software code based on waveform emulator demonstration results; provide waveform code for porting to communications hardware for demonstrations.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding in this project increased to support maturation of the HF Communications Hub,</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.264	-
Accomplishments/Planned Programs Subtotals	-	5.832	6.994

<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 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AQ1: <i>Spectrum Obfuscation Advanced Technology</i>	-	0.000	5.832	3.885	-	3.885	3.988	3.826	3.763	1.698	0.000	22.992

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603794A C3 Advanced Technology, Project:
 * EL4 Tactical Comms and Networking Technology Int

In Fiscal Year (FY) 2021 this Project is being realigned from:
 Program Element (PE) 0603118A Warfighter Advanced Technology, Project:
 AZ8: Soldier - Small Unit Detectability Adv Technology

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

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)

Title: Spectrum Obfuscation Advanced Technology	FY 2019	FY 2020	FY 2021
Description: This Project validates and demonstrates technologies that provide obfuscation of radio frequency (RF) spectrum signature in order to counter enemy electronic surveillance capabilities.	-	5.568	-
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Optimize the design of a proof-of-concept wideband alluring signal projection (WASP) system to provide electromagnetic spectrum protection through the use of multichannel signal emissions capability to project high-value assets, such as Battalion and Brigade-level command post electromagnetic signatures, on the battlespace; mature and demonstrate a proof-of-concept WASP system in a relevant field environment; and validate improved network communications through the operation of WASP systems to decoy high value targets and attract simulated enemy systems on the battlespace away from high-value assets.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort completes in FY20.</p>				
<p>Title: 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) to defeat advanced current and emerging adversary Intelligence, Surveillance and Reconnaissance (ISR) threats, and to reduce the probability of detection in multi-domain operations. Matures physics-based models for material and system performance that support probability of detection metrics in the multi-domain operational environment, assisting in closing the capability gap between current camouflage, concealment and deception technologies and defeating enemy sensorial capabilities in future operating environments.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: In FY21, this effort was realigned from PE 0603118A(Soldier Lethality Advanced Technology/ Project AZ8 (Camouflage, Concealment and Decoys Demonstration).</p>		-	-	3.885
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>		-	0.264	-

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	5.832	3.885

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AQ5: Sensor CE-Integrated Sensor Architecture Adv Tech	-	0.000	1.466	1.998	-	1.998	2.048	1.499	2.020	2.040	0.000	11.071

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603710A Night Vision Advanced Technology, Project:
 * K70 Night Vision Adv Tech

A. Mission Description and Budget Item Justification

This Project matures and demonstrates an interoperability architecture consisting of standards, interfaces, and services. The application managers will have added artificial intelligence and 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.

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)

Title: Sensor CE - Integrated Sensor Architecture	FY 2019	FY 2020	FY 2021
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.	-	1.400	1.998
FY 2020 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Demonstrate interoperability on limited-bandwidth communication networks with capability to recover from communication network denial; and mature tasking capability to dynamically fulfill mission objections while reducing operator knowledge burden.</p> <p>FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Planned program increase to fund higher priority improvements.</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.066	-
Accomplishments/Planned Programs Subtotals		-	1.466	1.998
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AQ8: High Tempo Data Driven Decision Tools Adv Tech	-	0.000	0.000	3.022	-	3.022	4.253	5.331	5.037	7.735	0.000	25.378

Note

This Project is a new start in FY2021.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates data driven decision tools that help develop cyber 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.

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

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

	FY 2019	FY 2020	FY 2021
Title: High Tempo Data Driven Decision Tools Advanced Technology	-	-	3.022
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 electronicmagnetic activities (CEMA) cell, the S-6 and other staff officers (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.			
FY 2021 Plans: Using vignettes, will 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.			
FY 2020 to FY 2021 Increase/Decrease Statement: This effort starts in FY2021.			
Accomplishments/Planned Programs Subtotals	-	-	3.022

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AQ8 / <i>High Tempo Data Driven Decision Tools 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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AR2: Energy Informed Operations Advanced Technology	-	0.000	1.944	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	1.944

Note
 In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology
 * Project 101 Tactical Command and Control

In Fiscal Year 2021 (FY21) this Project is realigned to:
 PE 0603465A Future Vertical Lift Advanced Technology
 * Project AM5 Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech

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.

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)

Title: Expeditionary Energy Informed Operations	FY 2019	FY 2020	FY 2021
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.	-	1.856	-
FY 2020 Plans: Demonstrate and validate intelligent power system technologies at user events targeting Multi-Domain Operations and joint applications; develop and demonstrate predictive power and use algorithms in multi-power source configurations in support of ad-			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AR2 / <i>Energy Informed Operations Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>hoc, mobile arrangements of power equipment for expeditionary Command, Control, Communications, computers, Intelligence, Surveillance and Reconnaissance (C4ISR) systems; demonstrate multiple-master control methodologies in intelligent power systems integrated into C4ISR platforms like vehicles, airframes or other platforms with critical power loads that must join together in an ad-hoc power network with competing prioritizations; and validate and demonstrate universal translation and mixed grid control capabilities.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This funding was realigned to PE 0603465A/Project New Start (AM5) Opt Energy Storage & Thermal Management for FVL Survivability</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.088	-
Accomplishments/Planned Programs Subtotals		-	1.944	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AR4: <i>Intelligent Env Battlefield Awareness Adv Tech</i>	-	0.000	0.641	3.257	-	3.257	4.125	4.184	5.201	7.334	0.000	24.742

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603728A Environmental Quality Technology Demonstrations, Project:
 * 03E Environmental Restoration Technology

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.

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 Engineer Research and Development Center.

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

	FY 2019	FY 2020	FY 2021
Title: Geo-Forensics for Reconnaissance Exploitation	-	0.641	1.560
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 2020 Plans: Develop of a software tool that predicts soil behavior, including ability to retain or alter chemical threats, at locations where access and knowledge are limited; and mature and demonstrate tools to allow incorporating this data onto geospatial maps to enable mission planning and forensics applications for predicting chemical movement in the soil.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AR4 / <i>Intelligent Env Battlefield Awareness Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Planned program increase.</p>				
<p>Title: Arctic Threat Demonstrations</p> <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: Will 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 2020 to FY 2021 Increase/Decrease Statement: This Effort begins FY 2021.</p>		-	-	1.697
Accomplishments/Planned Programs Subtotals		-	0.641	3.257
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AR6: <i>Understanding the Environment as a Threat Adv Tech</i>	-	0.000	2.245	2.809	-	2.809	2.555	3.301	3.656	4.636	0.000	19.202

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603728A Environmental Quality Technology Demonstrations, Project:
 * 03E Environmental Restoration Technology

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.

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 Engineer Research and Development Center.

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

Title: Environmental Threat Technology Demonstrations for route planning	FY 2019	FY 2020		FY 2021
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.	-	2.201		1.409
FY 2020 Plans: Demonstrate a new route planning capability for off-road options through the complex urban environment; and mature and optimize products that will inform the Soldier of risks to personnel and equipment expected along various routes, to weigh Soldier exposure and probability of mission success.				
FY 2021 Plans:				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Planned program decrease.				
Title: Hazard Prediction Demonstration 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: Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort begins in FY2021.		-	-	1.400
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.044	-
Accomplishments/Planned Programs Subtotals		-	2.245	2.809
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 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AR8: Sensing in Contested Environments Adv Tech	-	0.000	0.000	0.983	-	0.983	1.631	1.798	1.818	2.814	0.000	9.044

Note

This is a new start in FY2021.

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.

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

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

	FY 2019	FY 2020	FY 2021
Title: Non-Traditional Threat Detection Advance Technology	-	-	0.983
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: Will 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 2020 to FY 2021 Increase/Decrease Statement: Realigned to accelerate in support of Modernization Priorities.			
Accomplishments/Planned Programs Subtotals	-	-	0.983

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AS9: Persistent Geophysical Sensing-Infrasound Adv Tech	-	0.000	2.511	4.774	-	4.774	2.479	2.281	2.553	2.776	0.000	17.374

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

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.

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 in this Project conducted at U.S. Army Engineer Research and Development Center.

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

	FY 2019	FY 2020	FY 2021
Title: Remote Assessment of Infrastructure for Ensured Maneuver (RAFTER) Demonstrations	-	2.397	4.774
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. This effort complements PE 0602146A (Network C3I Technology) / Project AR9 (Persistent Geophysical Sensing-Infrasound Tech).			
FY 2020 Plans: Optimize and validate the persistent monitoring system and associated software for near-real-time geophysical data processing through multiple field demonstrations.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Planned program increase.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.114	-
Accomplishments/Planned Programs Subtotals		-	2.511	4.774
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AT3: <i>Subterranean Detection and Monitoring Adv Tech</i>	-	0.000	1.059	3.488	-	3.488	2.245	0.000	1.233	1.384	0.000	9.409

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

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.

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 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 2019	FY 2020	FY 2021
Title: Subterranean Threat Assessment by Real-time Sensing Demonstrations	-	1.011	3.488
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. This effort complements PE 0602146A (Network C3I Technology) / Project AT2 (Subterranean Detection and Monitoring Technology).			
FY 2020 Plans: Optimize seismic acquisition hardware and software components to speed up data acquisition and transfer rates, validate sensor coupling models, and demonstrate full waveform inversion data processing algorithms.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AT3 / <i>Subterranean Detection and Monitoring Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Planned program increase.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.048	-
Accomplishments/Planned Programs Subtotals		-	1.059	3.488
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AT8: Network-Enabled GeoSpatial-GEOINT Services AdvTech	-	0.000	3.880	2.997	-	2.997	3.097	4.522	0.000	0.000	0.000	14.496

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

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.

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

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

	FY 2019	FY 2020	FY 2021
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)	-	3.703	2.997
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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Review, compare, and document through experiments and demonstrations baseline of industry and government technologies in 3D data processing, and data models, in terms of adaptation to modernization of mission command network; and compare suitability for automated feature extraction and resources required for accurate Geo-registration and display.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.177	-
Accomplishments/Planned Programs Subtotals	-	3.880	2.997

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AU1: <i>Tactical GeoSpatial Information Capabilities ATech</i>	-	0.000	2.012	3.740	-	3.740	4.259	5.860	0.000	0.000	0.000	15.871

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

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.

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

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

	FY 2019	FY 2020	FY 2021
Title: 3D Terrain Analysis	-	1.246	3.181
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 2020 Plans: Conduct testing of preliminary compatible framework and workflow for remotely sensed tactical data exploitation that provisions an enhanced terrain analysis capability to the geospatial engineer toolkit.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU1 / <i>Tactical GeoSpatial Information Capabilities ATech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life style of this effort.				
Title: Previously Advanced Airborne LiDAR 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 2020 Plans: Mature new Geiger-mode LiDAR sensor payload components, for increasing performance and speed of collection and processing, for more realistic portrayal of multi-domain environments. FY 2021 Plans: Will 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 2020 to FY 2021 Increase/Decrease Statement: Planned program decrease.		-	0.675	0.559
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.091	-
Accomplishments/Planned Programs Subtotals		-	2.012	3.740
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU1 / <i>Tactical GeoSpatial Information Capabilities ATech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AU2: Optimization of Geospatial Data for Visualization	-	0.000	0.000	2.098	-	2.098	2.198	1.798	1.782	1.800	0.000	9.676

Note

This Project is a new start in Fiscal Year (FY) 2021.

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.

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

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

	FY 2019	FY 2020	FY 2021
Title: Optimization of Geospatial Data for Tactical Visualization-Demonstration	-	-	2.098
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: Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort starts in FY2021.			
Accomplishments/Planned Programs Subtotals	-	-	2.098

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>				Project (Number/Name) AU4 / <i>Geospatially Enabled Operational Design Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AU4: <i>Geospatially Enabled Operational Design Adv Tech</i>	-	0.000	4.819	8.205	-	8.205	8.054	7.663	0.000	0.000	0.000	28.741

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

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.

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

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

	FY 2019	FY 2020	FY 2021
Title: Geospatially Operational Design (GEOD) - Demonstration (Previously Virtual Collaborative Operational Design Demonstrations)	-	2.325	8.205
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 2020 Plans: Design and demonstrate tools to support Army Design Methodology (ADM) to frame the problem and visualize the desired end state in a geospatial context.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU4 / <i>Geospatially Enabled Operational Design Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Planned effort increase that will mature and demonstrate analytics and tools for framing an operational environment.</p>				
<p>Title: Tactical Data Analysis and Visualization Demonstration</p> <p>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.</p> <p>FY 2020 Plans: Design and conduct demonstrations to geospatially enable strategic guidance inputs to operational design, in a digital, integrated, collaborative planning environment.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This Effort transitions in FY 2021.</p>		-	2.485	-
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.009	-
Accomplishments/Planned Programs Subtotals		-	4.819	8.205
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AU4 / <i>Geospatially Enabled Operational Design Adv Tech</i>

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AU6: Automated Analytics for Operational Environment AT	-	0.000	1.661	0.000	-	0.000	0.000	0.000	2.278	2.278	0.000	6.217

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology, Project:
 * T08 Combat Eng Systems

In FY2021, this research in this Project is realigned to:
 PE 0602146A Network C3I Technology, Project:
 AT7 Network Enabled Geospatial - GEOINT Services

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.

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

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

Title: Simultaneous Multi-Domain Data Representation	FY 2019	FY 2020	FY 2021
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.	-	0.562	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Exploit available advanced spatio-temporally coherent multi-domain data representations that capture explicit and implicit relationships between threat actors, and operational environment changes, distilled from raw data. FY 2020 to FY 2021 Increase/Decrease Statement: Realignment to 0602146A Network C3I Technology /AT7 Network Enabled Geospatial - GEOINT Services for work in Optimization of Geospatial Data for Tactical Visualization.				
Title: Automated Analysis of Multi-Domain Data 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. FY 2020 Plans: Exploit available multi-domain data fusion capabilities for geospatial data processing, analytics and representations. FY 2020 to FY 2021 Increase/Decrease Statement: Realignment to 0602146A Network C3I Technology /AT7 Network Enabled Geospatial - GEOINT Services for work in Optimization of Geospatial Data for Tactical Visualization.		-	1.024	-
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.075	-
Accomplishments/Planned Programs Subtotals		-	1.661	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AV1: GEOInt/Ops Logistics Integration-Planning Adv Tech	-	0.000	0.000	3.914	-	3.914	3.915	2.897	4.948	4.948	0.000	20.622

Note

This is a new start in FY2021.

This new Project starts in Fiscal Year (FY) 2021

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 2019	FY 2020	FY 2021
Title: Integration of intel and logistics Multi Echelon Planning	-	-	3.914
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: Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort starts in FY2021.			
Accomplishments/Planned Programs Subtotals	-	-	3.914

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

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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)

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AV2: LEO Advanced Technology	-	0.000	1.927	1.979	-	1.979	0.000	0.000	0.000	0.000	0.000	3.906

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603006A Space Application Advanced Technology, Project:
 * 592 Space Application Tech

A. Mission Description and Budget Item Justification

Project AV2 will mature 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, GPS, and global communications.

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

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 2019	FY 2020	FY 2021
<p>Title: Payload Technology Development</p> <p>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.</p> <p>The work cited is consistent with the Under Secretary of Defense for Research and Engineering Science and Technology (S&T) priority focus areas and the Army Modernization Strategy.</p> <p>This work is performed by the Army Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT) in Huntsville, AL.</p> <p>FY 2020 Plans:</p>	-	1.886	1.979

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AV2 / <i>LEO Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Design and develop space payloads to operate in a LEO constellation and augment missile warning/defense, GPS, and provide global communications with tactical timelines. FY 2021 Plans: Will mature LEO constellation management technologies. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.041	-
Accomplishments/Planned Programs Subtotals	-	1.927	1.979

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AV4: Foundational S&T for Network C3I Advanced Tech	-	0.000	0.000	2.126	-	2.126	2.646	2.859	2.949	2.949	0.000	13.529

Note

In Fiscal Year (FY) 2020, this project is realigned from PE 0603772A / Advanced Tactical Computer Science and Sensor Technology.

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).

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

	FY 2019	FY 2020	FY 2021
Title: Demonstration of emerging technologies for holistic network integration	-	-	2.126
Description: This Project 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 2020 to FY 2021 Increase/Decrease Statement: Funding increase due to realignment from PE 0603772A / Advanced Tactical Computer Science and Sensor Technology.			
Accomplishments/Planned Programs Subtotals	-	-	2.126

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AV4 / <i>Foundational S&T for Network C3I Advanced 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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AV8: Navigation Warfare (NAVWAR) Advanced Technology	-	0.000	5.118	2.535	-	2.535	2.044	1.998	5.968	5.968	0.000	23.631

Note

In Fiscal Year (FY) 2020 this Project is realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology, Project:
 * 101 Tactical Command and Control

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.

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 2019	FY 2020	FY 2021
Title: NAVWAR for Ground Soldiers	-	4.886	-
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.			
FY 2020 Plans: Improve the performance of a Navigation Warfare (NAVWAR) breadboard that will enable continued military operations in hostile, GPS denied environments by integrating electronic attack, electronic protection and electronic support hardware and software; incorporate the new Military Code (M-Code) GPS signal for offensive and defensive NAVWAR operations into the breadboard; mature and code a PNT situational awareness software tool utilizing existing sensors and GPS receivers; mature and demonstrate a hardware solution using multi-GNSS signals for integrity monitoring; will integrate PNT technologies such as radio			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
frequency (RF) ranging beacons for in-building navigation to augment PNT solutions for mounted and dismounted platforms; and mature and demonstrate two way time transfer hardware that will provide accurate time to users and systems in the absence of GPS. FY 2020 to FY 2021 Increase/Decrease Statement: Effort completes in FY20.				
Title: PNT Situational Awareness (SA) Advanced Technology 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. FY 2021 Plans: Will select and demonstrate simulated aggregation of multi-domain sensor data into Computing Environment; improve current emitter characterization techniques/algorithms, and optimize data fusion software. FY 2020 to FY 2021 Increase/Decrease Statement: New research effort.		-	-	2.535
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.232	-
Accomplishments/Planned Programs Subtotals		-	5.118	2.535
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AW2: Autonomous Navigation Advanced Technology	-	0.000	0.292	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.292

Note
 In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology
 * Project 101 Tactical Command and Control

In FY2021, this Project is eliminated. Funding is realigned to PE 0603463A Network C3I Advanced Technology, Project AW6 Modular GPS Independent Sensors Advanced Technology.

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.

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)

Title: Autonomous Navigation	FY 2019	FY 2020	FY 2021
<p>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. Work accomplished under Program Element (PE) 0602146/Project AW1 (Autonomous Navigation Technology) complements this effort.</p> <p>FY 2020 Plans: Perform a candidate component demonstration on a Mounted platform for Assured Autonomous PNT, leveraging previous sensor and component work integrated with autonomous obstacle avoidance sensors (potential sensors include inertial measurement units, vision navigation sensors, RF ranging, etc.).</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	-	0.278	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>	Project (Number/Name) AW2 / <i>Autonomous Navigation Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
In FY2021, Project is eliminated and funding realigned to PE 0603463A Network C3I Advanced Technology / Project AW6 Modular GPS Independent Sensors Adv Tech in support of Soldier Integrated PNT.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.014	-
Accomplishments/Planned Programs Subtotals	-	0.292	-

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 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AW4: DoD PNT M&S Collaborative Initiative (CI) Adv Tech	-	0.000	2.916	2.997	-	2.997	0.000	0.000	0.000	0.000	0.000	5.913

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology, Project:
 * 101 Tactical Command and Control

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.

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 2019	FY 2020	FY 2021
Title: DoD PNT M&S Collaborative Initiative (CI)	-	2.784	2.997
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. Work accomplished under Program Element (PE) 0602146/Project AW3 (DoD PNT M&S Collaborative Initiative (CI) Technology) complements this effort.			
FY 2020 Plans: Conduct operational Tri-Service PNT M&S Analysis for a more comprehensive analysis of PNT in the battlespace; adopt and adapt operational mission/campaign level simulations; and demonstrate a PNT M&S capability in performing force effectiveness analysis of candidate PNT technologies.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will 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 will document how the candidate PNT Technologies impacted operational mission effectiveness in a specific scenario. FY 2020 to FY 2021 Increase/Decrease Statement: Nominal planned change of scope.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.132	-
Accomplishments/Planned Programs Subtotals		-	2.916	2.997
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AW6: Modular GPS Independent Sensors Advanced Tech	-	0.000	0.000	11.089	-	11.089	10.490	9.995	12.089	14.388	0.000	58.051

Note

This is a New Start in Fiscal Year 2021 (FY21)

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.

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 2019	FY 2020	FY 2021
Title: Soldier-Integrated PNT	-	-	11.089
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: Will 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 integrate and demonstrate modular Soldier-Integrated-PNT technologies and initial interfacing with a soldier form factor display device.			
FY 2020 to FY 2021 Increase/Decrease Statement: Increase in order to validate initial Soldier-Integrated PNT technologies based on an open architecture that incorporates multiple sensors and algorithmic approaches, and to validate and optimize multiple types of alternative PNT sensors.			
Accomplishments/Planned Programs Subtotals	-	-	11.089

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603463A / <i>Network C3I Advanced Technology</i>				Project (Number/Name) BP4 / <i>ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BP4: <i>ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)</i>	-	0.000	39.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	39.000

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 2019	FY 2020
Congressional Add: Unmanned Aerial Systems and Aerostat Operations FY 2020 Plans: Unmanned Aerial Systems and Aerostat Operations	-	4.000
Congressional Add: Sensor Advanced Technology FY 2020 Plans: Sensor Advanced Technology	-	10.000
Congressional Add: Assured Position, Navigation, and Timing FY 2020 Plans: Assured Position, Navigation, and Timing	-	9.000
Congressional Add: Payload and Ground Segment Research and Development for Small Satellite Science and Security Applications FY 2020 Plans: Payload and Ground Segment Research and Development for Small Satellite Science and Security Applications	-	5.000
Congressional Add: Urban Subterranean Mapping Technology FY 2020 Plans: Urban Subterranean Mapping Technology	-	3.000
Congressional Add: Anticipating Threats to Natural Systems FY 2020 Plans: Anticipating Threats to Natural Systems	-	6.000
Congressional Add: Army Visual and Tactical Arctic Reconnaissance	-	2.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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) BP4 / <i>ELECTRONIC WARFARE ADVANCED TECHNOLOGIES (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2020 Plans:</i> Army Visual and Tactical Arctic Reconnaissance		
Congressional Adds Subtotals	-	39.000

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	189.386	121.060	-	121.060	86.534	84.198	112.487	93.340	0.000	687.005
AE6: Strategic Long Range Cannon Advanced Technology	-	0.000	77.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	77.000
AE8: Land-Based Anti-Ship Missile (LBASM) Advanced Tech	-	0.000	6.761	10.057	-	10.057	15.892	26.269	18.350	0.000	0.000	77.329
AE9: Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech	-	0.000	14.149	10.077	-	10.077	0.000	0.000	0.000	0.000	0.000	24.226
AF2: Long Range Maneuverable Fires (LRMF) Advanced Tech*	-	0.000	0.000	0.000	-	0.000	0.000	0.000	11.199	11.313	0.000	22.512
AF4: Missile Simulation Advanced Technology	-	0.000	0.273	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.273
AG3: Extended Range Cannon Artillery (ERCA) Adv Tech	-	0.000	19.992	18.419	-	18.419	3.237	3.362	2.997	5.078	0.000	53.085
AG5: Extended Range Artillery Munition Suite Adv Tech	-	0.000	35.600	50.227	-	50.227	41.207	30.622	30.886	27.891	0.000	216.433
AG7: Energetic Materials and Adv Processing Adv Tech	-	0.000	2.040	2.079	-	2.079	2.121	2.163	0.000	0.000	0.000	8.403
AH3: Single Multi-mission Attack Missile Adv Tech	-	0.000	5.683	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.683
BO8: Long Range Precision Fires Advanced Tech (CA)	-	0.000	15.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	15.000
BS3: Strategic Missile Advanced Technology	-	0.000	12.888	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.888
BY2: Advanced Hypersonic Technology	-	0.000	0.000	30.201	-	30.201	24.077	21.782	49.055	49.058	0.000	174.173

*This project's R-2a exhibit has been suppressed due to funding not beginning until after FY 2021

Note
In Fiscal Year (FY) 2020, funding in this Program Element (PE) was realigned with continuity of effort from the following PEs:

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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- * 0603004A (Weapons and Munitions Advanced Technology)
- * 0603313A (Missile and Rocket Advanced Technology)

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 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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	174.386	118.682	-	118.682
Current President's Budget	0.000	189.386	121.060	-	121.060
Total Adjustments	0.000	15.000	2.378	-	2.378
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	15.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	2.378	-	2.378

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*

	FY 2019	FY 2020
	-	5.000
	-	10.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603464A / <i>Long Range Precision Fires Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

	FY 2019	FY 2020
Congressional Add Subtotals for Project: BO8	-	15.000
Congressional Add Totals for all Projects	-	15.000

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AE6: Strategic Long Range Cannon Advanced Technology	-	0.000	77.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	77.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 PE 0603004A Weapons and Munitions Advanced Technology
 * Project 232 Advanced Lethality & Survivability Demo

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 2019	FY 2020	FY 2021
Title: Strategic Long Range Cannon Advanced Technology	-	73.503	-
Description: This effort will mature and demonstrate subsystem technologies to further enhance range, lethality, and precision enablers for extended range cannon and munition systems.			
FY 2020 Plans: Will mature and optimize long range armament technologies for both weapons and munitions to support potential deep strike objective capabilities from future cannon artillery systems; will enhance component level technologies for novel cannon, munition, and fire control, including guidance and propulsion systems, for artillery fired projectiles. Will provide revolutionary performance for Long Range Fires by developing enhanced lethality and range extension technologies for integrated system level performance with maximum effects from cannons.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AE6 / <i>Strategic Long Range Cannon Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Advanced Technology Development (6.3) portion of SLRC effort completes in FY 2020.			
Title: FY 2020 SBIR/STTR Transfer	-	3.497	-
Description: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638			
Accomplishments/Planned Programs Subtotals	-	77.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AE8: Land-Based Anti-Ship Missile (LBASM) Advanced Tech</i>	-	0.000	6.761	10.057	-	10.057	15.892	26.269	18.350	0.000	0.000	77.329

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology, Project:
 * 263 Future Msl Tech Integr

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)

Title: Land Based Anti-Ship Missile (LBASM) Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	6.453	10.057
FY 2020 Plans: Will continue component integration/demonstration of multi-mode seeker that provides target classification/discrimination and aim-point selection on critical target features and lethal payload that provides maximum effects against multi-domain target sets. Will also continue to validate components and optimize concepts for system integration.			
FY 2021 Plans: Will 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			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
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 2020 to FY 2021 Increase/Decrease Statement: Funding increase due to FY 2021 integration and evaluation of seeker technologies through hardware-in-the-loop and flight testing.				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.308	-
Accomplishments/Planned Programs Subtotals		-	6.761	10.057
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AE9: Low-Cost Tact Ext Range Missile (LC-TERM) Adv Tech	-	0.000	14.149	10.077	-	10.077	0.000	0.000	0.000	0.000	0.000	24.226

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology:
 * Project 263 Future Msl Tech Integr

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 2019	FY 2020	FY 2021
Title: Low-Cost Tactical Extended Range Missile (LC-TERM) Advanced Technology	-	13.507	10.077
Description: Mature and demonstrate propulsion technologies that enables extended range target engagement and navigation component technologies that reduce dependence on GPS for precision.			
FY 2020 Plans: Will integrate enhanced long-range fires navigation components and demonstrate performance in high fidelity hardware-in-the-loop simulation environment validating improved precision guidance in GPS degrade environments. Will also integrate high temperature fiber, resin, nozzle, and structures propulsion component technologies and demonstrate performance through static solid rocket motor firing validating improved energy output in the same form factor.			
FY 2021 Plans:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Will 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; will 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 2020 to FY 2021 Increase/Decrease Statement: Funding decrease due to completion of final demonstration.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.642	-
Accomplishments/Planned Programs Subtotals	-	14.149	10.077

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AF4: <i>Missile Simulation Advanced Technology</i>	-	0.000	0.273	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.273

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology
 * Project 206 Missile Simulation

In Fiscal Year 2021 (FY21) 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)

Title: Missile Simulation Advanced Technology	FY 2019	FY 2020	FY 2021
Description: Mature and demonstrate enhanced analysis and high fidelity modeling and simulation technologies for advanced missiles and interceptor design and analysis.	-	0.260	-
FY 2020 Plans: Will mature the development of very high speed missile simulation architectures for rapid performance predictions; inform technology requirements; and reduce technology development timelines.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AF4 / <i>Missile Simulation Advanced Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Beginning in Fiscal Year 2021, efforts for this project are realigned to PE 0602147A Long Range Precision Fires Technology / Project AF8 Affordable Extended Range Precision Technology.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.013	-
Accomplishments/Planned Programs Subtotals	-	0.273	-

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

Remarks

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AG3: <i>Extended Range Cannon Artillery (ERCA) Adv Tech</i>	-	0.000	19.992	18.419	-	18.419	3.237	3.362	2.997	5.078	0.000	53.085

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology, Project:
 * 232 Advanced Lethality & Survivability Demo

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)

Title: Extended Range Cannon Artillery Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	19.084	15.309
FY 2020 Plans: Will continue maturation of integration and automation technologies for ammunition handling and weapon control, initial prototype and demonstration of advanced precision technologies from fire control sensors and systems; Will optimize cannon, mount, and weapon system components to maximize weight reduction and automation adaptability			
FY 2021 Plans: Will continue maturation of integrated automation technologies for the ammunition handling and weapon control components; will optimize cannon, mount, and weapon system components to maximize weight reduction, optimize cannon/projectile interfaces,			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
as well as ancillary components for automation; will demonstrate automated ammunition handling at high rates of fire; will demonstrate initial prototype of advanced precision technologies integrated in artillery fire control sensors and systems. FY 2020 to FY 2021 Increase/Decrease Statement: FY 2021 Funding decreased due to the prototype of precision technologies completing in FY 2020.				
Title: Synchronized High Op-Tempo (SHOT) Targeting for LRPF 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. FY 2021 Plans: Will mature and demonstrate initial multiple intelligence (multi-INT) algorithms capable of facilitating timely creation of intelligence to support long range fires missions. Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from PE 0603463A Network C3I Advanced Technology, Project AN8 COE - Every Receiver is a Sensor Advanced Tech.		-	-	3.110
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.908	-
Accomplishments/Planned Programs Subtotals		-	19.992	18.419
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AG5: <i>Extended Range Artillery Munition Suite Adv Tech</i>	-	0.000	35.600	50.227	-	50.227	41.207	30.622	30.886	27.891	0.000	216.433

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology:
 * Project 232 Advanced Lethality & Survivability Demo

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 2019	FY 2020	FY 2021
Title: Extended Range Artillery Munition Suite Advanced Technology	-	33.984	50.227
Description: Matures and optimizes long range unitary artillery projectile systems in the areas of range, precision, counter-measure, and payload technologies.			
FY 2020 Plans: Effort will validate system modeling and simulation to improve projectile performance by integrating the optimal configurations of technologies; will develop and demonstrate integrated concepts for Extended Range Artillery Projectiles (e.g. XM1155) in the areas of increased range, sensor optimization and integration, improved algorithms and refined concepts at extended ranges in Integrated Air Defense Systems (IADS) contested and GPS-denied environments for armor and counter-battery defeat; will optimize system development for extended range cargo munitions for advanced area effects munition compatible with legacy and ERCA in the following areas: 1) dispensing techniques and sensor optimization for improved area effects to service imprecisely located targets ; 2) optimal formulations and characteristics for smoke and illumination payloads that maximize effectiveness ; and 3) survivability of cannon-launched terrain shaping munition for maximum area denial effects; will conduct critical design review			

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>of component technologies; will perform demonstration to validate key enabling component technologies; optimize concepts for system integration; and will mature modeling and simulation concepts for subsequent validation.</p> <p>FY 2021 Plans: Will mature long range unitary artillery projectile systems to validate system modeling and simulation to optimize configurations of projectile technologies for increased performance; will demonstrate integrated concepts of Extended Range Artillery Projectiles (e.g. XM1155) including improved algorithms, increased range, sensor optimization and integration; will 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. Will perform demonstration to validate key enabling component technologies.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding increase is due to FY 2021 demonstrations of integrated matured components and munition dispensing technologies.</p>			
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	1.616	-
Accomplishments/Planned Programs Subtotals	-	35.600	50.227

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AG7: Energetic Materials and Adv Processing Adv Tech</i>	-	0.000	2.040	2.079	-	2.079	2.121	2.163	0.000	0.000	0.000	8.403

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology:
 * Project 232 Advanced Lethality & Survivability Demo

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)

Title: Scale-up of Insensitive Energetic Materials	FY 2019	FY 2020	FY 2021
<p>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.</p> <p>FY 2020 Plans: Will continue to qualify energetic materials for complete material characterization; demonstrate high-energy, reduced sensitivity, metalized formulations for dual purpose representative munitions; will demonstrate high-energy, reduced sensitivity formulations for shaped charge representative munitions; will demonstrate high energy propellant in representative applications; will continue to optimize and demonstrate advanced processing methods of novel materials.</p> <p>FY 2021 Plans: Will continue to demonstrate and qualify energetic materials for complete material characterization; will demonstrate developed high-energy explosive and propellant formulations in representative applications; will mature and optimize advanced processing methods for increased scale and higher throughput of energetic ingredients and formulations.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement:</p>	-	1.948	2.079

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603464A / <i>Long Range Precision Fires Advanced Technology</i>	Project (Number/Name) AG7 / <i>Energetic Materials and Adv Processing Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Nominal planned project increase				
Title: FY 2020 SBIR/STTR Transfer		-	0.092	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		-	2.040	2.079
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AH3: Single Multi-mission Attack Missile Adv Tech	-	0.000	5.683	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.683

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)

Title: Single Multi-mission Attack Missile (SMAM) Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	5.424	-
FY 2020 Plans: Will integrate certified mini-crypto module in an extended range missile digital datalink for secure missions. Develop and integrate inertial navigation aiding sensors and algorithms to provide suitable target accuracy for terminal engagement in GPS degraded/ denied environments. Perform static testing of multi-effects warhead technologies optimized to defeat future mechanized threats.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Beginning in FY 2021, efforts for this project were realigned to PE 0603465A / Future Vertical Lift Advanced Technology, AK5 / Multi-Role Small Guided Missile Advanced Tech.			
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638	-	0.259	-
Accomplishments/Planned Programs Subtotals	-	5.683	-

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BO8: Long Range Precision Fires Advanced Tech (CA)	-	0.000	15.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	15.000

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 2019	FY 2020
Congressional Add: High Energy Laser Development	-	5.000
FY 2020 Plans: High Energy Laser Development		
Congressional Add: Missile Rapid Demonstration Capability	-	10.000
FY 2020 Plans: Missile Rapid Demonstration Capability		
Congressional Adds Subtotals	-	15.000

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 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BS3: <i>Strategic Missile Advanced Technology</i>	-	0.000	12.888	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.888

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 (FMTI)
 * Project 704 Advanced Missile Demo
 PE 0603004A Weapons and Munitions Advanced Technology
 * Project 232 Advanced Lethality & Survivability Demo

In Fiscal Year 2021 (FY21) 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/miniaturize 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)

Title: Strategic Missile Advanced Technology	FY 2019	FY 2020	FY 2021
Description: This effort develops and matures critical technologies for ground-based strategic missiles.	-	12.303	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Will continue to develop and mature critical technologies to improve strategic missile components such as advanced structures and materials, thermal protection systems, guidance/seekers, navigation systems, electronic controls, improve/miniaturize avionics and automated flight termination systems.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: In FY 2021, this Project is realigned to: PE 0603464A Long Range Precision Fires Advanced Technology: * Project BY2 Advanced Hypersonic Technology</p>				
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.585	-
Accomplishments/Planned Programs Subtotals		-	12.888	-
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 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BY2: Advanced Hypersonic Technology	-	0.000	0.000	30.201	-	30.201	24.077	21.782	49.055	49.058	0.000	174.173

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 matures and develops subsystem and components technologies loading, thermal, environmental, vibration, transportation and erecting of a hypersonic weapon delivery system. The project also develops canister subsystem and components models to assess thermal, environmental, form, fit and function for vibration isolation and fit on a prototype hypersonic weapon system under a separate effort. The modeling effort, design and engineering efforts will be documented in a Technical Data Package (TDP) for a canister. The technologies will be assessed as part of a flight test for subsystem and component operability of a future hypersonic weapon.

The cited work is consistent with the Under Secretary of the 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) in coordination with the United States Army Rapid Capability and Critical Technologies Office (RCCTO).

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

	FY 2019	FY 2020	FY 2021
Title: Hypersonics Advanced Technology	-	-	30.201
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 2020 to FY 2021 Increase/Decrease Statement: In FY 2021, this Project is realigned from: PE 0603464A Long Range Precision Fires Advanced Technology:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
* Project BS3 Strategic Missile Advanced Technology			
Accomplishments/Planned Programs Subtotals	-	-	30.201

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	174.892	156.194	-	156.194	190.050	230.431	219.801	220.586	0.000	1,191.954
AI4: Joint Multi-Role (JMR) Demonstration Advanced Tech	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000
AI6: Next Gen Tactical UAS TD Advanced Technology	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000
AI8: Alternative Concept Engine Advanced Technology	-	0.000	2.929	2.602	-	2.602	1.735	0.000	0.000	0.000	0.000	7.266
AJ1: Future UAS Engine Advanced Technology	-	0.000	1.730	2.827	-	2.827	4.420	4.508	4.513	4.558	0.000	22.556
AJ3: Next Generation Rotorcraft Transmission Adv Tech	-	0.000	1.098	1.393	-	1.393	1.421	4.289	4.337	4.337	0.000	16.875
AJ5: Digital Vehicle Management & Control Advanced Tech	-	0.000	1.153	6.761	-	6.761	6.897	8.034	9.112	9.113	0.000	41.070
AJ7: Advanced Rotors Advanced Technology	-	0.000	2.500	2.498	-	2.498	2.508	2.558	2.575	2.601	0.000	15.240
AJ9: Integ Mission Equip for Vert Lift Systems Adv Tech	-	0.000	15.820	22.381	-	22.381	24.360	25.996	21.569	21.787	0.000	131.913
AK3: Aviation Survivability Advanced Technology	-	0.000	20.836	11.370	-	11.370	15.806	20.243	20.701	20.703	0.000	109.659
AK5: Multi-Role Small Guided Missile Advanced Tech	-	0.000	2.426	2.997	-	2.997	10.406	26.621	24.524	24.651	0.000	91.625
AK7: Adv Rotorcraft Armaments Protection Sys Adv Tech	-	0.000	3.139	6.344	-	6.344	10.671	9.361	2.997	0.000	0.000	32.512
AK8: Air Launched Effects Advanced Technology	-	0.000	3.215	29.419	-	29.419	29.262	28.144	27.157	27.159	0.000	144.356
AL1: Adv Teaming for Tactical Aviation Oper Adv Tech	-	0.000	20.964	41.328	-	41.328	40.580	40.284	46.770	46.774	0.000	236.700

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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>	-	0.000	4.958	5.046	-	5.046	5.136	5.301	5.360	5.414	0.000	31.215	
<i>AL6: Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>	-	0.000	29.151	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	29.151	
<i>AL7: Full Spectrum Targeting Advanced Technology</i>	-	0.000	5.425	9.907	-	9.907	10.115	10.317	10.432	10.537	0.000	56.733	
<i>AL9: Holistic Sit Awareness and Dec Making Adv Tech</i>	-	0.000	0.000	4.995	-	4.995	17.783	31.670	19.908	20.108	0.000	94.464	
<i>AM3: Aircraft and Aircrew Protection Advanced Tech</i>	-	0.000	4.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.548	
<i>AM5: Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>	-	0.000	0.000	1.998	-	1.998	3.537	5.348	5.391	5.391	0.000	21.665	
<i>BP8: Future Vertical Lift Air Platform Adv Tech (CA)</i>	-	0.000	35.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000	
<i>CA8: Adv Rotocraft Armaments Protection Sys</i>	-	0.000	0.000	0.999	-	0.999	1.249	2.797	9.298	12.296	0.000	26.639	
<i>CC4: FVL Radar Advanced Technologies</i>	-	0.000	0.000	3.329	-	3.329	4.164	4.960	5.157	5.157	0.000	22.767	

Note

In Fiscal Year (FY) 2020 this Program Element (PE) continues efforts previously funded in the following PEs:

- * PE 0603003A (Aviation Advanced Technology)
- * PE 0603004A (Weapons and Munitions Advanced Technology)
- * PE 0603270A (Electronic Warfare Technology)
- * PE 0603313A (Missile and Rocket Advanced Technology)
- * PE 0603710A (Night Vision Advanced Technology)
- * PE 0603734A (Military Engineering Advanced Technology)
- * PE 0603772 (Advanced Tactical Computer Science and Sensor Technology)

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army I 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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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.

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)

The cited work is consistent with the Under Secretary of Defense for Research and Engineering S&T 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 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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	151.640	145.543	-	145.543
Current President's Budget	0.000	174.892	156.194	-	156.194
Total Adjustments	0.000	23.252	10.651	-	10.651
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-11.748			
• Congressional Rescissions	-	-			
• Congressional Adds	-	35.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	10.651	-	10.651

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*

	FY 2019	FY 2020
	-	6.000
	-	5.000
	-	3.000
	-	2.000
	-	2.000
	-	5.000

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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: *Ferrium Steels for Improved Drive Systems*

Congressional Add: *Stretch Broken Composite Material Forms*

Congressional Add Subtotals for Project: BP8

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	4.000
	-	8.000
	-	35.000
	-	35.000

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 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>A14: Joint Multi-Role (JMR) Demonstration Advanced Tech</i>	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology
 * Project 313 Adv Rotarywing Veh Tech

In FY21, this Project is Eliminated.

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 2019	FY 2020	FY 2021
Title: Joint Multi-Role (JMR) Technology Demonstration	-	10.000	-
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.			
FY 2020 Plans: Will complete the Mission Systems Architecture Capstone Demonstration, which includes development of processes, tools, and standards necessary to specify, analyze, design, implement and qualify a Mission Systems Architecture for future programs using a Model-Based development approach. Will continue development of the Joint Common Architecture (JCA), including a functional model, data model, supporting documentation, and tools. Will continue final design, integration, and assessment of a notional			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Open Systems Architecture (OSA) that implements the Future Airborne Capability Environment (FACE) Technical Standard and Hardware Open Systems Technologies (HOST). Will deliver architectural models and technical reports from vendors participating in the demonstration of the architectures. <i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> JMR TD flight demonstration completed.			
Accomplishments/Planned Programs Subtotals	-	10.000	-

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 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
A16: <i>Next Gen Tactical UAS TD Advanced Technology</i>	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology
 * Project 313 Adv Rotarywing Veh Tech

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 2019	FY 2020	FY 2021
Title: Next Gen Tactical UAS Technology Demonstration	-	10.000	-
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.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p><i>FY 2020 Plans:</i> Air vehicle conceptual designs will be assessed against refined requirements for continuation to detailed design, fabrication, and demonstration in 2023. Proposed technology insertions will be prioritized to enable advanced UAS. Experiments will inform concepts of operation for future vertical lift family of systems within the ecosystem.</p> <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> This work is divested and funds are reallocated to a higher priority in FY 21, PE 0603465A (Future Vertical Lift Advanced Technology) / AK8 (Air Launched Effects Advanced Technology).</p>			
Accomplishments/Planned Programs Subtotals	-	10.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
A18: <i>Alternative Concept Engine Advanced Technology</i>	-	0.000	2.929	2.602	-	2.602	1.735	0.000	0.000	0.000	0.000	7.266

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology, Project:
 * 447 ACFT Demo Engines

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 2019	FY 2020	FY 2021
Title: Alternative Concept Engine (ACE)	-	2.929	2.602
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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Alternative concept engine component fabrication and component validation testing will be completed and engine testing will be initiated. <i>FY 2021 Plans:</i> Will 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. <i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	2.929	2.602

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ1: <i>Future UAS Engine Advanced Technology</i>	-	0.000	1.730	2.827	-	2.827	4.420	4.508	4.513	4.558	0.000	22.556

Note
In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A (Aviation Advanced Technology) / 447 (ACFT Demo Engines)

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)

Title: Reliable Advanced Small Power Systems	FY 2019	FY 2020	FY 2021
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.	-	1.730	2.827
FY 2020 Plans: Reliable Advanced Small Power System component fabrication and component validation testing will be completed and engine testing will be initiated.			
FY 2021 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Will perform Reliable Advanced Small Power System engine design optimization. Will 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. <i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	1.730	2.827

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ3: <i>Next Generation Rotorcraft Transmission Adv Tech</i>	-	0.000	1.098	1.393	-	1.393	1.421	4.289	4.337	4.337	0.000	16.875

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology, Project:
 * 313 Adv Rotarywing Veh Tech

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 2019	FY 2020	FY 2021
Title: Next Generation Rotorcraft Transmission	-	1.098	1.393
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.			
FY 2020 Plans: Variable speed transmission hardware fabrication and full scale transmission stand testing will be completed. Integration into ground test aircraft will be initiated.			
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.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	1.098	1.393

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 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AJ5: Digital Vehicle Management & Control Advanced Tech</i>	-	0.000	1.153	6.761	-	6.761	6.897	8.034	9.112	9.113	0.000	41.070

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology, Project:
 * 313 Adv Rotarywing Veh 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 2019	FY 2020	FY 2021
Title: Digital Vehicle Management and Control	-	1.153	-
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.			
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will complete North Atlantic Treaty Organization (NATO) working group research on rotorcraft simulation modeling fidelity assessment and improvement and publish lessons learned. Will develop unmanned FVL handling quality testing methods and requirements for flying in mission-relevant turbulent environments; Will validate and publish new response types for high-speed and mission task elements for a FVL design standard. Will analyze Joint Multi-Role Technology Demonstrator (JMR-TD) handling qualities flight test results for validation of simulation models and inclusion of new JMR-relevant requirements in a FVL design standard.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 to the Adaptive and Resilient Tactical Autonomy, Controls, and Structures (ARTACS) Adv Tech effort in this Project.</p>				
<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: Will 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. Will 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. Will 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 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from 0603465A (Future Vertical Lift Advanced Technology) / AM3 (Aircraft and Aircrew Protection), and the Digital Vehicle Management and Control effort in this Project.</p>		-	-	6.761
Accomplishments/Planned Programs Subtotals		-	1.153	6.761
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AJ7: Advanced Rotors Advanced Technology</i>	-	0.000	2.500	2.498	-	2.498	2.508	2.558	2.575	2.601	0.000	15.240

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology, Project:
 * 313 Adv Rotarywing Veh Tech

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)

Title: Advanced Rotors Technology	FY 2019	FY 2020		FY 2021
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.	-	2.500		2.498
FY 2020 Plans:				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Will conduct advanced low drag rotor wind tunnel testing. Will conduct individual blade control actuator testing. Will conduct design and testing of robust, efficient UAS rotors and propulsion systems for FUAS platforms.</p> <p><i>FY 2021 Plans:</i> Will conduct detailed design of high speed, highly efficient rotor system for FUAS platforms. Will complete component technology bench testing. Will conduct planning for fabrication of demonstration hardware.</p> <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>			
Accomplishments/Planned Programs Subtotals	-	2.500	2.498

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AJ9: Integ Mission Equip for Vert Lift Systems Adv Tech</i>	-	0.000	15.820	22.381	-	22.381	24.360	25.996	21.569	21.787	0.000	131.913

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology
 * Project 313 Adv Rotarywing Veh Tech

A. Mission Description and Budget Item Justification

This Project develops and demonstrates a mission systems architecture to support Future Vertical Lift (FVL) through utilization of a reconfigurable and flexible tiered architectural approach.

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 2019	FY 2020	FY 2021
Title: Integrated Mission Equipment for Vertical Lift Systems	-	15.820	22.381
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.			
FY 2020 Plans: Publish baseline requirements for both a representative mission package and instrumented architecture laboratory. Document detailed design of the Architecture Verification Environment (AVE). Instantiate initial AVE capabilities which will include architecture requirements validation processes, methods and tools for validating Future Attack Reconnaissance Aircraft (FARA)			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>and Future Long Range Assault Aircraft (FLRAA) architecture requirements. Establish AVE experimental framework to collect the body of knowledge necessary to effectively verify architecture implementations against specifications. Conduct initial development and testing of the IME software infrastructure to support representative mission packages. Document the Digital Backbone (DBB) specification for power, mechanical, thermal, hardware, software and data. Publish specific guidance documentation to assist the Government and Industry partners in the development of open architecture capabilities. Create a model based specification for documentation of the flying testbed mission system.</p> <p>FY 2021 Plans: Will develop the initial verification process and conduct experiments for the Architecture Verification Environment (AVE). Will 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. Will 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. Will complete Mission System Flying Testbed (FTB) requirements and design, identifying initial demonstration mission systems, acquiring FTB components and beginning aircraft modifications.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding increase is required to begin laboratory testing of candidate digital backbone technologies, and acquisition of core FTB components.</p>				
Accomplishments/Planned Programs Subtotals		-	15.820	22.381
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK3: <i>Aviation Survivability Advanced Technology</i>	-	0.000	20.836	11.370	-	11.370	15.806	20.243	20.701	20.703	0.000	109.659

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology, Project:
 * 313 Adv Rotarywing Veh Tech
 PE 0603270A Electronic Warfare Technology, Project:
 * K16 Non-Commo Ecm Tech Dem
 PE 0603710A Night Vision Advanced Technology, Project:
 * K86 Night Vision, Abn Sys

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 2019	FY 2020	FY 2021
Title: Survivability Against Integrated Networked Threats	-	4.802	3.720
Description: This effort increases rotorcraft survivability by reducing platform signatures, providing the means to more efficiently counter enemy detection and tracking systems			
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will mature and demonstrate Aircraft Survivability Correlator algorithms. Will improve and validate own-ship and team based survivability behaviors. Will mature and demonstrate holistic survivability technologies to enhanced FVL survivability.</p> <p>FY 2021 Plans: Will continue the development and refinement of Aircraft Survivability Correlator algorithms. Will develop and refine own-ship and team-based survivability behaviors. Will integrate holistic technologies to enhance Future Vertical Lift survivability. Will integrate components in preparation for System Integration Laboratory experimentations.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Digital Dual Use Sensors (DDUS)</p> <p>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.</p> <p>FY 2020 Plans: Will mature sensor optics; will complete fabrication of focal plane array (FPA) packages into cooled assemblies. Will integrate components into proof-of principle camera system; will demonstrate camera systems in laboratory and airborne field environments; will validate sensor to enable both pilotage and aircraft survivability functions. Will complete final technical report capturing lessons learned and recommendations.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This Effort ends in FY 2020.</p>		-	9.500	-
<p>Title: Multispectral Threat Detection and Countermeasure Technologies</p> <p>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.</p> <p>FY 2020 Plans: Will continue sensor system development and perform unit testing on sensor components; will document and publish sensor component and subsystem performance results; will collect and analyze clutter and threat data in a relevant environment with sensor subsystem and incorporate that data into modeling and simulation infrastructure; will perform an assessment of the sensor subsystem architectural approaches and the viability of each approach to operate against unknown/unexploited and emerging threats; will demonstrate agile radio frequency (RF) components in a relevant environment and assess the viability of meeting RF</p>		-	6.534	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
countermeasure requirements using those components; will characterize RF components and produce models for modeling and simulation integration. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 to the efforts Cognitive Countermeasures Maturation and Demonstration, and EW Air Sensors / CM efforts within this same Project to better address technological challenges.				
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: Will mature electronic countermeasure module and measure initial performance; will demonstrate countermeasure components to detect, identify, and locate threats; will mature supporting RF electronics and components for electronic countermeasure demonstration. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Multispectral Threat Detection and Countermeasure Technologies effort in this Project.		-	-	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: Will mature hardware and supporting components for demonstration; will complete proof-of-concept hardware; will perform data collection with hardware to verify functionality. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Multispectral Threat Detection and Countermeasure Technologies effort in this Project.		-	-	4.606
Title: UAS Survivability Demonstration 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		-	-	1.044

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
environment with minimal impacts to aircraft performance. This work supports Future Vertical Lift and Advanced Unmanned Aircraft Systems.			
<i>FY 2021 Plans:</i> Will develop UAS Survivability behaviors and mission profiles. Will develop UAS susceptibility and electromagnetic vulnerability reduction technologies.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding realigned in FY21 from PE 0602148A (Future Vertical Lift Technology) / AK1 (UAS Survivability Technology).			
Accomplishments/Planned Programs Subtotals	-	20.836	11.370

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK5: <i>Multi-Role Small Guided Missile Advanced Tech</i>	-	0.000	2.426	2.997	-	2.997	10.406	26.621	24.524	24.651	0.000	91.625

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology, Project:
 * 704 Advanced Missile Demo

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)

Title: Modular Missile Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	2.426	-
FY 2020 Plans: Will complete the integration of modular missile technology subsystems into the guided forward firing missile configuration and perform laboratory testing and simulation evaluations. Will demonstrate in a ground-launched flight test series, which includes			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
guidance and control performance of the guided forward firing missile configuration, payload, guidance electronics unit, control actuation subsystem, propulsion subsystem and subsystem interface bus. FY 2020 to FY 2021 Increase/Decrease Statement: This effort ends in FY20 as planned.				
Title: Single Multi-Mission Attack Missile 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. FY 2021 Plans: Will 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. FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from PE 0603464A (Long Range Precision Fires Advanced Technology) / AH3 (Single Multi-mission Attack Missile Adv Tech).		-	-	2.997
Accomplishments/Planned Programs Subtotals		-	2.426	2.997
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AK7: Adv Rotorcraft Armaments Protection Sys Adv Tech</i>	-	0.000	3.139	6.344	-	6.344	10.671	9.361	2.997	0.000	0.000	32.512

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603004A (Weapons and Munitions Advanced Technology) / 232 (Advanced Lethality & Survivability Demo)

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 2019	FY 2020	FY 2021
Title: Aviation Armament System Technologies	-	3.139	-
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.			
FY 2020 Plans: Will improve performance of medium caliber ammunition in 20mm and 30mm for a multi-role armaments solution on the Future Vertical Lift aircraft system. Effort will optimize lightweight 20mm and 30mm munitions for air combat systems and provide multi-purpose fuze and warhead functionalities.			
FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 to the efforts ARAPS-FARA and ARAPS-Dispenser in this Project.			
Title: ARAPS-FARA	-	-	5.744

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>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.</p> <p>FY 2021 Plans: Will mature and demonstrate a 20mm medium caliber armament system for integration onto Future Vertical Lift. Will demonstrate a novel 20mm multi-purpose munition with advanced capabilities versus current air launched munitions.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Aviation Armament System Technologies effort in this Project.</p>			
<p>Title: ARAPS-Dispenser</p> <p>Description: This effort matures and demonstrates 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.</p> <p>FY 2021 Plans: Will mature a countermeasure dispenser solution that provides increased survivability for current and future aviation platforms.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 from the Aviation Armament System Technologies effort in this Project.</p>	-	-	0.600
Accomplishments/Planned Programs Subtotals	-	3.139	6.344

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AK8: Air Launched Effects Advanced Technology</i>	-	0.000	3.215	29.419	-	29.419	29.262	28.144	27.157	27.159	0.000	144.356

Note

This Project is not a new start in Fiscal Year (FY) 2020. In FY19, Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / AK8 (Air Launched Effects Advanced Technology) was previously funded within PE 0603003A (Aviation Advanced Technology) / 313 (Adv Rotarywing Veh Tech).

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)

Title: Air Launched Effects	FY 2019	FY 2020		FY 2021
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.	-	3.215		29.419
FY 2020 Plans:				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Will demonstrate the ability to launch a UAS from a manned rotorcraft at tactical altitudes, and to control the UAS from an onboard crew station; integrate reconnaissance, surveillance, targeting, and communications relay payloads into the UAS; evaluate the mission effectiveness of organic UAS assets in support of the manned aircraft's mission.</p> <p>FY 2021 Plans: Will 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 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. Will develop and integrate advanced autonomy algorithms to decrease operator workload.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY21 funding increase is due to realignment of PE 0603465A (Future Vertical Lift Advanced Technology) / AI6 (Next Gen Tactical UAS TD) effort in accordance with FVL Cross Functional Team (CFT) guidance/re-prioritization.</p>			
Accomplishments/Planned Programs Subtotals	-	3.215	29.419

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL1: <i>Adv Teaming for Tactical Aviation Oper Adv Tech</i>	-	0.000	20.964	41.328	-	41.328	40.580	40.284	46.770	46.774	0.000	236.700

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology
 * Project 436 Rotarywing MEP Integ
 PE 0603710A Night Vision Advanced Technology
 * Project K86 Night Vision, Abn Sys

A. Mission Description and Budget Item Justification

This Project develops, demonstrates and drafts frameworks for certifiable autonomy of 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 2019	FY 2020	FY 2021
Title: Advanced Teaming Demonstration	-	20.964	33.543
Description: Develop and demonstrate teaming behaviors and autonomous decision making for mixed FVL and FUAS platform formations in combined arms operations that are beyond 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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will mature and integrate advanced teaming technologies into mission systems packages for test and evaluation; simulate autonomous teaming behaviors and operations in foundational mission based vignettes; draft frameworks for certifiable autonomy.</p> <p>FY 2021 Plans: Will 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.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding increase is required to integrate hardware and software into mission systems packages for demonstration and evaluation of modular open systems based frameworks for team autonomy.</p>				
<p>Title: Sensors / Multi-Function Imagers for Future Aviation</p> <p>Description: Mature and demonstrate multi-function sensing system concepts suitable for both manned and unmanned aviation platforms. The goal is to enable tactical operations in complex environments (e.g. high threat, degraded visuals, and urban) while reducing system cost/complexity through the use of sensing modules suitable for multiple tactical applications. Effort includes system-level integration and demonstration of state-of-the-art digital readout (DROIC), dual band infrared imaging technology.</p> <p>FY 2021 Plans: Will 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. Will demonstrate the suitability of the sensor module to support both pilotage and threat warning applications. Will 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 2020 to FY 2021 Increase/Decrease Statement: FY21 funding increase required for maturation effort of sensors and electronics to meet Advanced Teaming for Tactical Aviation Operations? needs and is realigned from the Advanced Teaming Demonstration in this project.</p>		-	-	7.785
Accomplishments/Planned Programs Subtotals		-	20.964	41.328
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 Adv Tech</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AL3: HPC for Rotorcraft Applications Adv Tech</i>	-	0.000	4.958	5.046	-	5.046	5.136	5.301	5.360	5.414	0.000	31.215

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603734A (Military Engineering Advanced Technology) / T08 (Combat Eng Systems)

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 2019	FY 2020	FY 2021
Title: Engineered Resilient Systems for Future Vertical Lift	-	4.958	-
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.			
FY 2020 Plans: Support Future Vertical Lift through the advancement of workflow automation processes for rotorcraft platforms; integrate mission effectiveness into the resulting trade spaces; will leverage emerging data analytics techniques and machine learning algorithms			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
to optimize insight prior to acquisition decision points; and mature novel methodologies that incorporate the use of high-fidelity, physics-based simulations to enable multi-disciplinary design and optimization.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> This effort ends in FY20 and is realigned to Engineered Resilient Systems (ERS) Capabilities for Army Aviation within this Project.			
<i>Title:</i> Engineered Resilient Systems (ERS) for Army Aviation	-	-	5.046
<i>Description:</i> 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.			
<i>FY 2021 Plans:</i> Will optimize the execution of high-fidelity computational modeling of candidate Future Attack Reconnaissance Aircraft (FARA) platforms during the next phase of FARA down-selection. Will improve the engineering analysis of FARA systems through the inclusion of mission effectiveness modeling and increased simulation fidelity. Will demonstrate the use of physics-informed machine learning techniques to increase the accuracy of design software for future FVL lines of effort.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding for this effort realigned within the scope of this project in FY21 from Engineered Resilient Systems for Future Vertical Lift effort within this Project.			
Accomplishments/Planned Programs Subtotals	-	4.958	5.046

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

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AL6: Degraded Vis Environ Mitigation (DVE-M) Adv Tech</i>	-	0.000	29.151	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	29.151

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 eliminated.

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)

Title: Degraded Visual Environment Mitigation (DVE-M)	FY 2019	FY 2020	FY 2021
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.	-	16.855	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Will develop and demonstrate integrated cutting-edge sensors, advanced flight controls, and refined cueing schemes to provide the ability to maintain terrain and obstacle situational awareness during Degraded Visual Environments (DVEs) such as aircraft-induced (brown-out & white-out) and environmentally-induced (fog, rain, snow etc.). Will flight test a mission adaptive autonomy system adapted for use on a partial-authority helicopter. Efforts include flight trials in various climates and environments which also presents an opportunity for DoD, North Atlantic Treaty Organization (NATO) nations, industry, and academia to participate with their own assets to foster information exchange and collaboration.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort ends in FY20.</p>				
<p>Title: Sensors for DVE-M</p> <p>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.</p> <p>FY 2020 Plans: Will complete initial flight testing and optimize DVE sensor subsystem; will integrate sensor subsystem with cueing and flight guidance/control subsystems onto single testbed aircraft. Will demonstrate combined DVE system in three DVEs. Will complete final technical report capturing lessons learned and recommendations.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: This effort ends in FY20.</p>		-	12.296	-
Accomplishments/Planned Programs Subtotals		-	29.151	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AL7: Full Spectrum Targeting Advanced Technology</i>	-	0.000	5.425	9.907	-	9.907	10.115	10.317	10.432	10.537	0.000	56.733

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603710A Night Vision Advanced Technology
 * Project K86 Night Vision, Abn Sys

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)

Title: Full Spectrum Targeting	FY 2019	FY 2020	FY 2021
Description: This effort will mature and demonstrate key targeting sensor system and automation (i.e. Artificial Intelligence / Machine Learning (AI/ML)) technologies essential 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.	-	5.425	9.907
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
<p>Will mature laser imaging and automation components; will collect broadband and multi / hyperspectral data and optimize for increased automation; will complete initial payload design consistent with FVL size, weight, and power constraints.</p> <p><i>FY 2021 Plans:</i> Will exploit broadband and multi/hyperspectral data from prior year collection to mature and demonstrate novel automated processing approaches for target detection, recognition, and identification. Will validate performance of broadband and multi/hyperspectral automated processing algorithms. Will complete initial data processing architecture design and demonstrate functionality and performance. Will optimize and complete packaging of a high performance dual band megapixel infrared imaging sensor for the integrated targeting system demonstrator.</p> <p><i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> The funding increase is required for demonstration of novel automated processing approaches for target detection, recognition and identification.</p>			
Accomplishments/Planned Programs Subtotals	-	5.425	9.907

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL9: <i>Holistic Sit Awareness and Dec Making Adv Tech</i>	-	0.000	0.000	4.995	-	4.995	17.783	31.670	19.908	20.108	0.000	94.464

Note

This project transitions technologies from 0601248A AL8 Holistic Situational Awareness and Decision Making Technology project for further maturation and demonstration.

A. Mission Description and Budget Item Justification

This Project focuses on the development and demonstration of 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 2019	FY 2020	FY 2021
Title: Holistic Situational Awareness and Decision Making	-	-	4.995
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: Will demonstrate the decision-aiding algorithms, next-generation crew stations, and architectures needed to operate in complex and high-threat environments. Will 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 degraded visual environments, aircraft system management, GPS-denied operations, air-launched effects, blue force tracking, and communications.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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) AL9 / <i>Holistic Sit Awareness and Dec Making Adv Tech</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Planned technology transitions from 0601248A (Future Vertical Lift Technology) Project AL8 (Holistic Situational Awareness and Decision Making Technology).			
Accomplishments/Planned Programs Subtotals	-	-	4.995

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AM3: Aircraft and Aircrew Protection Advanced Tech</i>	-	0.000	4.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.548

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
 Program Element (PE) 0603003A Aviation Advanced Technology:
 * Project 313 Adv Rotarywing Veh Tech

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)

A. Mission Description and Budget Item Justification

This Project demonstrates 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.

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)

Title: Aircraft and Aircrew Protection	FY 2019	FY 2020	FY 2021
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.	-	4.548	-
FY 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
Will mature and demonstrate integrated, advanced structural assemblies that enable FVL and FUAS platform improved crashworthiness, damage tolerance, weight efficiency, sustainment, and survivability.				
FY 2020 to FY 2021 Increase/Decrease Statement: This effort is realigned in FY21 to the PE 0603465A (Future Vertical Lift Advanced Technology) Project AJ5 (Digital Vehicle Management & Control Advanced Tech).				
Accomplishments/Planned Programs Subtotals		-	4.548	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>AM5: Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech</i>	-	0.000	0.000	1.998	-	1.998	3.537	5.348	5.391	5.391	0.000	21.665

Note

This project matures technologies transitioned from Program Element (PE) 0602148A
 * Project AM4 Opt Energy Stg & Therm Mgmt for FVL Survivability.

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 algorithms 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 2019	FY 2020	FY 2021
Title: Optimized Energy for C5ISR Platforms Advanced Technology	-	-	1.998
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: Will improve management strategies for loads based on SWaP requirements and aircraft platform constraints which include architectures and intelligent control variants. Will 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. Will optimize thermal management technologies to mitigate waste heat			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
generated from inefficiencies in power conversion. Will demonstrate hybrid energy storage technologies to support cyclic loads such as hybrid batteries or ultra-capacitor technology. Will mature intelligent controls for platform-integrated power systems. <i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	-	1.998

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

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 Adv Tech (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BP8: <i>Future Vertical Lift Air Platform Adv Tech (CA)</i>	-	0.000	35.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

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 2019	FY 2020
Congressional Add: Joint Tactical Aerial Resupply Vehicle	-	6.000
FY 2020 Plans: Joint Tactical Aerial Resupply Vehicle		
Congressional Add: Advanced Helicopter Seating System	-	5.000
FY 2020 Plans: Advanced Helicopter Seating System		
Congressional Add: Adhesive Technology	-	3.000
FY 2020 Plans: Adhesive Technology		
Congressional Add: Helicopter Emergency Oil Systems	-	2.000
FY 2020 Plans: Helicopter Emergency Oil Systems		
Congressional Add: UAV Fuel Systems Enhancements	-	2.000
FY 2020 Plans: UAV Fuel Systems Enhancements		
Congressional Add: Surface Tolerant Advanced Adhesives	-	5.000
FY 2020 Plans: Surface Tolerant Advanced Adhesives		
Congressional Add: Ferrium Steels for Improved Drive Systems	-	4.000
FY 2020 Plans: Ferrium Steels for Improved Drive Systems		
Congressional Add: Stretch Broken Composite Material Forms	-	8.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 Adv Tech (CA)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2020 Plans:</i> Stretch Broken Composite Material Forms		
Congressional Adds Subtotals	-	35.000

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>CA8: Adv Rotocraft Armaments Protection Sys</i>	-	0.000	0.000	0.999	-	0.999	1.249	2.797	9.298	12.296	0.000	26.639

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
 * Project AK6 Adv Rotorcraft Armaments Protection Sys

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 2019	FY 2020	FY 2021
Title: Advanced Rotorcraft Armanents Protection System-Future Long Range Assault Aircraft	-	-	0.999
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: Will mature a small caliber remote weapon system for integration on FVL. Will demonstrate the increased capability of a remotely operated, stabilized armament system versus current aviation armament solutions.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	-	0.999

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>CC4: FVL Radar Advanced Technologies</i>	-	0.000	0.000	3.329	-	3.329	4.164	4.960	5.157	5.157	0.000	22.767

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)

Title: Multi-mission Airborne Radar	FY 2019	FY 2020	FY 2021
Description: Advanced Digital radio frequency (RF) processing integration with final demonstration subsystem and system level radar hardware and software designs.	-	-	3.329
FY 2021 Plans: Will analyze radar modes and operations and conduct detailed system design review. Will perform full processing chain modeling and simulation to validate the models. Will optimize wide-band tuning applications for RF systems and exercise third party implementation through multi-function demonstrations.			
FY 2020 to FY 2021 Increase/Decrease Statement: In FY21, funding realigned from PE 0603772A / Advanced Tactical Computer Science and Sensor Technology, project 243 Sensors And Signals Processing.			
Accomplishments/Planned Programs Subtotals	-	-	3.329

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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>

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	82.113	58.130	-	58.130	53.396	56.188	46.280	46.600	0.000	342.707
AC8: Low Cost Extended Range Air Defense Adv Tech	-	0.000	21.050	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.050
AD1: High Energy Laser Tactical Vehicle Demo Adv Tech	-	0.000	29.914	27.241	-	27.241	27.680	0.000	0.000	0.000	0.000	84.835
AD4: Maneuver Air Defense Advanced Technology	-	0.000	0.000	20.131	-	20.131	19.981	22.670	12.381	12.382	0.000	87.545
AD6: Next Generation Fires Radar Advanced Technology	-	0.000	7.729	6.958	-	6.958	0.000	0.000	0.000	0.000	0.000	14.687
AE1: Close Combat High Energy Laser Advanced Technology	-	0.000	0.000	2.498	-	2.498	2.698	31.320	31.671	31.990	0.000	100.177
AE3: Unconventional Countermeasures-Survivability ATech	-	0.000	1.920	1.302	-	1.302	3.037	2.198	2.228	2.228	0.000	12.913
BN7: Weapons Components Adv Technology (CA)	-	0.000	21.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.500

Note

In Fiscal Year (FY) 2020 this Program Element (PE) continued efforts previously funded in the following PEs:

- * PE 0603004A Weapons and Munitions Advanced Technology
- * PE 0603313A Missile and Rocket Advanced Technology
- * PE 0603734A Military Engineering Advanced Technology
- * PE 0603772A Advanced Tactical Computer Science and Sensor Technology

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).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

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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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).

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	60.613	60.980	-	60.980
Current President's Budget	0.000	82.113	58.130	-	58.130
Total Adjustments	0.000	21.500	-2.850	-	-2.850
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	21.500			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-2.850	-	-2.850

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 Subtotals for Project: BN7

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	-	2.000
	-	2.500
	-	7.000
	-	10.000
Congressional Add Subtotals for Project: BN7	-	21.500
Congressional Add Totals for all Projects	-	21.500

Change Summary Explanation

FY21 increase due to congressional adds of \$21.000 Million

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AC8: Low Cost Extended Range Air Defense Adv Tech	-	0.000	21.050	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.050

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
 Program Element (PE) 0603313A Missile and Rocket Advanced Technology
 * Project 704 Advanced Missile Demo

In FY21 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 2019	FY 2020	FY 2021
Title: Low Cost Extended Range Air Defense (LowER AD) Advanced Technology	-	21.050	-
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			
FY 2020 Plans: Will integrate motor, airframe, mission computer, power supply, telemetry, and data link as an interceptor for demonstrating initial capability in two Ballistic Test Vehicle (BTV) flight tests. These tests will provide verification of component operation and aerodynamic parameters in a relevant environment. The control actuation system (CAS) and inertial measurement unit (IMU) will be integrated with the interceptor to demonstrate control authority and aerodynamic characterization in a Control Test Vehicle			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
(CTV). Will continue maturation of guidance and fuzing algorithms, and verify Guidance Electronic Unit (GEU) performance from pre-flight predictions for CTV and guided test vehicle (GTV) in the Hardware-in the-Loop (HWIL). FY 2020 to FY 2021 Increase/Decrease Statement: FY21 funding realigned into PE 0603466A (Air and Missile Defense Advanced Technology) / AD4 (Maneuver Air Defense Technology) to focus development of seeker and guidance technology in and accelerate demonstration in support of Maneuver-Short Range Air Defense capabilities.				
Accomplishments/Planned Programs Subtotals		-	21.050	-
C. Other Program Funding Summary (\$ in Millions) N/A				
Remarks				
D. Acquisition Strategy N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AD1: High Energy Laser Tactical Vehicle Demo Adv Tech	-	0.000	29.914	27.241	-	27.241	27.680	0.000	0.000	0.000	0.000	84.835

Note

In Fiscal Year 2020 (FY20) this effort was realigned from:
 Program Element (PE) 0603004A Weapons and Munitions Advanced Technology
 * Project L96 High Energy Laser Technology Demo

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)

Title: High Energy Laser Tactical Vehicle Demonstrator (HEL TVD) Advanced Technology	FY 2019	FY 2020	FY 2021
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.	-	29.914	27.241
FY 2020 Plans: Will begin integration and laboratory checkout of the HEL TVD subsystems. Will integrate the electrical and thermal management subsystems into the HEL TVD platform, a family of medium tactical vehicles (FMTV). Will begin integration of system software to			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
control all subsystems that will validate software functionality. Will begin test range coordination for HEL TVD FY22 demonstration to include range and non-range truth data sensors and purchase first RAM and UAS targets for system demonstrations and knowledge points. FY 2021 Plans: Will begin integration and checkout of the HEL TVD subsystems. Will integrate the electrical and thermal management subsystems into the HEL TVD platform. Will begin integration of system software in preparation for FY22 HEL TVD demonstration. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort			
Accomplishments/Planned Programs Subtotals	-	29.914	27.241

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AD4: <i>Maneuver Air Defense Advanced Technology</i>	-	0.000	0.000	20.131	-	20.131	19.981	22.670	12.381	12.382	0.000	87.545

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 2019	FY 2020	FY 2021
Title: Maneuver Air Defense Advanced Technology	-	-	20.131
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: Will integrate a Guidance Electronics Unit (GEU) for missile hardware-in-the-loop (HWIL) maturation prior to integration with a testbed missile. Will integrate GEU with a radome, airframe, motor, control actuation system for flight testing and demonstration.			
FY 2020 to FY 2021 Increase/Decrease Statement: Funding realigned from Project AC8 (Low Cost Extended Range Air Defense Adv Tech) in this PE in FY21 to accelerate Maneuver Air Defense Technology TRL6 demonstration from FY24 to FY23.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Integrates a Guidance Electronics Unit for Missile Hardware-in-the-loop maturation prior to integration with a testbed missile.			
Accomplishments/Planned Programs Subtotals	-	-	20.131

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AD6: Next Generation Fires Radar Advanced Technology	-	0.000	7.729	6.958	-	6.958	0.000	0.000	0.000	0.000	0.000	14.687

Note
 In Fiscal Year (FY) 2020 this Project was realigned from:
 Program Element (PE) 0603772A Advanced Tactical Computer Science and Sensor Technology:
 * Project 243 Sensors and Signals Processing

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)

Title: Next Generation Fires Radar Advanced Technology	FY 2019	FY 2020	FY 2021
<p>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.</p> <p>FY 2020 Plans: Will demonstrate Fires Radar Open System Technology architecture and back- end processing on the first version of Digital Array Radar Technology as well as other front end antenna configurations, as available, to verify scalability and modularity; Leverage the mode development efforts in FY19 (multi-mission, target identification, and multi-static) to complete a Mode Development Kit (MDK) that will be used to mature the interfaces of the open architecture backend; Continue development of the modes from FY19 to improve performance and optimize the multi-mission capability for future Fires radars; and Demonstrate additional Fires radar</p>	-	7.378	6.958

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) AD6 / <i>Next Generation Fires Radar Advanced Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
technology on different class (medium and light-weight) systems to provide multi-mode and multi-mission capabilities relevant to current and future radar systems. FY 2021 Plans: Will 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; will complete the MDK to improve the performance and optimize the multi-mission capability of next generation Fires radar system; will conduct final demonstrations of Fires radar technologies that will provide multi-mode and multi-mission capabilities relevant to current and future radar systems. FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort				
Title: FY 2020 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.351	-
Accomplishments/Planned Programs Subtotals		-	7.729	6.958
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AE1: <i>Close Combat High Energy Laser Advanced Technology</i>	-	0.000	0.000	2.498	-	2.498	2.698	31.320	31.671	31.990	0.000	100.177

Note

Fiscal Year 2021 (FY21) increase is the result of a Transition from:
 Program Element (PE) 0602150A Air and Missile Defense Technology:
 * Project AD9 Close Combat High Energy Laser Technology

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).

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 2019	FY 2020	FY 2021
Title: Close Combat High Energy Laser Advanced Technology	-	-	2.498
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: Will continue developing and validating laser and beam control technologies with extremely low SWaP to integrate on a risk reduction platform. Will perform systems engineering analyses, including beam director, environmental, and laser power trade			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
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 2019	FY 2020	FY 2021
studies; conduct modeling and simulation to inform system performance objectives; perform HEL lethality effectiveness analysis and static and live-fire testing against designated threats and/or targets.			
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i> Funding change reflects planned life cycle of this effort			
Accomplishments/Planned Programs Subtotals	-	-	2.498

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AE3: <i>Unconventional Countermeasures-Survivability ATech</i>	-	0.000	1.920	1.302	-	1.302	3.037	2.198	2.228	2.228	0.000	12.913

Note

In Fiscal Year 2020 (FY20), this Project was realigned from:
 Program Element (PE) 0603734A Military Engineering Advanced Technology
 * Project T08 Combat Eng Systems

In Fiscal Year 2021 (FY21), 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.

Work in this Project complements PE 0602150A (Air and Missile Defense Technology) / Project AE2 (Unconventional Countermeasures Survivability 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 Engineer Research and Development Center (ERDC) and coordinated with the Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Development of Unconventional Countermeasures for Enhanced Survivability (DeUCES) Demonstrations	-	1.897	1.007
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 2020 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
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 2019	FY 2020	FY 2021
<p>Demonstrate novel tonedown techniques for critical fixed and semi-fixed assets to include novel application of commercial off the shelf materials.</p> <p>FY 2021 Plans: Will mature and demonstrate integrated unconventional countermeasure protection for fixed and semi-fixed Air and Missile Defense assets.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding decrease due to realignment to support higher priority Army S&T efforts.</p>				
<p>Title: Applications of Environmentally-Inspired Unconventional Countermeasures</p> <p>Description: This effort matures and demonstrates rapidly-deployable, eco-friendly materials with spectral signatures that alter or obscure underlying target spectral signatures.</p> <p>FY 2021 Plans: Will mature and demonstrate a robust countermeasure spectral feature selection to detect and compare spectral vegetation ranges essential for the performance of unconventional countermeasures.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding change reflects planned life cycle of this effort</p>		-	-	0.295
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.023	-
Accomplishments/Planned Programs Subtotals		-	1.920	1.302
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603466A / <i>Air and Missile Defense Advanced Technology</i>	Project (Number/Name) AE3 / <i>Unconventional Countermeasures- Survivability ATech</i>

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

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 Adv Technology (CA)
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BN7: Weapons Components Adv Technology (CA)	-	0.000	21.500	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	21.500

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 2019	FY 2020
Congressional Add: Advanced Explosion Resistant Window Systems	-	2.000
FY 2020 Plans: Advanced Explosion Resistant Window Systems		
Congressional Add: Silicon Carbide Power Electronics Packaging	-	2.500
FY 2020 Plans: Silicon Carbide Power Electronics Packaging		
Congressional Add: Enterprise Science and Technology Demonstration Prototyping	-	7.000
FY 2020 Plans: Enterprise Science and Technology Demonstration Prototyping		
Congressional Add: High-Energy Laser Development for All-Terrain Vehicles	-	10.000
FY 2020 Plans: High-Energy Laser Development for All-Terrain Vehicles		
Congressional Adds Subtotals	-	21.500

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603606A / <i>Landmine Warfare and Barrier Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	16.860	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.860
608: <i>Countermines & Bar Dev</i>	-	10.860	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.860
64C: <i>COUNTERMINE DEMONSTRATIONS (CA)</i>	-	6.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:

- * PE 0603118A Soldier Lethality Advanced Technology
- * PE 0603462A Next Generation Combat Vehicle Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates sensors, subsystems, and neutralization technologies that can be used by dismounted forces as well as ground and air platforms to detect, identify and mitigate the effects of landmines, improvised explosive devices, minefields, and other explosive hazards. This PE also conducts modeling and simulation activities to assess the effectiveness of detection and neutralization concepts. Project 608 (Countermines and Bar Dev) supports the maturation and demonstration of enabling component and subsystems for counter explosive hazards and countermines technologies in the areas of countermines and barrier development and Project 683 (Area Denial Sensors) funds efforts on area denial sensors.

Work in this PE is fully coordinated with PE 0602120A (Sensors and Electronic Survivability), PE 0602622A (Chemical, Smoke and Equipment Defeating Technology), PE 0602624A (Weapons and Munitions Technology), PE 0602712A (Countermines Systems), PE 0602784A (Military Engineering Technology), PE 0603004 (Weapons and Munitions Advances Technologies), PE 0603270 (Electronic Warfare Technology), and PE 0603710A (Night Vision Advanced Technology).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603606A / <i>Landmine Warfare and Barrier Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	17.097	0.000	0.000	-	0.000
Current President's Budget	16.860	0.000	0.000	-	0.000
Total Adjustments	-0.237	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.237	-			

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

Project: 64C: *COUNTERMINE DEMONSTRATIONS (CA)*

Congressional Add: *Program Increase - Multi-Sensor Drone Swarms for Explosive Hazard Detection*

Congressional Add Subtotals for Project: 64C

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	6.000	-
	6.000	-
	6.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603606A / <i>Landmine Warfare and Barrier Advanced Technology</i>	Project (Number/Name) 608 / <i>Countermine & Bar Dev</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
608: <i>Countermine & Bar Dev</i>	-	10.860	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.860

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project BC9 Adv Soldier Sensors/Displays AdvTech for Dismounts
 PE 0603462A Next Generation Combat Vehicle Advanced Technology:
 * Project BJ8 Detection of Explosive Hazards Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies for finding and neutralizing explosive hazards in varying vegetation, soil, and weather conditions both day and night. Activities include maturation and demonstration of modular, semi-autonomous, and autonomous air, ground, and Soldier borne technologies to enable standoff and close-in detection and neutralization of explosive threats. Efforts are supported by modeling and simulation assessments to define potential system effectiveness.

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

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

	FY 2019	FY 2020	FY 2021
Title: Autonomous Explosive Hazard Detection	10.860	-	-
Description: This effort demonstrates an integrated modular sensor and sensor data processing capability to enable remote and semi-autonomous detection of mines, other explosive hazards, and indicators of emplacement, such as command wires and initiation devices from a safe standoff distance using small unmanned ground and air platforms. This effort also matures and demonstrates explosive hazard (EH) detection technologies that can be adapted to address near-peer threats in multiple environments.			
Accomplishments/Planned Programs Subtotals	10.860	-	-

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

N/A

Remarks

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603606A / <i>Landmine Warfare and Barrier Advanced Technology</i>	Project (Number/Name) 608 / <i>Countermine & Bar Dev</i>

D. Acquisition Strategy
N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603606A / <i>Landmine Warfare and Barrier Advanced Technology</i>	Project (Number/Name) 64C / <i>COUNTERMINE DEMONSTRATIONS (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
64C: <i>COUNTERMINE DEMONSTRATIONS (CA)</i>	-	6.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Countermine Advanced Technology and Demonstrations.

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 United States Army Futures Command (AFC).

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

<u>B. Accomplishments/Planned Programs (\$ in Millions)</u>	FY 2019	FY 2020
<i>Congressional Add:</i> Program Increase - Multi-Sensor Drone Swarms for Explosive Hazard Detection	6.000	-
<i>FY 2019 Accomplishments:</i> Program Increase - Multi-Sensor Drone Swarms for Explosive Hazard Detection		
Congressional Adds Subtotals	6.000	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603607A / <i>Joint Service Small Arms Program</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	22.628	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	22.628
627: <i>Jt Svc Sa Prog (JSSAP)</i>	-	5.708	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.708
62D: <i>SMALL ARMS ADVANCED TECHNOLOGY DEV (CA)</i>	-	16.920	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.920

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PE:
 * PE 0603118A Soldier Lethality Advanced Technology

A. Mission Description and Budget Item Justification

This Program Element (PE) matures and demonstrates advanced technologies that provide greater lethality, target acquisition, fire control, and range at a significantly reduced weight. These technologies lighten the Soldier's load, provide improved battlefield mobility, and reduce logistics burden while maintaining or improving current levels of performance.

Efforts in this PE support the Army Science and Technology Lethality Portfolio.

In FY19, work in this PE was related to and fully integrated with the efforts funded in PE 0602623A (Joint Service Small Arms Program), PE 0602624A (Weapons and Munitions Technology) and PE 0602618A (Ballistic Technology). Beginning in FY20, work in this PE is related to, and fully coordinated with PE 0603118A (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. All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

The 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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603607A / <i>Joint Service Small Arms Program</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	22.799	0.000	0.000	-	0.000
Current President's Budget	22.628	0.000	0.000	-	0.000
Total Adjustments	-0.171	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.171	-			

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

Project: 62D: *SMALL ARMS ADVANCED TECHNOLOGY DEV (CA)*

Congressional Add: *Next Generation Squad Weapon - Carbine*

Congressional Add: *Next Generation Squad Weapon Ammunition*

Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun*

	FY 2019	FY 2020
	8.755	-
	8.120	-
	0.045	-
Congressional Add Subtotals for Project: 62D	16.920	-
Congressional Add Totals for all Projects	16.920	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603607A / Joint Service Small Arms Program				Project (Number/Name) 627 / Jt Svc Sa Prog (JSSAP)			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
627: Jt Svc Sa Prog (JSSAP)	-	5.708	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.708

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603118A Soldier Lethality Advanced Technology:
 * Project AY5 Soldier Squad Small Arms Armaments Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates advanced technologies that provide greater lethality, target acquisition, fire control, training effectiveness and range at a significantly reduced weight. These technologies lighten the Soldier's load, provide improved battlefield mobility, and reduce logistics burden while maintaining or improving current levels of performance.

Efforts in this Project support the Army Science and Technology Lethality Portfolio.

In FY19 work in this Project is related to, and fully integrated with the efforts funded in PE 0602623A (Joint Service Small Arms Program) and PE 0602624A (Weapons and Munitions Technology). Beginning in FY20, work in this PE is related to, and fully coordinated with PE 0603118A (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.

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

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

	FY 2019	FY 2020	FY 2021
Title: Volume Effects	1.900	-	-
Description: This effort addresses the maturation and demonstration of emerging small arms technologies from PE 0602623A efforts into current and next generation weapon systems to address Volume (sustained suppressive and lethal fires for area targets) capability gaps for improved effectiveness at extended ranges.			
Title: Precision Effects	1.008	-	-
Description: This effort focuses on the maturation and demonstration of emerging small arms technologies from PE 0602623A efforts into current and next generation weapon systems to address precision fire (Precision fire is support fire in the offense during the assault and engagement of targets to the maximum effective range of the weapon), and fire control capability gaps for improved accuracy at extended ranges.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603607A / <i>Joint Service Small Arms Program</i>	Project (Number/Name) 627 / <i>Jt Svc Sa Prog (JSSAP)</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Small Arms Systems Integration and Demo</p> <p>Description: This effort addresses the maturation and demonstration of small arms component technologies resulting from PE 0602623A efforts and applied into advanced small arms technologies as to inform the user requirement process, address operational capability gaps and transition mature components and technology concepts.</p>	1.450	-	-
<p>Title: Joint Service Small Arms Science and Technology Collaboration</p> <p>Description: This effort addresses the continued operations of the Joint Service Small Arms Program (JSSAP) office to coordinate and harmonize new Services' materiel requirements with potential joint applications, and to maintain awareness of the Services' efforts to improve Small Arms capabilities thus reducing duplication of ongoing and planned technology, acquisition and sustainment activities.</p>	1.350	-	-
Accomplishments/Planned Programs Subtotals	5.708	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603607A / Joint Service Small Arms Program				Project (Number/Name) 62D / SMALL ARMS ADVANCED TECHNOLOGY DEV (CA)			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
62D: SMALL ARMS ADVANCED TECHNOLOGY DEV (CA)	-	16.920	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.920

A. Mission Description and Budget Item Justification

Congressional Interest FY 2019 Program Increase for Soldier Lethality.

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

	FY 2019	FY 2020
Congressional Add: Next Generation Squad Weapon - Carbine	8.755	-
FY 2019 Accomplishments: Next Generation Squad Weapon - Carbine		
Congressional Add: Next Generation Squad Weapon Ammunition	8.120	-
FY 2019 Accomplishments: Next Generation Squad Weapon Ammunition		
Congressional Add: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.045	-
FY 2019 Accomplishments: FY 2018 NDAA SEC 825 MDAP Cost Overrun		
Congressional Adds Subtotals	16.920	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	69.094	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	69.094
K70: <i>Night Vision Adv Tech</i>	-	41.406	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	41.406
K86: <i>Night Vision, Abn Sys</i>	-	27.688	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.688

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:

- * PE 0603118A Soldier Lethality Advanced Technology
- * PE 0603462A Next Generation Combat Vehicle Advanced Technology
- * PE 0603463A Network C3I Advanced Technology
- * PE 0603465A Future Vertical Lift Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates sensor technologies that increase Warfighter situational understanding, survivability, and lethality by providing sensor capabilities to acquire and engage targets at longer ranges in complex environments and operational conditions (e.g. day/night, obscured, smoke, adverse weather, and other degraded visual environments). Project K70 pursues technologies that provide our Warfighters with a Common Operating Picture (COP) to enable increased situational understanding and combat overmatch. Specific areas of maturation and demonstration include technologies that integrate disparate sensor architectures, perform multispectral aided target detection (AiTD), enable passive long range target identification (ID), improve day/night visualization systems, allow rapid wire area search, and facilitate augmented reality. Project K86 matures and validates airborne platform sensors and algorithms designed to detect targets (vehicles and personnel) in camouflage, concealment, and deception. This Project provides pilotage and situational understanding imagery to multiple pilots/crew members independently to enhanced operations in day/night/adverse weather conditions.

Work in this PE is fully coordinated with efforts in PE 0602120A (Sensors and Electronic Survivability), PE 0602270A (Electronic Warfare Technology), PE 0602709A (Night Vision Technology), PE 0602712A (Countermeasure Systems), PE 0603001A (Warfighter Advanced Technology), PE 0602211A (Aviation Technology), PE 0603003A (Aviation Advanced Technology), PE 0603005A (Combat Vehicle and Automotive Advanced Technology), PE 0603606A (Landmine Warfare and Barrier Advanced Technology), PE 0603774A (Night Vision Systems Advanced Development) and PE 0604710A (Night Vision Systems Engineering Development).

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

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603710A / <i>Night Vision Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	61.313	0.000	0.000	-	0.000
Current President's Budget	69.094	0.000	0.000	-	0.000
Total Adjustments	7.781	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	9.700	-			
• SBIR/STTR Transfer	-1.919	-			

Change Summary Explanation

FY19 increase related to \$9.700 million reprogramming.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>				Project (Number/Name) K70 / <i>Night Vision Adv Tech</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>K70: Night Vision Adv Tech</i>	-	41.406	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	41.406

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology:
 * Project AQ5 Sensor CE-Integrated Sensor Architecture Adv Tech
 PE 0603118A Soldier Lethality Advanced Technology:
 * Project AY7 Small Arms Fire Control Advanced Technology
 * Project BC9 Adv Soldier Sensors/Displays AdvTech for Dismounts
 PE 0603462A Next Generation Combat Vehicle Advanced Technology:
 * Project BG1 Sensors for Auto Oper and Survivability Adv Tech
 * Project BI3 Sensor Protection Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates high-performance sensor technologies and architectures that enhance situational understanding, increase target detection and identification ranges, reduce target acquisition (TA) timelines, enable threat detection and mitigation, and support operations in degraded environments against threats that are partially obscured by terrain, weather, or other features. This Project provides improved capabilities and Common Operating Picture (COP) for mounted and dismounted Soldiers and tactical vehicles.

FY20 realignments are due to financial restructuring in support of 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 (U.S.) Army Futures Command (AFC).

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

Title: Sensor Interoperability	FY 2019	FY 2020	FY 2021
Description: This effort matures and demonstrates an interoperability sensor architecture that allows a system to dynamically discover and leverage other systems on a network without any specific or prior knowledge. 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.	2.904	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>	Project (Number/Name) K70 / <i>Night Vision Adv Tech</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Ground Based Sensors and Integration for Degraded Visual Environments (DVE)</p> <p>Description: This effort provides uncooled infrared (UCIR) sensor technologies to improve survivability through increased Situational Awareness (SA) in all conditions and environments, to include DVE, for manned and unmanned ground vehicle systems. Current uncooled IR requires improvement in sensitivity and development of signal processing techniques to penetrate obscurants. Integration of improved sensors, signal processing algorithms, and data fusion will maintain mission capabilities in DVE (e.g. smoke, dust, fog). Demonstration of scalable, multi-functional (360 degree SA, Hostile Fire Detection (HFD), Aided Driving), low cost SA systems with in-vehicle displays that can be tailored to the ground platform and mission requirements will bring timely and useful information to the vehicle crew and squad.</p>		7.599	-	-
<p>Title: Soldier Maneuver and Lethality Sensors</p> <p>Description: This effort matures and demonstrates dismounted Soldier capabilities that improve Soldier mobility, maneuver, situational understanding, threat detection, targeting, and lethality. Innovative technologies for Soldier weapon or head mounted sensors, head mounted displays, and tactical lasers will be provided to users to gain feedback about performance and utility. The technologies provided through this effort address human factors/human dimension and provide lower weight, reduced cost, and improved performance for Soldier based sensor systems. In FY 2019, work in this effort are realigned to support the Army science and technology (S&T) priorities as identified at the December 2016 S&T Army Requirements Oversight Council by the Chief of Staff of the Army.</p>		3.808	-	-
<p>Title: Augmented Reality for Tactical Operations</p> <p>Description: This effort will mature and demonstrate an integrated mounted and dismounted tactical Augmented Reality (AR) capability that provides a Common Operating Picture (COP) for mounted and dismounted elements, increased maneuverability and survivability, and enhanced situational understanding by integrating sensor imagery, geo-location information, accurate real time Situational Understanding (SU) and command and control information for all warfighter operational environments.</p>		2.904	-	-
<p>Title: New Long Range Advanced Scout Surveillance System (LRAS3)</p> <p>Description: This effort matures and demonstrates sensor technologies that provide reconnaissance crews the ability to rapidly detect, identify, and respond to hybrid threats beyond their current tactical capability to include integration of third-generation forward looking infrared (FLIR) with low cost optics, multi-function laser module enabling range finding, marking and pointing, rapid detection of threat optical systems, precision target location, and advanced image processing and aided target recognition algorithms.</p>		4.727	-	-
<p>Title: Down Range Electro-Optical Wind Sensing</p>		2.815	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>	Project (Number/Name) K70 / <i>Night Vision Adv Tech</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Description: This effort will integrate crosswind sensing and range measurement with real time compensation of the aim-point offset for a shooter to rapidly and accurately engage targets from effective weapon ranges. The effort will mature and demonstrate sensing and imaging technologies to measure crosswinds and target range to provide an aim-point compensation of the bullet trajectory and increase the first round probability of hit.</p>			
<p>Title: One Sensor for Fire Support/Scout Operations</p> <p>Description: This effort will optimize and demonstrate a modular and tailorable single sensor solution for both Scouts and Forward Observers integrating advanced sensor technologies with increased identification (ID) range and improved target location accuracy. The effort will enable a synchronized SA picture to enhance overall lethality and survivability. A single sensor approach will increase human performance with common training, common materiel repair parts, and economy of scales to support expeditionary operations.</p>	2.012	-	-
<p>Title: Asymmetric Vision / Decide Faster</p> <p>Description: This effort will mature and demonstrate sensing, image processing, display and mission decision aid capabilities to provide disaggregated mounted and dismounted teams with the ability to act autonomously, outmaneuver, and outthink the enemy in close combat with limited and intermittent access to higher echelon command and control systems. In FY 2019, this effort is developed from realigned funds in support of the Army science and technology (S&T) priorities as identified at the December 2016 S&T Army Requirements Oversight Council by the Chief of Staff of the Army.</p>	4.937	-	-
<p>Title: Turret</p>	9.700	-	-
Accomplishments/Planned Programs Subtotals	41.406	-	-

<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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>	Project (Number/Name) K86 / <i>Night Vision, Abn Sys</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>K86: Night Vision, Abn Sys</i>	-	27.688	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	27.688

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
 Program Element (PE) 0603465A Future Vertical Lift Advanced Technology:
 * Project AK3 Aviation Survivability Advanced Technology
 * Project AL1 Adv Teaming for Tactical Aviation Oper Adv Tech
 * Project AL7 Full Spectrum Targeting Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates intelligence, surveillance, reconnaissance, targeting, and pilotage technologies in support of the Army's aviation and networked systems. This effort focuses on improved reconnaissance, surveillance, and target acquisition, pilotage sensors, high-resolution heads-up displays, sensor fusion, and aided target recognition (AiTR) capabilities for Army vertical lift aircraft, utility helicopters, and unmanned aerial systems (UAS) in day/night, obscured, smoke, adverse weather, and other Degraded Visual Environments (DVE). UAS payload efforts mature and demonstrate small, lightweight, and modular payloads (e.g. electro-optical/infrared, laser radar, designator) to support target detection, identification, location, tracking, and targeting of tactical targets for the Brigade Combat Team.

Work in this Project is fully coordinated with PE 0602211A (Aviation Technology) and PE 0603003A (Aviation Advanced Technology).

FY20 realignments are due to financial restructuring in support of 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 (U.S.) Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Local Area Intelligence, Surveillance, and Reconnaissance (ISR) for Tactical Small Units	5.148	-	-
Description: This effort develops and demonstrates sensors enabling simultaneous display of wide and narrow field-of-view (FOV) infrared imagery for enhanced Situational Awareness (SA)/targeting. This effort optimizes multi-band image fusion and the ability to image battlefield laser spot locations for improved targeting accuracy and reduced fratricide caused by laser misalignment.			
Title: Sensors and Sensor Fusion for Rotorcraft Degraded Visual Environment Mitigation	10.692	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603710A / <i>Night Vision Advanced Technology</i>	Project (Number/Name) K86 / <i>Night Vision, Abn Sys</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Description: This effort leverages work previously accomplished under the ?Multifunction Imagers for Rotary Wing? and ? Pilotage Sensor Fusion? efforts. This effort matures sensing and processing approaches to improve pilotage in DVEs. This effort optimizes Long Wave Infrared (LWIR) imaging sensors capable of providing actionable imagery over a wide range of DVEs. This effort also demonstrates a distributed aperture sensing (DAS) approach in which sensing modules are placed around the airframe to enable 360 degree coverage and provide information on potential threats and obstacles for increased SA. The effort provides DVE-specific multimodal fusion techniques to leverage the strengths and mitigate the weaknesses of multiple sensor modalities.</p> <p>Title: Digital Dual Use Sensors (DDUS)</p> <p>Description: This effort will mature and demonstrate the core camera technology for a multi-spectral, multi-mode distributed aperture pilotage system while supporting aircraft survivability. This synergistic single sensor technology will support aircraft survivability by providing hostile fire and missile warning cues while simultaneously providing pilotage and situational understanding in DVEs. This effort leverages technology from the Dual Band Infrared Focal Plane Arrays (IRFPA) ManTech as well as from the three-dimensional D Digital Read-Out Integrated Circuit (DROIC) Science and Technology Objective (STO) to fabricate the digital multi-function readout circuit to enable the multi-function capability.</p>	11.848	-	-
Accomplishments/Planned Programs Subtotals	27.688	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	28.079	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	28.079
002: <i>Environmental Compliance Technology</i>	-	2.352	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.352
03E: <i>Environmental Restoration Technology</i>	-	5.727	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.727
03F: <i>Environmental Quality Tech Demonstrations (CA)</i>	-	20.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.000

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is being eliminated, with continuity of effort realigned to the following PEs:

- * PE 0603119A Ground Advanced Technology
- * PE 0603462A Next Generation Combat Vehicle Advanced Technology
- * PE 0603463A Network C3I Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates technologies that assist the Army to reduce or eliminate environmental impacts both in the United States and abroad, and provide science and technology solutions to Army environmental challenges as a force multiplier in mission planning, material acquisition and soldier preparedness. Project 002 demonstrates tools and methods for compliance with environmental laws relevant to conservation of natural and cultural resources while providing a flexible realistic training environment for mission activities. The Army also requires the ability to assess, establish, upgrade, and secure infrastructure while in theatre to enable deployed force operations. This project matures and demonstrates tools for robotic and autonomous agile infrastructure modification and custom designed construction for expeditionary structures on demand. Project 025 demonstrates pollution prevention tools and methods to minimize the Army's use and generation of toxic chemicals and hazardous wastes. Project 03E focuses on technologies for advanced life cycle analysis, advanced sensing, and technologies to empower rapid fielding of next generation energetics, propellants and munitions.

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

FY 2020 realignments are due to financial restructuring in support of Army Modernization Priorities.

This PE is fully coordinated and complementary to PE 0602720A (Environmental Quality Technology).

Work in this PE is performed by the Army Engineer Research and Development Center, Vicksburg, MS, and the Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	29.132	0.000	0.000	-	0.000
Current President's Budget	28.079	0.000	0.000	-	0.000
Total Adjustments	-1.053	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.933	-			
• SBIR/STTR Transfer	-0.120	-			

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

Project: 03F: *Environmental Quality Tech Demonstrations (CA)*

- Congressional Add: *Autonomous Transport Innovation*
- Congressional Add: *Rapid Safe Carbon Nanotechnology Research*
- Congressional Add: *Smart Bases*
- Congressional Add: *Environmental Sensors for Explosives*

Congressional Add Subtotals for Project: 03F

Congressional Add Totals for all Projects

	FY 2019	FY 2020
	5.000	-
	8.000	-
	5.000	-
	2.000	-
Congressional Add Subtotals for Project: 03F	20.000	-
Congressional Add Totals for all Projects	20.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>	Project (Number/Name) 002 / <i>Environmental Compliance Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>002: Environmental Compliance Technology</i>	-	2.352	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	2.352

Note
 In FY 2020 this Project is realigned to:
 Program Element (PE) 0603462A Next Generation Combat Vehicle Advanced Technology, Project:
 * BK8 Robotics for Engineer Operations Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies transitioned from PE 0602720A (Environmental Quality Technology), Projects 048 and 896, and PE 0602784 (Military Engineering), Projects T41 and T45. This Project assists Army installations and operations in achieving environmental compliance. Army facilities are subject to fines and facility shutdowns for violations of federal, state, and local environmental regulations. Efforts under this Project enable the Army to reduce environmental constraints at installations while complying with the myriad of federal, state, local, and host country environmental regulations and policy. In addition, this project matures capabilities to assess, establish, upgrade, and construct infrastructure to project power and enable deployed force operations. Current and planned efforts enable the Army to perform additive and advanced manufacturing for deployed force infrastructure, support robotic and autonomous engineering during combat operations, and ensure infrastructure resiliency. Technologies demonstrated aim to reduce the cost of resolving compliance issues for the Army, sustain the viability of testing and training ranges, protect critical resources, and expand capacity to perform construction and supporting tasks in high risk/threat and dynamic environments.

The work cited is consistent with the Under Secretary of Defense for Research and Engineering priority focus areas, supports the Army Strategy for the Environment, and supports the Army Modernization Priority for Next Generation Combat Vehicle, Air Missile Defense and Network/C3I.

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

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

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

	FY 2019	FY 2020	FY 2021
Title: Robotics for Engineer Operations	2.352	-	-
Description: Mature and demonstrate robotic and autonomous technologies for Engineer operations supporting mobility, counter-mobility, and advanced construction methods for deployed operations.			
Accomplishments/Planned Programs Subtotals	2.352	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>	Project (Number/Name) 002 / <i>Environmental Compliance Technology</i>
C. Other Program Funding Summary (\$ in Millions) N/A		
Remarks		
D. Acquisition Strategy N/A		

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>				Project (Number/Name) 03E / <i>Environmental Restoration Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
03E: <i>Environmental Restoration Technology</i>	-	5.727	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	5.727

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology, Projects:
 * AR4 Intelligent Environmental Battlefield Awareness Advanced Technology
 * AR6 Understanding the Environment as a Threat Advanced Technology
 PE 0603119A Ground Advanced Technology, Project:
 * BM1 Protection from Advanced Weapon Effects Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates technologies transitioned from PE 0602720A (Environmental Quality Technology) Projects 835 and 896 that address the management and mitigation of hazardous materials and chemicals, with a focus on mitigating impacts of new materiel that will enter the Army inventory within the next decade and beyond. This Project will shape and protect Army investments in next generation fires by delivering proactive, scientifically sound risk and environmental impact management strategies. Efforts in this Project assess environmental factors in mission planning activities that impact the battlefield landscape of future threats while also identifying opportunities and impacts to mission success in sparse data environments. These efforts will enable mission planners to identify the industrial/commercial resources used as components of weapons development. Technologies matured within this Project: inform the Army of potential environmental threats, opportunities, and mission impacts; help decision makers understand environmental threats in urban and industrial contested environments; and provide rapid sensing and assessment of the presence and extent of dangerous compounds in battlefield environments.

A key aspect of this work is the enhancement of risk assessment and life cycle analysis techniques that can more accurately predict and identify the environmental liabilities associated with fielding new systems and technologies. Efforts also identify ways to economically comply with myriad federal, state, and host country regulations dealing with contaminated soil and water. This Project includes pilot-scale field studies to demonstrate technological feasibility and optimize performance and productivity of risk mitigation techniques.

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

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

Work in this Project is performed by the Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>	Project (Number/Name) 03E / <i>Environmental Restoration Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Hazard Assessment for Military Materials</p> <p>Description: This effort demonstrates tools to assess hazard and risk of Army-unique chemicals and materials. The tools provide for rapid environmental baseline survey reporting and screening assessments of existing and future militarily relevant compounds and allow for improved predictive risk assessment and provide environmental life cycle assessment capability.</p>	0.273	-	-
<p>Title: Rapid Risk Analysis of Fires</p> <p>Description: This effort is focused on health implications of new, to-be fielded munitions and investigates the overall life cycle of the materials to shape and protect Army investments in next generation fires supporting Army Modernization Priority Long Range Precision Fires.</p>	2.822	-	-
<p>Title: Understanding the Environment as a Threat</p> <p>Description: This effort provides environmental conditions and hazards in contested environments to enable operational planning and decisions to understand environmental threats from informed modeling and simulation supporting Modernization Priority Network/C3I Mission Planning Applications.</p>	2.632	-	-
Accomplishments/Planned Programs Subtotals	5.727	-	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603728A / <i>Environmental Quality Technology Demonstrations</i>				Project (Number/Name) 03F / <i>Environmental Quality Tech Demonstrations (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
03F: <i>Environmental Quality Tech Demonstrations (CA)</i>	-	20.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.000

A. Mission Description and Budget Item Justification

Congressional increases supporting the maturation and demonstration of technologies that assist the Army in becoming environmentally compliant and limiting future liability without compromising readiness or training assets critical to the success of the future force.

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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

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

	FY 2019	FY 2020
Congressional Add: Autonomous Transport Innovation	5.000	-
FY 2019 Accomplishments: Autonomous Transport Innovation		
Congressional Add: Rapid Safe Carbon Nanotechnology Research	8.000	-
FY 2019 Accomplishments: Rapid Safe Carbon Nanotechnology Research		
Congressional Add: Smart Bases	5.000	-
FY 2019 Accomplishments: Smart Bases		
Congressional Add: Environmental Sensors for Explosives	2.000	-
FY 2019 Accomplishments: Environmental Sensors for Explosives		
Congressional Adds Subtotals	20.000	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

UNCLASSIFIED

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	100.359	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	100.359
T08: <i>Combat Eng Systems</i>	-	24.759	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.759
T15: <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	-	75.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	75.600

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is being realigned, with continuity of effort realigned to the following PEs:

- * PE 0603119A Ground Advanced Technology Projects
- * PE 0603462A Next Generation Combat Vehicle Advanced Technology
- * PE 0603463A Network C3I Advanced Technology
- * PE 0603465A Future Vertical Lift Advanced Technology
- * PE 0603466A Air and Missile Defense Advanced Technology

A. Mission Description and Budget Item Justification

This Program Element (PE) demonstrates data and information architectures and software applications, as well as sensing systems, that can be used to provide Warfighters with timely, accurate, easily interpretable data and information for the operational and tactical mission environments, focusing on physical and human terrain and weather; methodologies, software applications, and hardware for improving ground vehicle mobility and countermobility to support ground force operations including manned-unmanned teaming; demonstrates material technologies and tools for force projection, and sustainment. This PE also demonstrates subsystems and systems to increase the survivability of personnel, critical assets, and facilities through structures, shields, and barriers to combat highly adaptive and increasingly severe threats; and systems and interoperable systems of systems for detecting threats, assessing situations, defending against threats, and communicating information and warnings for force protection.

This work is fully coordinated with and complementary to PE 0602784A (Military Engineering Technology).

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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 PE is led by the Army Engineering Research and Development Center (ERDC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	101.438	0.000	0.000	-	0.000
Current President's Budget	100.359	0.000	0.000	-	0.000
Total Adjustments	-1.079	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.300	-			
• SBIR/STTR Transfer	-0.779	-			

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

Project: T15: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

- Congressional Add: *Resilient Energy Systems*
- Congressional Add: *Additive Manufacturing/3D Printing*
- Congressional Add: *Advanced Polymer Development*
- Congressional Add: *Bathymetric-topographic LIDAR Research*
- Congressional Add: *Extreme Terrain Research*
- Congressional Add: *Secure Management of energy generation and storage*
- Congressional Add: *Rapid low energy mobile manufacturing*
- Congressional Add: *Centrifuge Enabled Research*
- Congressional Add: *Energy and technology research in cold and arctic regions*
- Congressional Add: *ERDC Collaboration (Transportation System Assessment Technologies)*
- Congressional Add: *Natural Gas technology*
- Congressional Add: *Reliable Distributed Energy in Austere Environments*
- Congressional Add: *Research Facility Modernization*
- Congressional Add: *Research in the Permafrost environment*
- Congressional Add: *Secure and resilient power generation in cold region environments*
- Congressional Add: *Silicone anode technology*

	FY 2019	FY 2020
	1.000	-
	2.000	-
	20.000	-
	8.200	-
	4.000	-
	3.000	-
	3.000	-
	2.500	-
	4.000	-
	2.000	-
	4.000	-
	3.000	-
	2.000	-
	4.000	-
	5.000	-
	4.000	-

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603734A / <i>Military Engineering Advanced Technology</i>
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Congressional Add Details (\$ in Millions, and Includes General Reductions)

Congressional Add: *Transportation infrastructure evaluation system*

	FY 2019	FY 2020
Congressional Add Subtotals for Project: T15	3.900	-
Congressional Add Totals for all Projects	75.600	-

Change Summary Explanation

FY19 funds reprogrammed out for higher priority Army requirements.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>				Project (Number/Name) T08 / <i>Combat Eng Systems</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
T08: <i>Combat Eng Systems</i>	-	24.759	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	24.759

Note
 In FY20 this Project is being realigned to:
 Program Element (PE) 0603119A Ground Advanced Technology, Projects:
 * BL6 Expedient Passive Protection for Critical Assets Advanced Technology
 * BL8 Power Projection in A2/AD Environments Advanced Technology
 * BM1 Protection from Advanced Weapon Effects Advanced Technology
 PE 0603462A Next Generation Combat Vehicle Advanced Technology, Projects:
 * BF2 Autonomous Ground Resupply (AGR) Advanced Technology
 * BG3 Modeling & Simulation for MUMT Advanced Technology
 PE 0603463A Network C3I Advanced Technology, Projects:
 * AS9 Asymmetric Vision by Persistent Geophysical Sensing and Infrasound Advanced Technology
 * AT3 Subterranean Detection and Monitoring Advanced Technology
 * AU4 Geospatially Enabled Operational Design (GEOD) Advanced Technology
 * AT8 Network-Enabled GeoSpatial and GEOINT Services Advanced Technology
 * AU6 Automated Analytics for Understanding the Operational Environment Advanced Technology
 * AU1 Tactical GeoSpatial Information Capabilities Advanced Technology
 PE 0603465A Future Vertical Lift Advanced Technology, Project:
 * AL3 High Performance Computing for Rotorcraft Applications Advanced Technology
 PE 0603466A Air and Missile Defense Advanced Technology, Project:
 * AE3 Unconventional Countermeasures & Survivability Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates software and architectures for geospatial mapping applications and decision aids for the Warfighter. Project components, systems, system of systems, and decision aids enable ground vehicle mobility (freedom of movement), including force projection, and counter-mobility to impede movement of threat forces. Additional components, systems, system of systems for survivability support protection of personnel, facilities, and assets through design and reinforcement of structures, and for force protection to detect, assess, and defend against threats for troops and critical fixed and semi-fixed assets. Protection measures support force projection in areas such as air and sea ports of debarkation, dispersed small units, and units operating in complex and urban environments, which may include subterranean challenges. Work is in support of current and future ground force operations and future vertical lift. Software and architectures for geospatial projects mature and validate geospatial decision tools in support of operations planning and decision making to advance utility of geospatial capability and techniques across the Army, services, and coalition, and to advance and mature the information architecture that supports the total Army's discovery and access to data, geospatial information, and analytical tool suites. Methods to characterize and visualize behavior and population dynamics mature and validate efforts to portray the operational

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>	Project (Number/Name) T08 / <i>Combat Eng Systems</i>
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environment including culture, demographics, terrain, climate, and infrastructure, into geospatial frameworks. Force protection activities are focused on filling critical gaps in protecting forces operating in disbursed small units over complex and urban terrain and include maturation, integration, and demonstration of components, systems, and systems of systems for rapidly deployable threat detection in direct line-of-site and nonline-of-site environments; situation assessment to help reduce false alarms and decrease manpower required to monitor the environment; and passive protection to mitigate blast and weapon effects from advanced and emerging threats. Work in survivability and force protection also includes maturing and demonstrating software to characterize blast effects generated from explosive events, such as improvised explosive device detonation in soils, and supports design and decision aids. Force protection activities are also focused on protection of critical assets and infrastructure required to project forces into denied access areas. Work in mobility and force projection includes maturing and demonstrating software and hardware to assess and improve freedom of movement for ground forces, including autonomous ground resupply and manned-unmanned teaming and demonstrates infrastructure health monitoring assessment technologies to support emerging projection challenges in complex, contested environments such as distributed sustainment over large distances. Engineered Resilient Systems (ERS) activities focus on developing capabilities for "upfront engineering" that will result in more operationally efficient and resilient systems that are more affordable in a more rapid fashion. This effort develops and demonstrates an end-to-end thread involving analysis to inform requirements, reduce risk, and assess lifecycle cost pre-milestone A through tradespace analytics for selected systems of interest.

This work is being fully coordinated and is complementary to the ERS work described in the Office of the Secretary of Defense (OSD) Program Element (PE) 0603832/ Project D8Z.

This work is fully coordinated with and complementary to PE 0602784A (Military Engineering Technology). Geospatial activities are coordinated with the National Geospatial Intelligence Agency (NGA). Autonomous ground resupply activities are coordinated with PEs 0603005A (Combat Vehicle and Automotive Advanced Tech) / Project 515 (Robotic Ground Systems), and PE 0602601A (Combat Vehicle and Automotive Technology) / Project H77 (National Automotive Center), and 0602601A (Combat Vehicle and Automotive Technology) / H91 (Ground Vehicle Technology) in collaboration with the Tank and Automotive Research, Development and Engineering Center (TARDEC). Autonomous ground resupply activities are also coordinated with PEs 0603001A (Warfighter Advanced Technology) / Project 543 (Ammunition Logistics), PE 0604639A (Weapons and Munitions - Advanced Development) / EC3 (Ammunition Logistics Prototyping), and 0605805A (Munitions Standardization, Effectiveness and Safety) / Project 297 (Mun Survivability & Log). Unconventional Countermeasure activities are coordinated with PE 0602720A (Environmental Quality Technology) / Project 835 (Mil Med Environ Crit) and PE 0603728 (Environmental Quality Technology Demonstrations) / Project 03E (Environmental Restoration Technology).

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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 led by the Army Engineering Research and Development Center (ERDC).

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Title: Geo-Enabled Mission Command Enterprise	2.797	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>	Project (Number/Name) T08 / <i>Combat Eng Systems</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Description: This effort matures methods and demonstrates data, information, and software tools and architectures to bring physical and human terrain and effects data into decision frameworks for consistent and accurate implementation in the Army Geospatial Enterprise (AGE). This provides ready-access of low-overhead, light-weight, analytic tools to other Services and the Department of Defense (DoD) and increases situational awareness of the operational environment in support of mission planning and operations.</p>			
<p>Title: GeoIntelligence - Enabling Technology Demonstration</p> <p>Description: This effort provides demonstration of analytic tools and algorithms that use multi-source (e.g. optical, Light detection and ranging (LiDAR)), multiplatform (e.g. satellite, light Unmanned Aerial Vehicle (UAV)), multi-temporal image sources to build urban tactical decision aids suitable for use on mobile devices to provide geospatial analysis to the Army, other Services, and DoD, in support of mission planning and operations (such as small units in an urban setting). This effort continues work that was part of Geo-Enabled Mission Command Enterprise.</p>	1.914	-	-
<p>Title: Human Geography Demonstration</p> <p>Description: This effort matures and demonstrates the integration of behavior and population dynamics research and analysis into geospatial frameworks to depict aspects of the operational environment including culture, demographics, terrain, climate, and infrastructure for mission planning and awareness. Efforts include exploitation of existing open source text, leveraging multi-media and cartographic materials, and data collection methods from the tactical edge to characterize parameters of social, cultural, and economic geography of special interest to the Warfighter.</p>	0.969	-	-
<p>Title: Austere Entry and Maneuver Support Demonstrations</p> <p>Description: This effort matures and demonstrates improved means for achieving force projection in austere and complex environments and integrated sensing and simulation systems for predicting physical conditions in these operational environments. This effort matures and demonstrates technologies to assess, construct, or repair infrastructure required to support entry, sustainment, and maneuver operations in complex and contested battlespaces. This effort matures and demonstrates simulation technology for manned-unmanned teaming maneuver.</p>	6.598	-	-
<p>Title: Adaptive Protection Demonstrations</p> <p>Description: This effort validates protection solutions for facilities and critical assets, including fixed and semi-fixed. A focus will be on technologies to defeat new and emerging advanced weapons threats. Technologies include: low-logistics protective construction and facility protection, use of indigenous materials, innovative structural hardening and retrofit, and the synergistic</p>	7.698	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>	Project (Number/Name) T08 / <i>Combat Eng Systems</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
use of unconventional countermeasures to increase the effectiveness of protection to critical assets. This effort also demonstrates rapidly deployable protective measures and retrofit technologies for use in urban environments.				
Title: Engineered Resilient Systems				
Description: This effort matures and demonstrates capabilities (tools and methodologies) to rapidly create high-fidelity environmental data 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. The Engineered Resilient Systems (ERS) initiative has been identified as a Science and Technology emphasis area by the Assistant Secretary of Defense for Research and Engineering, ASD(R&E). This effort focuses on Army systems of interest and on high-fidelity environmental data for the associated battlespace, on linkages to force-on-force combat simulations representing the systems of interest, and on tools to explore trades in order to help inform requirements, reduce risk, and assess lifecycle cost pre-milestone A.		4.783	-	-
Accomplishments/Planned Programs Subtotals		24.759	-	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

UNCLASSIFIED

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>				Project (Number/Name) T15 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
T15: <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>	-	75.600	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	75.600

A. Mission Description and Budget Item Justification

Congressional Interest Item for Military Engineering Technology Demonstrations.

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

	FY 2019	FY 2020
Congressional Add: Resilient Energy Systems	1.000	-
FY 2019 Accomplishments: Resilient Energy Systems		
Congressional Add: Additive Manufacturing/3D Printing	2.000	-
FY 2019 Accomplishments: Additive Manufacturing/3D Printing		
Congressional Add: Advanced Polymer Development	20.000	-
FY 2019 Accomplishments: Advanced Polymer Development		
Congressional Add: Bathymetric-topographic LIDAR Research	8.200	-
FY 2019 Accomplishments: Bathymetric-topographic LIDAR Research		
Congressional Add: Extreme Terrain Research	4.000	-
FY 2019 Accomplishments: Extreme Terrain Research		
Congressional Add: Secure Management of energy generation and storage	3.000	-
FY 2019 Accomplishments: Secure Management of energy generation and storage		
Congressional Add: Rapid low energy mobile manufacturing	3.000	-
FY 2019 Accomplishments: Rapid low energy mobile manufacturing		
Congressional Add: Centrifuge Enabled Research	2.500	-
FY 2019 Accomplishments: Centrifuge Enabled Research		
Congressional Add: Energy and technology research in cold and arctic regions	4.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603734A / <i>Military Engineering Advanced Technology</i>	Project (Number/Name) T15 / <i>MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020
<i>FY 2019 Accomplishments:</i> Energy and technology research in cold and arctic regions		
<i>Congressional Add:</i> ERDC Collaboration (Transportation System Assessment Technologies)	2.000	-
<i>FY 2019 Accomplishments:</i> ERDC Collaboration (Transportation System Assessment Technologies)		
<i>Congressional Add:</i> Natural Gas technology	4.000	-
<i>FY 2019 Accomplishments:</i> Natural Gas technology		
<i>Congressional Add:</i> Reliable Distributed Energy in Austere Environments	3.000	-
<i>FY 2019 Accomplishments:</i> Reliable Distributed Energy in Austere Environments		
<i>Congressional Add:</i> Research Facility Modernization	2.000	-
<i>FY 2019 Accomplishments:</i> Research Facility Modernization		
<i>Congressional Add:</i> Research in the Permafrost environment	4.000	-
<i>FY 2019 Accomplishments:</i> Research in the Permafrost environment		
<i>Congressional Add:</i> Secure and resilient power generation in cold region environments	5.000	-
<i>FY 2019 Accomplishments:</i> Secure and resilient power generation in cold region environments		
<i>Congressional Add:</i> Silicone anode technology	4.000	-
<i>FY 2019 Accomplishments:</i> Silicone anode technology		
<i>Congressional Add:</i> Transportation infrastructure evaluation system	3.900	-
<i>FY 2019 Accomplishments:</i> Transportation infrastructure evaluation system		
Congressional Adds Subtotals	75.600	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	45.799	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	45.799
101: <i>Tactical Command and Control</i>	-	20.042	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.042
1AA: <i>Tactical Computer Science Demonstrations (CA)</i>	-	9.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.000
243: <i>Sensors And Signals Processing</i>	-	16.757	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.757

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:

- * PE 0603462A Next Generation Combat Vehicle Advanced Technology
- * PE 0603463A Network C3I Advanced Technology
- * PE 0603466A Air and Missile Defense Advanced Technology

A. Mission Description and Budget Item Justification

This PE matures and demonstrates technologies that allow the Warfighter to effectively collect, analyze, transfer and display situational awareness information in a network-centric battlefield environment, and the technologies that enable the integration of Robotics and Autonomous Systems (RAS) through Mission Command. It matures and demonstrates architectures, hardware, software and techniques that enable synchronized mission command (MC) during rapid, mobile, dispersed and Joint operations. Project 101 matures software, algorithms, services and devices to more effectively integrate MC across all echelons and enable more effective utilization of Warfighter resources including intelligent power management and distribution through accelerated information to decisions and rapid MC on the move. Project 243 matures and demonstrates signal processing and information/intelligence fusion software, algorithms, services and systems for Army sensors; radio frequency (RF) systems to track and identify enemy forces and personnel; and multi-sensor control and correlation software and algorithms to improve reconnaissance, surveillance, tracking, and target acquisition.

Work in this PE complements PE 0602120A (Sensors and Electronic Survivability), PE 0602270A (Electronic Warfare Technology), PE 0602303A (Missile Technology), PE 0602705A (Electronics and Electronic Devices), PE 0602782A (Command, Control, Communications Technology), and PE 0603270A (Electronic Warfare Technology), and is coordinated with PE 0602783A (Computer and Software Technology).

FY20 realignments are due to financial restructuring in support of 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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>
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Work in this PE is performed by the Research, Development, and Engineering Command, Aberdeen Proving Ground, MD.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	43.856	0.000	0.000	-	0.000
Current President's Budget	45.799	0.000	0.000	-	0.000
Total Adjustments	1.943	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	2.800	-			
• SBIR/STTR Transfer	-0.857	-			

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

Project: 1AA: *Tactical Computer Science Demonstrations (CA)*
 Congressional Add: *Assured Positioning, Navigation and Timing*
 Congressional Add: *FY 2018 NDAA SEC 825 MDAP Cost Overrun*

	FY 2019	FY 2020
	8.997	-
	0.003	-
Congressional Add Subtotals for Project: 1AA	9.000	-
Congressional Add Totals for all Projects	9.000	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>				Project (Number/Name) 101 / <i>Tactical Command and Control</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
101: <i>Tactical Command and Control</i>	-	20.042	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	20.042

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603462A Next Generation Ground Combat Vehicle Advanced Technology:
 * Project BH3 C4ISR Modular Autonomy Advanced Technology
 PE 0603463A Network C3I Advanced Technology:
 * Project AQ8 High Tempo Data Driven Decision Tools Adv Tech
 * Project AV8 Navigation Warfare (NAVWAR) Advanced Technology
 * Project AW2 Autonomous Navigation Advanced Technology
 * Project AW4 DoD PNT M&S Collaborative Initiative (CI) Adv Tech
 * Project AW6 Modular GPS Independent Sensors Advanced Tech
 * Project AR2 Energy Informed Operations Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates software, algorithms, services and devices that move and display timely and relevant information across the battlefield to provide Commanders at all echelons with situational awareness (SA) that allows them to understand, decide and act faster than their adversaries. This project also matures and demonstrates software, algorithms and devices supporting information storage and retrieval; digital transfer and display of battlefield SA, with an emphasis on positioning, navigation, and timing (PNT) and power and energy resource information while keeping in mind the cognitive limit of the Soldier's use of software, algorithms and services optimized for expeditionary and uninterrupted mission command.

FY20 realignments are due to financial restructuring in support of 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.

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

	FY 2019	FY 2020	FY 2021
Title: Integrated Mission Command (MC)	3.641	-	-
Description: This effort matures and demonstrates technologies to simplify mission command (MC) software and data architectures and reduce complexity in all battlefield environments, to include command post (CP), mounted, and dismounted operations.			
Title: Assured Positioning, Navigation and Timing (A-PNT)	9.395	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>	Project (Number/Name) 101 / <i>Tactical Command and Control</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
Description: This effort 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.			
Title: Advanced Intelligent Power Management & Distribution	2.000	-	-
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			
Title: Assault Breaker II (DARPA)	5.000	-	-
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.006	-	-
Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun			
Accomplishments/Planned Programs Subtotals	20.042	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>				Project (Number/Name) 1AA / <i>Tactical Computer Science Demonstrations (CA)</i>			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
1AA: <i>Tactical Computer Science Demonstrations (CA)</i>	-	9.000	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.000

A. Mission Description and Budget Item Justification

Congressional Interest Item funding for Tactical Computer Science and Sensor advanced technology development.

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

	FY 2019	FY 2020
Congressional Add: Assured Positioning, Navigation and Timing	8.997	-
FY 2019 Accomplishments: Assured Positioning, Navigation and Timing		
Congressional Add: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.003	-
FY 2019 Accomplishments: FY 2018 NDAA SEC 825 MDAP Cost Overrun		
Congressional Adds Subtotals	9.000	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>	Project (Number/Name) 243 / <i>Sensors And Signals Processing</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
<i>243: Sensors And Signals Processing</i>	-	16.757	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	16.757

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology:
 * Project AO1 UNT - Every Receiver is a Sensor Advanced Tech
 * Project AV4 Foundational S&T for Network C3I Advanced Tech
 PE 0603466A Air and Missile Defense Advanced Technology:
 * Project AD6 Next Generation Fires Radar Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates improved radar, sensor fusion, and correlation software, services, devices and systems for wide area reconnaissance, surveillance, tracking and targeting of ground and aerial platforms and individuals, including complex and urban environments. Sensor fusion efforts mature and demonstrate software, algorithms and services for sensor management, data correlation, and relationship discovery for a multi-intelligence fusion system. Sensor and simulated sensor candidates may include moving-target-indicator/synthetic aperture radar, electro-optical/infrared (EO/IR), signals intelligence (SIGINT), measurements and signatures intelligence (MASINT), human intelligence (HUMINT), multiple intelligence (Multi-Int) and biometrics.

FY20 realignments are due to financial restructuring in support of Army Modernization Priorities.

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

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

	FY 2019	FY 2020	FY 2021
Title: Collaborative Intelligence, Surveillance and Reconnaissance (ISR) Sensor processing and analytics	4.550	-	-
Description: This effort develops software that gathers data from multi-function Airborne ISR sensor sources into a single common operating environment to streamline analysts processing, exploitation and dissemination (PED) workflows. The focus centers on developing scalable software that provides a near real time PED capability on board the platform with applicability at the ground stations and reach back for forensics and pattern analysis. It will increase the utility of moving target indicator (MTI) radar to the greater multiple intelligence (multi-INT) picture for better origin-to-destination tracking, which is crucial to understanding the higher-level threat picture and increases the effectiveness and action-ability of battlespace awareness/intelligence data throughout an area of operations. This effort implements an open architecture extensible throughout the tactical enterprise, allowing for growth to include future ISR sensors.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603772A / <i>Advanced Tactical Computer Science and Sensor Technology</i>	Project (Number/Name) 243 / <i>Sensors And Signals Processing</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Counter-concealment Moving Target Indicator (MTI) Airborne Radar Demonstration</p> <p>Description: This effort will mature antenna design and signal processing and define the architecture to ensure simplified integration on a Multi-Int platform to deliver an advanced generation of airborne MTI radars. This will allow for third party mode development and exploitation techniques, with emphasis on automated target declaration and tracking. Efforts focus on antenna and signal processing advancements that allow the detection/tracking of targets despite camouflage, concealment and deception and a well-defined systems architecture to cover large areas and persistently scan named areas of interest.</p>	2.908	-	-
<p>Title: Multi-mode Air Defense Radar Demonstration</p> <p>Description: This effort matures 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 area/base camp protection.</p>	5.391	-	-
<p>Title: Degraded Visual Environment (DVE) ? Air</p> <p>Description: This effort matures and demonstrates software and hardware for a millimeter wave radar system (conformal phased array radar) to provide obscurant penetration for terrain and object awareness while providing pilotage aids in all degraded visual environments.</p>	3.903	-	-
<p>Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p> <p>Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun</p>	0.005	-	-
Accomplishments/Planned Programs Subtotals	16.757	-	-

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 2021 Army **Date:** February 2020

Appropriation/Budget Activity 2040: Research, Development, Test & Evaluation, Army / BA 3: Advanced Technology Development (ATD)	R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	45.168	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	45.168
EL4: Tactical Comms and Networking Technology Int	-	36.544	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.544
EL5: Secure Tactical Information Integration	-	8.624	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.624

Note

In Fiscal Year 2020 (FY20) this Program Element (PE) was realigned with continuity of effort to the following PEs:

- * PE 0603463A Network C3I Advanced Technology
- * PE 0603457A C3I Cyber Advanced Development

A. Mission Description and Budget Item Justification

This PE matures and demonstrates technologies to address the integrated tactical communications challenge with distributed, secure, mobile, wireless, and self-organizing communications networks and networked transceivers that must operate reliably in diverse and complex terrains and environments. Efforts demonstrate seamlessly integrated communications and information security technologies across all network tiers, ranging from unattended networks and sensors, through maneuver elements using airborne and space assets. Project EL4 matures and integrates antennas, wireless networking devices, protocols, and software; network operations tools and techniques; and combines these with current fielded networks and systems in a series of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) network modernization demonstrations to measure their technology readiness levels and assess them against currently fielded network architectures in an operationally relevant environment. Project EL5 matures information security devices, techniques, services, software and algorithms to protect tactical wired and wireless networks against modern network attacks; generates and distributes tactical cyber situational awareness; and focuses on configuration, operation, monitoring, defense and network reconstitution in bandwidth constrained tactical environments while reducing the operator workload required to conduct these functions.

Work in this PE complements PE 0602782A (Command, Control, Communications Technology), and fully coordinated with PE 0602120A (Sensors and Electronic Survivability), PE 0602270A (Electronic Warfare Technology), PE 0602783A (Computer and Software Technology), PE 0603001A (Warfighter Advanced Technology), PE 0603270A (Electronic Warfare Technology) and PE 0603772A (Advanced Tactical Computer Science and Sensor Technology).

FY20 realignments are due to financial restructuring in support of 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 PE is performed by U.S. Army Futures Command (AFC).

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603794A / C3 <i>Advanced Technology</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	52.332	0.000	0.000	-	0.000
Current President's Budget	45.168	0.000	0.000	-	0.000
Total Adjustments	-7.164	0.000	0.000	-	0.000
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-5.505	-			
• SBIR/STTR Transfer	-1.659	-			

Change Summary Explanation

FY2019 decrease of \$5.505M realigned to support higher priority Army modernization efforts.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology				Project (Number/Name) EL4 / Tactical Comms and Networking Technology Int			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
EL4: <i>Tactical Comms and Networking Technology Int</i>	-	36.544	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	36.544

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology:
 * Project AM7 Modular RF Communications Advanced Technology
 * Project AM9 Protected SATCOM Advanced Technology
 * Project AN2 Narrowband SATCOM Advanced Technology
 * Project AN4 Non Traditional Waveforms Advanced Technology
 * Project AN6 Prot SATCOM-WB Global SATCOM Inter Canc Adv Tech
 * Project AO3 Robust Grey C3I Advanced Technology
 * Project AP6 C4ISR Integrated Demonstrations Advanced Tech
 * Project AP8 Comms Supp to CSA/Horizontal Int Fields Adv Tech
 * Project AP9 Next Generation HF Advanced Technology
 * Project AQ1 Spectrum Obfuscation Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates key communications and mobile networking technologies, such as antennas, transceivers, transceiver components, networking software and novel techniques to provide secure, reliable, mobile network solutions that function in complex and diverse terrains. This Project concentrates on four major goals: to provide a series of technology demonstrations of new and emerging command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) technology enabled capabilities to significantly reduce risk associated with the network-of-networks concept; to lower the size, weight, power and cost of wireless networking systems deployed on Army platforms through hardware and software convergence; to provide critical improvements in the ability to communicate and move large amounts of information in radio frequency (RF) contested environments, in a seamless, integrated manner across the Army's highly mobile manned and unmanned force structure; and to assess the technology readiness level (TRL) of emerging network technologies in an operationally relevant environment.

FY20 realignments are due to financial restructuring in support of 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.

This work is performed by United States Army Futures Command (AFC).

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020		
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology	Project (Number/Name) EL4 / Tactical Comms and Networking Technology Int		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>Title: Enabling C4ISR Infrastructure, formerly C4ISR On the Move (OTM)</p> <p>Description: This effort provides a venue for the demonstration of new and emerging Command, Control, Communications, computers, Intelligence, Surveillance and Reconnaissance (C4ISR) technologies. This venue performs field based risk reduction (FBRR) and technology readiness assessments (TRAs) by evaluating the Technology Readiness Levels (TRLs) of candidate Army science and technology (S&T) and best of Industry efforts to support tactical network modernization. The yearly themes for the integrated capabilities event are determined by the maturity of the tech base programs across the Army S&T command, control, communications and intelligence (C3I) portfolio. On an annual basis, those programs at or approaching TRL 6 will be solicited for participation based on their maturity to enter TRA in the FBRR environment located at Joint Base McGuire-Dix-Lakehurst (JB-MDL) (Fort Dix). Upon the completion of technology selection, themes will be developed that inform Army S&T, CERDEC Thrust Areas, Army Warfighting Challenges, Training and Doctrine Command (TRADOC) key technology imperatives, and the overall development of the Mission Command Network of 2025 and beyond.</p>		3.524	-	-
<p>Title: Communications, Adaptive Networks to Improve Maneuver Operations, formerly Networking to Improve Maneuver Operations</p> <p>Description: This effort matures and demonstrates technologies and capabilities to provide a range of robust, reliable, scalable, interoperable and resource efficient communications capabilities to expeditionary forces and troops on the move. These capabilities will allow forces to conduct maneuver operations, develop situational understanding, and sustain operations while maintaining freedom of movement.</p>		6.374	-	-
<p>Title: Communications, Robust Tactical Systems, formerly Uninterrupted Communications</p> <p>Description: This effort matures and demonstrates components, software, algorithms and technologies that enable Army tactical wireless networks to operate more efficiently in congested, contested and competitive electromagnetic environments across a multi-domain architecture for mission success. The capabilities developed in this effort provide assured uninterrupted access to critical communications and information links. Efforts will result in robust, reliable and secure terrestrial and satellite communication networks in austere, congested and hostile electromagnetic environments using cost-effective solutions while ensuring that the capability is interoperable and resource efficient. Work accomplished under PE 0602782A/Project H92 complements this effort.</p>		13.121	-	-
<p>Title: Advanced Modular Radio Frequency (RF)</p> <p>Description: This effort will enable connectivity in contested & congested spectrum environments by applying modular radio frequency (RF) technologies within an automated network to adapt and continue operation under interference signals. This</p>		13.510	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology	Project (Number/Name) EL4 / Tactical Comms and Networking Technology Int

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
capability will reduce the rigorous network management through intelligent selection of diverse network connections to seamlessly transmit data and maintain communications within a contested RF environment.			
Title: FY 2018 NDAA SEC 825 MDAP Cost Overrun Description: FY 2018 NDAA SEC 825 MDAP Cost Overrun	0.015	-	-
Accomplishments/Planned Programs Subtotals	36.544	-	-

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology				Project (Number/Name) EL5 / Secure Tactical Information Integration			
COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
EL5: Secure Tactical Information Integration	-	8.624	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.624

Note

In Fiscal Year 2020 (FY20) this Project was realigned to:
 Program Element (PE) 0603463A Network C3I Advanced Technology:
 * Project AO9 Information Trust Advanced Technology
 * Project AP2 Decoy and Deterrence Advanced Technology
 PE 06034457A C3I Cyber Advanced Development:
 * Project 6CY Autonomous Cyber Advanced Technology

A. Mission Description and Budget Item Justification

This Project matures and demonstrates software, algorithms and services that focus on tactical cyber and cyberspace electromagnetic activities (CEMA) situational understanding (SU), autonomous network defense, cross domain security and encryption solutions to secure the Army's tactical network. Efforts focus on configuration, operation, monitoring, defense and network reconstitution in bandwidth constrained tactical environments while reducing the operator workload required to conduct these functions. This Project codes, optimizes, and demonstrates software based technologies for intrusion detection, high assurance internet protocol (IP) encryption, seamless communications across security boundaries, as well as information sharing across operations and intelligence functions. These capabilities to automate, protect, monitor, report and access cyber elements of the tactical network are intended to greatly reduce Soldier burden and protect the Army's tactical network by building upon enterprise solutions from commercial, Department of Defense, Department of the Army and other government agencies. This Project cumulatively builds science and technology capabilities in accordance with Army Cyber Material Development Strategy and the Office of the Secretary of Defense Cyber Community of Interest.

FY20 realignments are due to financial restructuring in support of 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.

This work is performed by United States Army Futures Command (AFC).

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

	FY 2019	FY 2020	FY 2021
Title: Defensive Cyber Operations, Cyber Situational Understanding	1.456	-	-
Description: This effort matures and demonstrates software and algorithms that facilitate actionable decision making through mission critical CEMA information knowledge and by applying analysis and judgment to relevant information to help determine the relationships among the operational and mission variables across cyberspace.			

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603794A / C3 Advanced Technology	Project (Number/Name) EL5 / Secure Tactical Information Integration

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021
<p>Title: Defensive Cyber Operations, Tactical Cyber Resilient Architectures & Platforms</p> <p>Description: This effort matures and demonstrates software, architectures and frameworks to allow systems and networks to withstand cyber-attacks, sustain or recover critical functions, and dynamically reshape cyber systems as conditions/goals change to escape harm.</p>	4.459	-	-
<p>Title: Defensive Cyber Operations, Trusted Self Defending Networks & Systems, formerly Cyber/CEMA Operations, Trusted Self Defending Networks & Systems</p> <p>Description: This effort matures and demonstrates software, architectures and frameworks to support establishment of a known degree of assurance that devices, networks and cyber dependent functions perform as expected, despite attack or error and allow the Warfighter to maintain confidence in network information, resources, and identities.</p>	2.709	-	-
Accomplishments/Planned Programs Subtotals	8.624	-	-

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	0.000	8.515	-	8.515	8.756	8.730	8.789	8.966	0.000	43.756
CD5: <i>Humanitarian Demining</i>	-	0.000	0.000	8.515	-	8.515	8.756	8.730	8.789	8.966	0.000	43.756

Note

This is a new start in FY2021.

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.

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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
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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 0603920A / <i>Humanitarian Demining</i>
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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).

Work in this PE was previously conducted under DoD PE 0603920D8Z, Humanitarian Demining.

B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	8.515	-	8.515
Total Adjustments	0.000	0.000	8.515	-	8.515
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	8.515	-	8.515

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 2021 Army **Date:** February 2020

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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CD5: <i>Humanitarian Demining</i>	-	0.000	0.000	8.515	-	8.515	8.756	8.730	8.789	8.966	0.000	43.756

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

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 (HDTC) 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-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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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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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. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020	FY 2021
<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: Will deploy 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. Will complete 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. Will continue 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. Will convene 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 2020 to FY 2021 Increase/Decrease Statement: The increase in FY21 is due to a realignment from PE 0603920D8Z Humanitarian Demining, as a result of the transfer to the Army.</p>	-	-	8.515
Accomplishments/Planned Programs Subtotals	-	-	8.515

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

N/A

Remarks

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army Date: February 2020

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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D. Acquisition Strategy

N/A