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*							
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

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)	FY 2019	FY 2020
Project: BO3: *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*		
Congressional Add: *Electrical System Safety and Reliability*	-	5.000
Congressional Add: *Cold Regions Research*	-	5.000
Congressional Add: *High-Performance Concrete Technology*	-	5.000
Congressional Add: *Lightweight Airfield Matting*	-	10.000
Congressional Add: *Secure Management of Energy Generation and Storage*	-	3.000
Congressional Add: *Rapid Low Energy Mobile Manufacturing*	-	3.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603119A *I Ground Advanced Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Congressional Add: *Composite Flywheel Technology*	-	5.000
Congressional Add: *Lead-Acid Battery Life Extension*	-	10.000
Congressional Add: *Robotic Construction Equipment*	-	9.700
Congressional Add: *Terrain Conditions Forecasting*	-	3.000
Congressional Add: *Environmental Sensors for Explosives*	-	3.000
Congressional Add: *Robotic 4-D Printing of Geopolymer-Based Composites*	-	2.000
Congressional Add: *Waste to Energy Disposal*	-	3.000
Congressional Add: *Advanced Polymer Development for Force Protection*	-	4.500
Congressional Add: *Micrometeorological-Soil Synthetic Test Environment*	-	1.000
Congressional Add: *Partnership and Technology Transfer*	-	4.000
Congressional Add: *Sensor Systems for Underground Detection*	-	3.000
Congressional Add: *UAS Mounted Hostile Threat Detection*	-	5.000
Congressional Add: *Heavy Load Simulator*	-	6.000
Congressional Add: *Measurement and Control of Frozen Surface Properties*	-	4.000
Congressional Add: *Resilient Energy Systems*	-	2.500
Congressional Add: *Operations in Permafrost Environment*	-	4.000
Congressional Add: *Power Generation Technologies in Cold Regions*	-	5.000
Congressional Add: *Sensing and Prediction of Arctic Maritime Coastal Ice Conditions*	-	5.000
Congressional Add: *Thermosyphons*	-	2.000
Congressional Add: *Materials and Manufacturing Technology for Cold Environments*	-	3.500
Congressional Add: *Energy Technology Research in Cold and Arctic Regions*	-	4.000
Congressional Add: *Research Facility Modernization*	-	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.

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BK8 / *Robotics for Engineer Operations 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
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

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)	FY 2019	FY 2020	FY 2021
Title: Robotic Integrated Engineer Operations (RIENO)	-	1.922	-
Description: This effort matures and demonstrates remote control and semi-autonomous protocols and processes on small scale construction equipment to provide information that scales to larger legacy equipment as well as assess the applicability of small scale equipment working in collaboration and coordination.			
FY 2020 Plans:			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BK8 / *Robotics for Engineer Operations Adv Tech*

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

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BK9 / *Ground System Fluids and Fuels 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
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

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			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BK9 / *Ground System Fluids and Fuels Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
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. ***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.			
Title: Ground System Fluids and Fuels ***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. Assess additional candidate synthetic fuel blends to determine their suitability for military ground systems. 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. ***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. ***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.	-	-	1.748
Title: FY 2020 SBIR/STTR Transfer ***Description:*** Funding transferred in accordance with Title 15 USC ?638 ***FY 2020 Plans:***	-	0.096	-

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BK9 / *Ground System Fluids and Fuels Adv Tech*

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	-	2.118	1.748

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BL3 / *Explosives Forensics 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
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

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:			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BL3 / *Explosives Forensics Advanced Technology*

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 ***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	-	0.092	-
Accomplishments/Planned Programs Subtotals	-	2.038	2.077

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BL6 / *Expedient Passive Protection 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
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

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:			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BL6 / *Expedient Passive Protection Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
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. ***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	-	0.067	-
Accomplishments/Planned Programs Subtotals	-	3.703	3.166

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BL8 / *Power Projection in A2AD Environments 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
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

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:			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BL8 / *Power Projection in A2AD Environments Adv Tech*

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

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BM1 / *Protection from Advanced Weapon Effects 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
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

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:			

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BM1 / *Protection from Advanced Weapon Effects Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
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. ***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).			
Title: Defeat of Complex Attack Demonstrations ***Description:*** This effort demonstrates force protection technologies that mitigate the effects of emerging peer and near peer adversaries advanced penetrating threats and high yield blast effects by optimizing high-performance, logistically feasible material solutions and processes. ***FY 2020 Plans:*** Demonstrate baseline protection of current structural hardening solutions against fragmentation effects and scaled high velocity penetrator effects from precision strike weapons. ***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. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.	-	1.673	2.184
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	-	0.008	-
Accomplishments/Planned Programs Subtotals	-	1.919	2.184

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BM1 / *Protection from Advanced Weapon Effects Adv Tech*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

Exhibit 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 / *Ground Advanced Technology*	Project (Number/Name) BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (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
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

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

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

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

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

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

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit 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 / *Ground Advanced Technology*	**Project (Number/Name)** BO3 / *MILITARY ENGINEERING TECHNOLOGY DEMONSTRATION (CA)*

D. Acquisition Strategy

N/A