Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602784A *I Military Engineering Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	114.947	101.124	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	216.071
855: *Topographical, Image Intel & Space*	-	17.603	18.172	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.775
H71: *Meteorological Research For Battle Command*	-	6.599	5.675	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.274
T40: *Mob/Wpns Eff Tech*	-	27.706	32.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	60.254
T41: *Mil Facilities Eng Tec*	-	6.335	7.693	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.028
T42: *Terrestrial Science Applied Research*	-	5.040	5.127	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.167
T45: *Energy Tec Apl Mil Fac*	-	3.464	2.909	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.373
T53: *Military Engineering Applied Research (CA)*	-	48.200	29.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	77.200

Note

In Fiscal Year (FY) 2020 this Program Element (PE) is realigned with continuity of effort to following:
* PE 0602144A Ground Technology
* PE 0602145A Next Generation Combat Vehicle Technology
* PE 0602146A Network C3I Technology
* PE 0602150A Air and Missile Defense Technology

A. Mission Description and Budget Item Justification

This PE investigates and advances technologies, techniques, and tools for representation of the physical and human environment for use in military planning and operations; for characterizing geospatial, atmospheric, and weather conditions and impacts on systems and military missions; for conducting mobility, counter-mobility, survivability, and force protection planning and operations; and for enabling secure, sustainable, energy efficient facilities. Research focuses on special requirements for battlefield visualization, tactical decision aids, weather intelligence products, and capabilities to exploit space assets. Project 855 conducts geospatial research and development supporting a standard sharable geospatial foundation enabling a common operating environment across mission and command systems. Project H71 supports the materiel development, testing, and operations communities in evaluating the impacts of weather and atmospheric obscurants on military materiel and operations. Project T40 advances force protection technologies across the range of military operations, including expedient protection and hardened construction to defeat complex threats. This Project also designs and develops software and hardware to identify and mitigate ground obstacles for manned and unmanned vehicles; characterizes austere navigation environments, including complex urban environments, and designs and develops materiel solutions, including rapidly emplaced bridging and expedient repair technologies, to allow austere port and airfield entry of forces; and builds and uses modeling and simulation tools to advance

understanding of the interactions of weapons/munitions and novel defeat methodologies with protective construction and critical infrastructure. Project T41 investigates application of technologies to enable garrison/post commanders to plan, monitor, and operate facilities more efficiently, cost-effectively, securely, and sustainably; creates tools (including advanced models and simulations) that provide a framework for making trades and decisions; and supports research to assess non-combat population characteristics and status from social and cultural perspectives to achieve mission objectives. Project T42 develops and validates models and simulations to understand the impacts of the physical environment on the performance of forces, ground and air vehicles, and sensors; as well as the impact of natural and man-made changes in the environment on military operations. Project T45 investigates materials, components, and systems that have potential to reduce energy losses in buildings and shelters; and potential to detect and mitigate consequences of contaminants, such as bacteria and molds, in air handling equipment and building materials.

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

Research is transitioned to PE 0603734A (Military Engineering Advanced Technology).

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 Army Engineer Research and Development Center (ERDC) and the Army Futures Command (AFC).

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	67.720	78.159	80.145	-	80.145
Current President's Budget	114.947	101.124	0.000	-	0.000
Total Adjustments	47.227	22.965	-80.145	-	-80.145
• Congressional General Reductions	-0.020	-0.035			
• Congressional Directed Reductions	-	-6.000			
• Congressional Rescissions	-	-			
• Congressional Adds	48.200	29.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.953	-			
• Adjustments to Budget Years	-	-	-80.145	-	-80.145

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: T53: *Military Engineering Applied Research (CA)*		
Congressional Add: *Innovative Construction Materials for the Arctic*	8.000	8.000
Congressional Add: *Secure Management of Energy Storage*	3.000	-
Congressional Add: *Advanced Blast Load Simulator*	4.500	-

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army	Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602784A *I Military Engineering Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Congressional Add: *Construction Materials*	7.000	-
Congressional Add: *Engineered Resilient Systems*	10.000	-
Congressional Add: *Lightweight High Performance Materials*	10.000	-
Congressional Add: *M1 Abrams Tank Track System*	1.600	-
Congressional Add: *Smart Runway Program*	2.100	-
Congressional Add: *Bio-inspired Functionally Graded Composites for Hazard Mitigation*	2.000	-
Congressional Add: *Program Increase: Unspecified*	-	5.000
Congressional Add: *Cellulose Nanocomposites Research*	-	15.000
Congressional Add: *Vehicle-born IED Screening*	-	1.000
Congressional Add Subtotals for Project: T53	48.200	29.000
Congressional Add Totals for all Projects	48.200	29.000

Change Summary Explanation

FY18 increase related to congressional adds totaling $48.2 Million.
FY19 increase related to congressional adds totaling $29 Million
FY20 decrease related to science and technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) 855 / *Topographical, Image Intel & Space*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
855: *Topographical, Image Intel & Space*	-	17.603	18.172	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.775

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602146A Network C3I Technology:
* Project AT7 Network-Enabled GeoSpatial and GEOINT Services Tech
* Project AT9 Tactical GeoSpatial Information Capabilities Technology
* Project AU3 Geospatially Enabled Operational Design Technology
* Project AU5 Automated Analytics for Understanding the Operational Environment Technology

A. Mission Description and Budget Item Justification

This Project investigates and advances capabilities for collection, processing, and creation of data and information depicting physical and human terrain, environmental conditions, and relationships in time and space; digital map creation, transmission, and dissemination; and map-based analytics for planning, decision making, and execution. This Project uses non-traditional methods that exploit existing open source text, multi-media, and cartographic materials addressing social, cultural, and economic geography to advance the capability to produce and transmit high fidelity digital maps depicting the physical terrain, human terrain, and environmental conditions. This Project also develops software tools and methods for map-based analytics that allow deeper insights into the effects of the physical terrain, human terrain, and environmental conditions on military operations, to include tactics and effects upon equipment and Soldier performance. This Project explores and advances components and methods that optimize the utility of the Army Geospatial Enterprise (AGE) to the total Army, which provides map and geospatial data, information, and software services to the total force.

All FY20 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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: GeoIntelligence - Geospatial Data Collection, Processing, and Decision Support (Previously titled GeoIntelligence - Geospatial Data Generation and Decision Support)	2.282	5.989	-
Description: This effort investigates novel map content generation and geo-temporal analytics for the development of geospatially-based decision support tools. This research focuses on automatic inference and the correlation between events and objects (i.e., people, places) through space and time from massive data sets developed in the Geoenabled Computing			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Environments effort. In addition, the effort investigates advanced models to forecast effects of the physical terrain, human terrain, and environment for applications to the Military Decision Making Process, an analysis that informs course of action development and evaluation of tactics, equipment, and mission risk. ***FY 2019 Plans:*** Investigate emerging computational models to increase the tempo of small unit tactical decision making through spatial reasoning, analysis, and multi-domain information and data fusion toward narrative information packages aligned with the current mission and situation. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technologies) / Project AT7 (Network-Enabled GeoSpatial and GEOINT Services Tech) in FY20 as part of the financial restructuring.			
Title: GeoIntelligence - Geospatial Data Analysis and Decision Support ***Description:*** This effort develops means to collect, process, and visualize very high-fidelity data and information to capture the dynamic effects of the physical and human terrain impacting military ground operations. The research focuses on tactical, rather than national or commercial, remote sensing of physical terrain to achieve the fidelity required for current and future operations. Research includes investigating new methods for effective sensor systems and materials to 'tag' features, items, and people of interest based upon novel and emerging Light Detection and Ranging (LiDAR) sensor systems, innovative LiDAR collection and analysis techniques, and an array of other sensor systems for intermittent and persistent optimal data collection, object identification, and classification for ground operations. ***FY 2019 Plans:*** Investigate enhanced utility and quality of three-dimensional (3D) imagery for wide area mapping and surveillance of dense urban areas; assess utility and sufficiency of Geiger mode LiDAR prototype for wide area mapping at increasingly higher altitudes and increasing area coverage rates; research emerging remote sensing technologies for a multi-modal, tiered sensing approach to rapidly increase density and quality of 3D urban environment data, merging exterior, interior and below ground geospatial information. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technologies) / Project AU5 (Automated Analytics for Understanding the Operational Environment Technology) and Project AT9 (Tactical GeoSpatial Information Capabilities Technology) in FY20 as part of the financial restructuring.	4.686	4.923	-
Title: Human Geography - Spatial Reasoning, Analysis, and Visualization	4.060	3.008	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: This effort investigates integration of behavior and population dynamics research and analysis into geospatial frameworks to depict the operational environment including culture, demographics, terrain, climate, and infrastructure. Research exploits existing open source text, leverages multi-media and cartographic materials, and investigates data collection methods to ingest geospatial data directly from the tactical edge to characterize parameters of social, cultural, and economic geography. Results of this research augment existing conventional geospatial datasets by providing the rich context of the human aspects of the operational environment, which offers a holistic understanding of the operational environment for the Warfighter. ***FY 2019 Plans:*** Develop beta model for estimating future risks and impacts of extreme weather and climate variability on water, energy and food systems to inform the Joint Preparation of the Operational Environment; develop critical enhancements to the suite of methods and tools supporting mission analysis for civil-military operations to enhance stability and mitigate threats to the civilian population. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This effort ends in FY19.			
Title: Weather and Terrain Integration ***Description:*** This effort investigates innovative methods for integrating weather and physical terrain applications with geospatial systems compliant with the Army's Common Operating Environment approach to the Army Geospatial Enterprise thereby providing significant advancement to fused all-weather and all-season tactical decision aids supporting risk-based assessments.	2.590	-	-
Title: Map-Based Planning Services (MBPS) ***Description:*** This effort develops geospatially-enabled, collaborative mission planning capabilities providing services, data, and information to Army planners, staffs, and leaders. These mission planning capabilities will allow collecting, processing, storing, displaying, and sharing of authoritative data and information in a geo-temporal context. Work will leverage Army Geospatial Enterprise standard data sets and incorporate Geo-Enabled Mission Command tools and analytical capabilities.	3.985	-	-
Title: Geo-enable Computing Environments ***Description:*** This effort develops geospatially-enabled, collaborative mission planning capabilities providing services, data, and information to Army planners, staffs, and leaders. Work leverages Army geospatial enterprise standard data sets and incorporate geo-enabled mission command tools and analytical capabilities. ***FY 2019 Plans:***	-	3.926	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** 855 / *Topographical, Image Intel & Space*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Investigate a compatible framework for sharing a relevant and focused geospatially enabled visualization of the operational environment within the command post computing environment; investigation focuses on geospatial-enabled collaborative mission planning capabilities providing services, data, and information to the Army planners, staffs, and leadership. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AU3 (Geospatially Enabled Operational Design Technology) in FY20 as part of the financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.326	-
Accomplishments/Planned Programs Subtotals	17.603	18.172	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) H71 / *Meteorological Research For Battle Command*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
H71: *Meteorological Research For Battle Command*	-	6.599	5.675	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.274

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602146A Network C3I Technology:
* Project AV7 Atmospheric Modeling and Meterological Technology

A. Mission Description and Budget Item Justification

This Project develops tactical weather and atmospheric effects/impacts algorithms for their integration into battlefield information products. Efforts include high-resolution, local assessments and forecasts of meteorological conditions in near real time including effects of urban and mountainous terrain; analytical tools to assess the impact of the atmosphere to optimize system performance and operations planning and advanced atmospheric sensing applications to characterize and mitigate wind and turbulence in complex terrain. It provides detailed model applications for various effects of the atmosphere on electro-optical and acoustic target detection, location, and identification. This Project develops both physics-based decision aids and rule-based decision support systems for assessing the impacts of weather/ atmosphere across a spectrum of friendly and threat weapons systems, sensors, platforms, and operations. Information can be applied to mission planning and execution, battlefield visualization, reconnaissance surveillance and target acquisition, route planning to maximize stealth and efficiency, web enabled tactical decision aids, and also modeling of environmental impacts for combat simulations and war games.

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.

This work transitions technologies to the Department of Defense weather and operations modeling community, the United States Air Force 557th Weather Wing to improve their operational weather support to the Army Project Leader-Fire Support Command and Control and Marine Corps Systems Command (MCSC) for field artillery systems, the Project Manager, Distributed Common Ground System-Army (DCGS-A), the Joint Improvised Threat Defeat Agency, the Program Executive Office Aviation/Tactical Airspace Integration System (TAIS).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Atmospheric Characterization, Modeling, and Impacts (formerly Atmospheric Modeling)	5.593	5.620	-
Description: This effort develops high resolution, short-range forecasting, and high resolution atmospheric modeling capabilities for mountainous, urban, and forest complex terrain.			
FY 2019 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** H71 / *Meteorological Research For Battle Command*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Research and develop decision support technology, including characterizing atmospheric impacts on and optimized paths for hypersonic munitions; research and develop enhancements to automated routing capabilities to include accounting for acoustic signatures of air/ground platforms in varying environments (e.g. complex terrain and dense urban environments); develop and implement methods for decision support tools to ingest and represent probabilistic components and forecast certainty/uncertainty of atmospheric prediction models; develop a densely-instrumented urban environmental testbed to characterize urban flow processes under varied background meteorological conditions; develop system for optimizing Weather Running Estimate-Nowcast (WRE-N) configuration based on geographical characteristics including system verification and validation; optimize the atmospheric boundary layer environment using Lattice Boltzman method (ABLE-LBM) dynamical core for use on small platforms with accelerator cards; demonstrate capability of incorporating unmanned aerial systems (UAS) and other local data sources into a networked- constrained Nowcast model; develop tailored model for improved autonomous system performance; refine of next generation atmospheric acoustic decision support tool used to determine the detection footprint of small UAS by investigating physics constrained machine learning ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AV7 (Atmospheric Modeling and Meterological Technology) in FY20 as part of the financial restructuring.			
Title: Local Area Atmospheric Prediction for Geospatial Applications (formerly Atmospheric Prediction for Local Areas) ***Description:*** This effort designs and determines software models and sensors to improve local characterization and prediction of atmospheric conditions in urban and complex terrain by directly integrating atmospheric boundary layer (the lowest part of the atmosphere in contact with the surface) meteorological measurements into high resolution models and decision aids and validates these improvements with field measurements.	1.006	-	-
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.055	-
Accomplishments/Planned Programs Subtotals	6.599	5.675	-

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** H71 / *Meteorological Research For Battle Command*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T40 / *Mob/Wpns Eff Tech*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
T40: *Mob/Wpns Eff Tech*	-	27.706	32.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	60.254

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602144A Ground Technology:
* Project BL5 Expedient Passive Protection for Technology
* Project BL7 Power Projection in A2/AD Environments Technology
* Project BL9 Protection from Advanced Weapon Effects Technology
PE 0602145A Generation Combat Vehicle Technology:
* Project BF1 Autonomous Ground Resupply
* Project BG2 Modeling & Simulation for MUMT Technology
PE 0602146A Network C3I Technology:
* Project AR9 Persistent Geophysical Sensing-Infrasound Tech
* Project AT2 Subterranean Detection and Monitoring Technology
PE 0602150A Air and Missile Defense Technology
* Project AE2 Unconventional Countermeasures-Survivability Tech

A. Mission Description and Budget Item Justification

This Project investigates, designs, and develops technologies for adaptive and expedient force protection and projection across the range of military operations. Focus areas include force projection and maneuver, including austere port and airfield entry; prediction, definition, avoidance, or defeat of natural and manmade gaps and obstacles to support ground force operations; scalable weapons effects; and high-resolution representation of near-surface terrain and environment for use with sensor models for target detection and unmanned ground systems (UGS) navigation. This research also provides physics-based representations of ground vehicle mobility, obstacle and barrier placement, survivability, and weapons effects in complex and urban terrain modeling and simulation. Work in this Project increases the protection of soldiers and critical assets from conventional, unconventional, and emerging threats and enables maneuver support of ground forces, while reducing their logistical footprint. This Project supports efforts for overcoming critical capability gaps for operations in a number of environments including dismounted Soldiers conducting missions in urban and subterranean environments, distributed small units, and projection and sustainment of forces across an increasing large battlefield.

All FY20 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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

This work is fully coordinated with and complementary to PE 0603734A (Military Engineering Advanced Technology). Autonomous ground resupply activities are coordinated in collaboration with the Tank and Automotive Research, Development and Engineering Center (TARDEC) through PE 0603005A (Combat Vehicle and Automotive Advanced Tech) / Project 515 (Robotic Ground Systems), PE 0602601A (Combat Vehicle and Automotive Technology) / Project H77 (National Automotive Center), and PE 0602601A (Combat Vehicle and Automotive Technology) / Project H91 (Ground Vehicle Technology). Autonomous Ground Resupply activities are also coordinated in collaboration with the Armament Research Development and Engineering Center (ARDEC) through 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).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Adaptive Protection	10.739	13.550	-
Description: This effort develops new analytical techniques, advanced materials, and integrated protection systems to support the protection of critical assets on the battlefield. Technology development efforts include techniques and materials to protect fixed and semi-fixed assets and soldiers in complex, urban and contested environments; techniques to increase survivability through unconventional means and advanced hardening material solutions; and techniques to identify subterranean threats against forces and critical assets. ***FY 2019 Plans:*** Develop algorithms to predict a range of threat weapon effects on relevant urban construction types and design an assessment tool to ensure safe building occupation decisions; develop and examine rapid signature reduction materials and methods to increase critical asset survivability; develop perimeter security and surveillance technologies and algorithms to detect, track, and classify surface, maritime, and subterranean threat activities; design and develop new protective technologies to defeat future near-peer adversarial threats. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602144A (Ground Technology) / Project BL5 (Expedient Passive Protection for Technology), Project BL9 (Protection from Advanced Weapon Effects Technology), and PE 0602150A (Air and Missile Defense Technology) / Project AE2 (Unconventional Countermeasures-Survivability Tech) in FY20 as part of the financial restructuring.			
Title: Austere Entry and Maneuver	11.956	13.103	-
Description: This effort investigates, designs, and creates tools and technologies that identify, assess, and monitor structural and functional suitability of theater access points and infrastructure. This effort investigates materials and models to rapidly repair or construct infrastructure to support power projection and maneuver. This effort creates tools that allow planning of distributed sustainment nodes and tactical logistics resupply networks across the complex, contested battlefield. This effort, investigates			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
techniques and creates tools to simulate manned/unmanned tactical maneuver and mobility of small disbursed units in complex and urban terrains. ***FY 2019 Plans:*** Provide an updated version of a real-time hardware-in-the-loop simulation environment to investigate autonomous vehicle maneuver; develop software to automatically detect mobility obstacles in near-real time; develop algorithms and begin interface design to automate analyses of seismic-infrasound-acoustic-meteorological (SIAM) data for non-subject matter expert use while monitoring infrastructure; identify materials and technologies for modeling efforts to assess and plan projection and protection for dispersed small units in extreme, constantly evolving, and complex environments; begin physics-based modeling efforts to predict projection material performance under repetitive loading during projection operations; identify and examine new materials to reduce weight, increase durability, and enable rapid constructability during force projection and sustainment operations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602144A (Ground Technology) / Project BL7 (Power Projection in A2/AD Environments Technology), and PE 0602145A (Next Generation Combat Vehicle Technology0 / Project BF1 (Autonomous Ground Resupply Tech) in FY20 as part of the financial restructuring.			
Title: Environmental Impacts on Sensor Performance	3.745	3.862	-
Description: This effort investigates, designs, and creates physics-based, multiscale numerical models of the geo-environment and synthetic environments representing geo-environment impacts on various sensor modalities and systems. These enable the development of sensors and sensor algorithms for object or target detection, sensor-target pairing, unconventional countermeasures experiments, and autonomous navigation and tactical behaviors in unmanned ground systems. This effort further investigates the design of non-line-of-sight sensors for remote areas, including the investigation of coupling between sensors and their environment for understanding surface and subsurface activities. This effort supports persistent surveillance and detection capabilities and air missile defense. ***FY 2019 Plans:*** Develop computational capabilities to investigate unconventional countermeasures to enhance the protection of critical assets; develop new and expand current computational test bed capabilities to simulate dynamic adaptive sensing technologies in emerging threat environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:***			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AT2 (Subterranean Detection and Monitoring Technology) and Project AR9 (Persistent Geophysical Sensing and Infrasound Tech) in FY20 as part of the financial restructuring.			
Title: Materials Modeling ***Description:*** This effort investigates and leverages physics-based computational models and laboratory experiments to understand the relationships between the chemical and micro-structural composition of materials and their performance characteristics when used in protecting facilities. ***FY 2019 Plans:*** Provide the first spiral of a virtual material by design procedure to predict engineering properties for force protection material performance; continue laboratory investigations of novel composites, ceramics, polymers, and other non-cementitious materials for layered force protection methods. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602145A (Next Generation Combat Vehicle Technology) / Project BG2 (Modeling & Simulation for MUMT Technology) in FY20 as part of the financial restructuring.	1.266	1.384	-
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.649	-
Accomplishments/Planned Programs Subtotals	27.706	32.548	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T40 / *Mob/Wpns Eff Tech*

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T41 / *Mil Facilities Eng Tec*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
T41: *Mil Facilities Eng Tec*	-	6.335	7.693	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	14.028

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0602144A Ground Technology:
*Project BK7 Robotics for Engineer Operations Technology

A. Mission Description and Budget Item Justification

This Project investigates and develops technologies and techniques to support robotic and autonomous operations capabilities, ensure sustainable, cost efficient, and effective facilities, and to achieve resilient and sustainable installation and expeditionary operations. The project focuses on facilities and operations technologies directly supporting training, readiness, force projection, force protection, and homeland security. Facility enhancement technologies contribute to cost reductions in the Army facility life cycle process (infrastructure planning, assessment, design, construction, revitalization, sustainment, and disposal), and the supporting installation operations. This work improves the capability of autonomous engineering during combat operations to perform construction and supporting tasks in high risk/threat and dynamic environments, enables installations to support forces to meet transformation goals, improves designs for close battle training facilities, and enhances security of Soldiers, families, and civilians. Technologies evolving from this work include integrated planning and design tools for United States (U.S.) facilities and on-demand expeditionary structures, models predicting water dispersed contaminant effects on facilities and occupants; sustainable facility and base management; collaborative decision support tools; and advanced materials. In addition, technologies from this work will support analysis of socio-cultural and facility issues in contingency operations, including urban environments.

All FY20 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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Infrastructure for Combat Operations (Previously titled Adaptive and Resilient Installations)	3.692	1.925	-
Description: The Army requires the ability to assess, establish, upgrade, and secure infrastructure while in theatre to enable deployed force operations. This effort provides tools for the assessment of physical and ecological impacts on operations, agile infrastructure modification, and custom designed construction for expeditionary structures on demand.			
FY 2019 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T41 / *Mil Facilities Eng Tec*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Design and develop a prototype decision tool to identify types of additional design scenario variables that relate to the social, cultural, economic and political conditions that impact operational planning; and investigate approaches to fully integrate enterprise business processes and information infrastructure across Army power projection platforms. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Effort ends in FY19.			
Title: Human Geography ? Fundamentals of Behavior and Population Dynamics ***Description:*** This effort researches population dynamics including physical, cultural, psychological, and behavioral attributes critical to United States Army engagement activities in an area of operations, including urban environments. Technology development efforts include means to identify dynamic indicators in the socio-cultural realm to assist in estimating or predicting behavioral response to operations and to display indicators in spatial-temporal views for the Warfighter. ***FY 2019 Plans:*** Develop a workflow and methodology to incorporate key authoritative Civil Affairs sociocultural datasets into the Army?s military decision making process for informing intelligence preparation of battlefield products for civil considerations and the commander?s critical information requirements; develop a computational framework to integrate multi-scale computational models of environmental, infrastructural, and social systems, enabling information support to the Joint Intelligence Preparation of the Operational Environment (JIPOE) within complex environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Effort ends in FY19.	2.643	2.561	-
Title: Robotics for Engineer Operations ***Description:*** Develop and demonstrate robotic engineer construction equipment capability allowing Engineers to conduct autonomous and semi-autonomous Mobility, Countermobility and Construction missions. This effort supports the Army's Modernization Priority Next Generation Combat Vehicle (NGCV), Maneuver Robotics and Autonomous Systems, and is intended to provide capabilities that enable and increase the effectiveness of future maneuver formations with extended reach (area and time), by enabling increased force survivability by combining manned and robotic teaming in the conduct of cross-domain maneuver in complex terrain while reducing risk to Soldier and units. ***FY 2019 Plans:***	-	2.929	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T41 / *Mil Facilities Eng Tec*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Develop robotic construction equipment capabilities allowing Engineers to conduct autonomous and semi-autonomous mobility, countermobility and construction missions. Design proof of concept for a prototype robotic obstacle-removal platform, and develop advanced construction methods for deployed forces. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602144A (Ground Technology) /Project BK7 (Robotics for Engineer Operations Technology) in FY20 as part of the financial restructuring.			
Title: FY 2019 SBIR / STTR Transfer ***Description:*** FY 2019 SBIR / STTR Transfer ***FY 2019 Plans:*** FY 2019 SBIR / STTR Transfer ***FY 2019 to FY 2020 Increase/Decrease Statement:*** FY 2019 SBIR / STTR Transfer	-	0.278	-
Accomplishments/Planned Programs Subtotals	6.335	7.693	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T42 / *Terrestrial Science Applied Research*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
T42: *Terrestrial Science Applied Research*	-	5.040	5.127	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.167

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
Program element (PE) 0602146A Network C3I Technology:
* Project AT4 GeoINT - OPS Merge Technology

A. Mission Description and Budget Item Justification

This Project investigates and advances technologies to characterize and respond to impacts of the terrestrial environment on the performance of emerging and deployed Army systems, as well as the impact of natural and man-made changes in the environment on all phases of unified land operations. Research efforts model the dynamics of electromagnetic, acoustic, and seismic propagation in response to changing terrain state and complex terrain features and geometry, and their depiction in geospatial information and mission command systems. Numerical modeling of weather effects on terrain properties supports intelligence preparation of the battlefield products including mobility estimates and intelligence, surveillance, and reconnaissance planning. This effort integrates terrain knowledge and weather forecast in a mission context to provide geospatial information and mission command-delivered solutions to the Soldier. The understanding gained and products developed improve the ability to predict signature (emitter) behavior and sensor performance in complex operational environments, and support materiel development, sensor performance products for tactical decision-making, and visualization for mission command.

All FY20 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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Army Terrestrial Environmental Modeling & Intelligence System (ARTEMIS)	3.539	-	-
Description: This effort integrates terrain knowledge and the dynamic effects of weather and mission to provide geospatial reasoning solutions to the Soldier. The understanding gained and products developed improve the ability to predict signature behavior and sensor performance in complex operational environments, improve sensor performance products for tactical decision-making, and improve visualization for mission command. In FY19, funds from this effort are realigned to Geospatial Analytics for High Resolution Enriched Terrain 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.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T42 / *Terrestrial Science Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: GeoIntelligence - Terrestrial Phenomenology Characterization for Geospatial Applications (Previously Titled Analysis for Signal & Signature Phenomenology) ***Description:*** This effort investigates the dynamics of electromagnetic, acoustic, and seismic signatures in response to changing terrain state and complex terrain geometry. Research results improve sensor employment tactics, techniques and procedures, and numerical modeling of terrain properties for tactical advantage and geospatial tactical decision aids. In FY19, funds from this effort are realigned to Geospatial Representation of Dynamic Phenomena in support of the Army S&T priorities as identified at the December 2016 S&T Army Requirements Oversight Council by the Chief of Staff of the Army.	1.501	-	-
Title: Tactical Augmented Reality for Operational Technologies - 3D Terrain ***Description:*** This effort partnered with Communications - Electronics Research, Development, and Engineering Center, designs and exploits an innovative geospatial framework for storage, extraction, processing and visualization of high-resolution three-dimensional (3D) terrain data for tactical visualization systems, helmet-mounted, and other displays. Research results will mature technological components to enable a leap ahead in Soldier situational awareness by introducing geo-registered geospatial cues with military symbology on the Soldiers view of the real world, enabling more rapid decision making by the mounted and dismounted Warfighters. ***FY 2019 Plans:*** Develop advanced algorithms for the detection and delineation of edges, sides, and corners of built infrastructure within collected 3D urban data, and export results as light-weight wireframe or mesh to augment the Soldier?s situational awareness in dense and congested urban and complex terrain. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AT9 (Tactical GeoSpatial Information Capabilities Techn) in FY20 as part of the financial restructuring.	-	1.000	-
Title: Geospatial Analytics for High Resolution Enriched Terrain ***Description:*** This effort investigates and develops enhanced and automated analytical capabilities to update, revise and complete 3D high-resolution geospatial representations of the time-stable objects and geometries of complex and urban terrain (e.g. buildings) for the common operating picture. Research results, a new and innovative set of geospatial models, apply to a variety of planning and visualization capabilities for enabling the Soldier to effectively operate with greater situational awareness in complex terrain and dense urban environments. ***FY 2019 Plans:***	-	3.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T42 / *Terrestrial Science Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Investigate emerging man/machine learning algorithms to automate production processes, to enable change detection, and to support learning by manned and autonomous systems with the capability to collect and/or complete 3D high-resolution common operating picture of complex and urban terrain. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AT9 (Tactical GeoSpatial Information Capabilities Techn) in FY20 as part of the financial restructuring.			
Title: Geospatial Representation of Dynamic Phenomena ***Description:*** This effort investigates and develops capabilities for automated techniques and tools to identify, characterize, and visualize dynamic geospatial features (e.g., non-combatant clutter) to selectively overlay on high-resolution 3D geospatial representations of infrastructure and terrain surfaces for the Common Operating Picture and tactical displays. These dynamic geospatial features include natural and man-made ephemeral conditions affecting military operations (e.g., obstacles, traffic, population, degraded visual environment, snow, ephemeral water bodies, etc.), such as movement and maneuver, and sensor performance. ***FY 2019 Plans:*** Investigate new methods to identify, characterize, track and visualize battlespace objects that change with time (examples include rubble, bridge damage, vehicles, street markets, flooding and other weather induced effects) impacting Soldier and unmanned systems movement and maneuver in complex terrain. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602146A (Network C3I Technology) / Project AT7 (Network-Enabled GeoSpatial and GEOINT Services Tech) in FY20 as part of the financial restructuring.	-	1.127	-
Accomplishments/Planned Programs Subtotals	5.040	5.127	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T45 / *Energy Tec Apl Mil Fac*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
T45: *Energy Tec Apl Mil Fac*	-	3.464	2.909	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.373

Note

In Fiscal Year (FY) 2020 this Project is realigned to:
Program Element (PE) 0602144A Ground Technology:
* Project BK7 Robotics for Engineer Operations Technology

A. Mission Description and Budget Item Justification

This Project investigates and evaluates technologies necessary for secure, efficient, sustainable military installations and expeditionary structures, emphasizing systems protection in response to evolving needs, including autonomous and semi-autonomous mobility, countermobility and construction. Technologies and processes are also applied to the Army's industrial base to maintain its cost-effective readiness for munitions production and training, and in the theater of operations to reduce logistical footprint. This effort investigates technologies to assess, establish, upgrade, and secure infrastructure while in theatre to enable deployed force operations, develops methods to optimize sustainable operations and maintenance to minimize lifecycle costs, and provides capabilities that enable future maneuver formations. In addition, technologies from this work mature a better understanding of critical infrastructure interdependencies to support sustainable and flexible facility operations and evolving mission requirements.

All FY20 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 Army Engineer Research and Development Center (ERDC), Vicksburg, Mississippi.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Infrastructure for Combat Operations (Previously titled Adaptive and Resilient Installations) ***Description:*** The Army requires the ability to assess, establish, upgrade, and secure infrastructure while in theatre to enable deployed force operations. This effort provides tools for the assessment of physical and ecological impacts on operations, agile infrastructure modification, and custom designed construction for expeditionary structures on demand.	3.464	-	-
Title: Robotics for Engineer Operations ***Description:*** Develop and demonstrate robotic engineer construction equipment capability allowing Engineers to conduct autonomous and semi-autonomous Mobility, Countermobility and Construction missions. This effort supports the Army's Modernization Priority Next Generation Combat Vehicle (NGCV), Maneuver Robotics and Autonomous Systems, and is intended to provide capabilities that enable and increase the effectiveness of future maneuver formations with extended reach (area and	-	2.909	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T45 / *Energy Tec Apl Mil Fac*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
time), enabling increased force survivability by combining manned and robotic teaming in the conduct of cross-domain maneuver in complex terrain while reducing risk to Soldier and units. ***FY 2019 Plans:*** Develop robotic construction capabilities for forward deployed Engineers. This includes autonomous site characterization for construction; debris and obstacle removal; horizontal infrastructure repair; obstacle emplacement; control methodologies for multiple robotic construction equipment to work collaboratively and cooperatively, and additive printing using concrete or other cementitious materials for onsite implementation and use. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned to PE 0602144A (Ground Technology) /Project BK7 (Robotics for Engineer Operations Technology) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	3.464	2.909	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602784A / *Military Engineering Technology*	Project (Number/Name) T53 / *Military Engineering Applied Research (CA)*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
T53: *Military Engineering Applied Research (CA)*	-	48.200	29.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	77.200

Note

Congressional increases for Program increase

A. Mission Description and Budget Item Justification

Congressional increases supporting the investigation and advancement of technologies, techniques, and tools for representation of the physical and human environment for use in military planning and operations; for characterizing geospatial, atmospheric, and weather conditions and impacts on systems and military missions; for conducting mobility, counter-mobility, survivability, and force protection planning and operations; and for enabling secure, sustainable, energy efficient facilities.

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 2018	FY 2019
Congressional Add: Innovative Construction Materials for the Arctic	8.000	8.000
FY 2018 Accomplishments: Innovative Construction Materials for the Arctic		
FY 2019 Plans: Innovative Construction Materials for the Arctic		
Congressional Add: Secure Management of Energy Storage	3.000	-
FY 2018 Accomplishments: Secure Management of Energy Storage		
Congressional Add: Advanced Blast Load Simulator	4.500	-
FY 2018 Accomplishments: Advanced Blast Load Simulator		
Congressional Add: Construction Materials	7.000	-
FY 2018 Accomplishments: Construction Materials		
Congressional Add: Engineered Resilient Systems	10.000	-
FY 2018 Accomplishments: Engineered Resilient Systems		
Congressional Add: Lightweight High Performance Materials	10.000	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602784A / *Military Engineering Technology*	**Project (Number/Name)** T53 / *Military Engineering Applied Research (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
FY 2018 Accomplishments: Lightweight High Performance Materials		
Congressional Add: M1 Abrams Tank Track System	1.600	-
FY 2018 Accomplishments: M1 Abrams Tank Track System		
Congressional Add: Smart Runway Program	2.100	-
FY 2018 Accomplishments: Smart Runway Program		
Congressional Add: Bio-inspired Functionally Graded Composites for Hazard Mitigation	2.000	-
FY 2018 Accomplishments: Bio-inspired Functionally Graded Composites for Hazard Mitigation		
Congressional Add: Program Increase: Unspecified	-	5.000
FY 2019 Plans: Program Increase: Unspecified		
Congressional Add: Cellulose Nanocomposites Research	-	15.000
FY 2019 Plans: Cellulose Nanocomposites Research		
Congressional Add: Vehicle-born IED Screening	-	1.000
FY 2019 Plans: Vehicle-born IED Screening		
Congressional Adds Subtotals	48.200	29.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A