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 1: *Basic Research*					**R-1 Program Element (Number/Name)** PE 0601104A I *University and Industry Research Centers*							

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	-	103.957	114.003	86.164	-	86.164	87.621	89.301	91.116	93.058	0.000	665.220
AB4: *Army Research Centers*	-	0.000	0.000	26.150	-	26.150	26.452	26.973	27.513	27.818	0.000	134.906
AB7: *Army Collaborative Research and Tech Alliances*	-	0.000	0.000	42.863	-	42.863	43.482	44.295	45.122	45.564	0.000	221.326
AB8: *Army Educational Outreach Program*	-	0.000	0.000	10.466	-	10.466	10.675	10.893	11.111	12.225	0.000	55.370
AC6: *International Science and Technology*	-	0.000	0.000	6.685	-	6.685	7.012	7.140	7.370	7.451	0.000	35.658
EA6: *Cyber Collaborative Research Alliance*	-	3.204	4.880	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.084
F17: *Neuroergonomics Collaborative Technology Alliance*	-	4.725	4.714	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.439
FF5: *Distributed Collaborative Intelligent Systems CTA*	-	4.012	5.813	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.825
FF7: *Internet of Battlefield Things CTA*	-	2.946	4.174	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.120
H04: *HBCU/MI Programs*	-	1.475	1.589	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.064
H05: *Institute For Collaborative Biotechnologies*	-	5.759	5.992	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.751
H09: *Robotics CTA*	-	3.971	4.235	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.206
H50: *Network Sciences Cta*	-	6.208	5.821	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.029
H59: *International Tech Centers*	-	6.459	6.549	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.008
H73: *Automotive Research Center (ARC)*	-	3.113	3.292	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.405
J08: *Institute For Creative Technologies (ICT)*	-	6.057	6.432	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.489

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 1: *Basic Research*					**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*						
J12: *Institute For Soldier Nanotechnology (ISN)*	-	5.759	5.992	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.751
J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*	-	20.000	22.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	42.000
J14: *Army Educational Outreach Program*	-	9.646	10.259	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	19.905
J15: *Network Sciences ITA*	-	3.919	4.106	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.025
J17: *Vertical Lift Research Center Of Excellence*	-	3.005	3.182	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.187
VS2: *Multi-Scale Materials Modeling Centers*	-	8.686	8.743	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.429
VS3: *Center For Quantum Science Research*	-	5.013	6.230	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.243

Note

In Fiscal Year (FY) 2020 this Program Element (PE) was previously funded with continuity of effort realigned to several new Projects in the following PEs:
* 0601104A University and Industry Research Centers
* 0601121A Cyber Collaborative Research Alliance

A. Mission Description and Budget Item Justification

This PE fosters university and industry based research to provide a scientific foundation for enabling technologies for future force capabilities. Broadly, the work in this PE falls into the categories of Collaborative Technology Alliances / Collaborative Research Alliances (CTAs/CRAs), University Centers of Excellence (COE), University Affiliated Research Centers (UARCs), Army-sponsored educational outreach, and Army investments at international academic and industrial partners. The Army formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs are industry-led partnerships between industry, academia, and the Army Futures Command to incorporate the practicality of industry, the expansion of the boundaries of knowledge from universities, and Army scientists to shape, mature, and transition technology relevant to the Army mission. CRAs are academia-led partnerships, which leverage the cutting-edge innovation found in the academic environment. The COEs focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, and couples state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in automotive and rotary wing technology. Also included are Army Educational Outreach Program (AEOP) and activities to stimulate interest in science, math, and technology among middle and high school students. This PE includes support for basic research at three Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long- term multidisciplinary effort. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies focuses on enabling network centric-technologies, and broadening the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for

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 1: *Basic Research*	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*

training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. This PE also includes the Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence that address critical research areas for Army Transformation.

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.

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	87.395	92.115	88.203	-	88.203
Current President's Budget	103.957	114.003	86.164	-	86.164
Total Adjustments	16.562	21.888	-2.039	-	-2.039
• Congressional General Reductions	-0.068	-0.112			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	20.000	22.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.001	-			
• SBIR/STTR Transfer	-3.369	-			
• Adjustments to Budget Years	-	-	-2.039	-	-2.039

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2018	FY 2019
Project: J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*		
Congressional Add: *Congressional Program Increase - University and Industry Research Centers*	15.000	10.000
Congressional Add: *Congressional Program increase - Materials in Extreme Dynamic Environments*	5.000	10.000
Congressional Add: *Congressional Program Increase - university assisted hypervelocity testing*	-	2.000
Congressional Add Subtotals for Project: J13	20.000	22.000
Congressional Add Totals for all Projects	20.000	22.000

Change Summary Explanation
FY18 increase related to Congressional Adds totaling $20 million.
FY19 increase related to Congressional Adds totaling $22 million.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army										Date: March 2019	

Appropriation/Budget Activity 2040 / 1				R-1 Program Element (Number/Name) PE 0601104A / *University and Industry Research Centers*						Project (Number/Name) AB4 / *Army Research Centers*	

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
AB4: *Army Research Centers*	-	0.000	0.000	26.150	-	26.150	26.452	26.973	27.513	27.818	0.000	134.906

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0601104A University and Industry Research Centers
* Project H04 HBCU/MI Programs
* Project H05 Institute For Collaborative Biotechnologies
* Project H73 Automotive Research Center
* Project J08 Institute For Creative Technologies
* Project J12 Institute For Soldier Nanotechnology
* Project J17 Vertical Lift Research Center of Excellence

A. Mission Description and Budget Item Justification

This Project encompasses The Partnered Research Initiative (PRI) which supports Army's research partnerships with Historically Black Colleges and Universities and Minority Institutions (HBCU/MI), University Affiliated Research Centers (UARCs), and Army Centers of Excellence (COEs). The PRI Program was established as the next phase of what was previously known as Partnership in Research Transition (PIRT) Program that ended in FY16. The focus of the PRI Program is to advance innovative basic research leading to potential technology development in areas of strategic importance to the Army by bringing competitively selected HBCUs and Minority-Serving Institutions (MIs) research teams into existing Army Futures Command Collaborative Research Alliances (CRAs) and Collaborative Technology Alliances (CTAs). The CTAs and CRAs are large collaborative centers focused on developing and transitioning research in Army critical areas. Army UARCs have been created to exploit opportunities to advance new capabilities through a sustained long- term multidisciplinary effort. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies focuses on enabling network centric-technologies, and broadening the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. The COEs focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, and couples state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in automotive and rotary wing technology.

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

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019	
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AB4 *I Army Research Centers*	

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Title: Centers of Excellence for Battlefield Capability Enhancements (BCE)	-	-	1.629
Description: The PRI Program was established as the next phase of what was previously known as PIRT Program that ended in FY16. The focus of the PRI Program is to advance innovative basic research leading to potential technology development in areas of strategic importance to the Army by bringing competitively selected HBCUs and MIs research teams into existing Army Futures Command CRAs and CTAs. The CTAs and CRAs are large collaborative centers focused on developing and transitioning research in Army critical areas. *FY 2020 Plans:* New Mexico Institute of Mining and Technology will collaborate with Multiscale Modeling of Electronic Materials (MSME) CRA by investigating how Uncertainty Quantification techniques and Optimization algorithms can be used to complete the pipeline for robust design of nanoparticles; City College of New York will contribute to Cognition and Neuroergonomics (CaN) CTA by focusing on measuring the relevance of peripheral stimuli to neural reliability via experiments in combined electroencephalogram and eye-tracking during passive free viewing of films; University of Texas at El Paso will collaborate with Cyber Security CRA by designing and running behavioral game theory experiments on group decision making; and North Carolina Agricultural & Technical State University will contribute to Materials in Extreme Dynamic Environments (MEDE) CRA with experiments to understand the effects of loading conditions such as temperature (from ambient to 773 Kelvin) and strain rate (from quasi-static to ultra-high) and their coupled effects on the mechanical properties and microstructure evolution of magnesium alloys. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE 0601104A University and Industry Research Centers/ Project H04 HBCU/MI Programs.			
Title: Institute for Collaborative Biotechnologies	-	-	5.344
Description: This effort performs sustained multidisciplinary basic research supporting technology to provide the Army with bio-inspired materials and biomolecular sensor platforms. *FY 2020 Plans:* Will continue to support projects and seedlings started in FY19 in systems and synthetic biology and bio-enabled materials. These efforts will include synthetic biology tools for novel thermal bioswitches, field-programmable molecular circuits, biological thermoelectric gels, and novel photochromic materials for load bearing. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE0601104A University and Industry Research Centers / Project H05 Institute For Collaborative Biotechnologies			
Title: Institute for Creative Technologies	-	-	6.569

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** AB4 / *Army Research Centers*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: This effort focuses on the basic research of Immersive Environments and spans a number of key areas to include virtual humans, three-dimensional (3D) sound and visual media to achieve more efficient and affordable training, modeling, simulation and application solutions and tools. Research includes: investigation of techniques and methods to address the rapid development of synthetic environments and the study of perception and cognition to help direct the development of new technologies and techniques that evoke more realistic responses from users; auditory aspects of immersion to provide the sound stimulus for increasing the realism for military training and simulation devices; new computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations; innovative methods for automatically generating animations and gestures for virtual humans based on what is being communicated; new technologies for scanning real people and rapidly generating virtual humans which look like these people significantly reducing the time, expense and effort required to develop virtual humans and virtual environments; methods and techniques for creating virtual human computer-generated characters that look, communicate and behave like real people that are autonomous, use verbal and non-verbal communication, exhibit emotions, model their own beliefs, desires and intentions as well as those of others, and reason using advanced artificial intelligence; and methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans and explore how people relate to virtual humans. *FY 2020 Plans:* Will use learning science and social simulations to understand and develop the human dimension of immersive environments and its complement to the physical dimensions of synthetic immersive environments, as well as the mixed reality live-synthetic training environment. Will define accurate articulation and behavior of virtual entities that will include the use of machine learning and artificial intelligence. Will use social simulations and cognitive network techniques to understand the critical human interactions that are necessary for effective virtual humans to replicate accurate training scenarios. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE0601104A University and Industry Research Centers/ Project J08 Institute For Creative Technologies (ICT)			
Title: Institute for Soldier Nanotechnologies *Description:* This effort investigates Nanomaterials and Nanotechnologies for Soldier Application focused on light-weight, multifunctional nanostructured fibers and materials. *FY 2020 Plans:* Will advance high-fidelity 3D dynamical modeling for simulation of durability, fracture, and failure of materials under blast to create resilient structural materials. Will advance the use of nanooptoelectronics and novel light-matter interactions for optical	-	-	5.998

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / *University and Industry Research Centers*	Project (Number/Name) AB4 / *Army Research Centers*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
sensing and energy. Through nanoscience, will advance next generation electronics including two-dimensional systems, photonic integrated circuits for ultra-low power electrons, and electromagnetic pulse-resistant circuits. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE0601104A University and Industry Research Centers / Project J12 Institute For Soldier Nanotechnology (ISN)			
Title: Vertical Lift Research Center of Excellence (VLRCOE) *Description:* VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology to supplement a robust experimental and analytic basic research program in rotorcraft technologies including: Aeromechanics, Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations. *FY 2020 Plans:* Will implement year four of VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology to conduct a robust experimental and analytic basic research program in broad rotorcraft technologies areas relevant to future vertical lift to include high-performing composite materials to enable extremely light-weight rotor and airframe structures, aeromechanics of high-speed compound rotors and multi-rotor interactions, enhanced damping for high-speed rigid rotors. Following the annual review at the three rotorcraft Centers, will adjust technical directions of the research tasks as necessary to ensure that the research remains relevant to the Army's Science and Technology goals. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE0601104A University and Industry Research Centers/ Project J17 Neuroergonomics Collaborative Technology Alliance	-	-	3.249
Title: Automotive Research Center (ARC) *Description:* The ARC is an U.S. Army Center of Excellence for Modeling and Simulation of ground vehicles. The Center relies on the collaboration of researchers from multiple universities and disciplines to bridge fundamental technology gaps in five research thrust areas of strategic importance to the Army; mobility, human factors and man-machine integration, lightweight structure and materials, power and energy, and design integration. A major integrative focus of these five areas are autonomy and manned-unmanned teaming. *FY 2020 Plans:* Will conduct advanced modeling and simulation research on autonomy and mobility problems for ground vehicles. Topics will include teleoperated, semi-, fully-, and multiple autonomous vehicle operation and control, high fidelity operational evaluations of autonomy related technologies, high performance terramechanics models, machine learning, robotic trust, etc. Will research	-	-	3.361

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019	
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** AB4 / *Army Research Centers*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
optimal power generation storage and distribution for autonomous vehicles expanding in application for drone and electric vehicles in support of the third offset strategy.			
FY 2019 to FY 2020 Increase/Decrease Statement: This work was previously performed in PE0601104A University and Industry Research Centers/ Project H73 Automotive Research Center (ARC)			
Accomplishments/Planned Programs Subtotals	-	-	26.150

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 *I* 1	R-1 Program Element (Number/Name) PE 0601104A *I University and Industry Research Centers*	Project (Number/Name) AB7 *I Army Collaborative Research and Tech Alliances*

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
AB7: *Army Collaborative Research and Tech Alliances*	-	0.000	0.000	42.863	-	42.863	43.482	44.295	45.122	45.564	0.000	221.326

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0601104A University and Industry Research Centers
* Project EA6 Cyber Collaborative Research Alliance
* Project F17 Neuroergonomics Collaborative Technology Alliance
* Project FF5 Distributed Collaborative Intelligent Systems CTA
* Project FF7 Internet of Battlefield Things CTA
* Project H05 Institute For Collaborative Biotechnologies
* Project J15 Network Sciences ITA
* Project VS2 Multi-Scale Materials Modeling Centers
* Project VS3 Center For Quantum Science Research

A. Mission Description and Budget Item Justification

This Project supports the Army Collaborative Research Alliances (CRAs) and Collaborative Technology Alliances (CTAs). CTAs and CRAs are partnerships between Army laboratories and centers, private industry, and academia that focus on the rapid transition of innovative technologies to the Warfighter to enable the Army's Future Force. The collaboration between industry, academia and the government is a key element of the alliance concept as each member brings with it a distinctly different approach to research. Academia are known for its cutting-edge innovation; the industrial partners are able to leverage existing research results for transition and to deal with technology bottlenecks; the Army Futures Command researchers keep the program oriented toward solving complex Army technology problems. This approach enables an Alliance to bring together world class research and development talent and focus it on Army-specific technology objectives for application to Army needs. The topics covered by CRAs and CTAs include cyber security, the internet of battlefield things, distributed and collaborative intelligent systems technology, neuroergonomics and neuroscience, advanced materials, exploitation of quantum effects, and machine learning and artificial intelligence.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Internet of Battlefield Things CTA (IoBT CTA) *Description:* The IoBT CTA seeks to gain fundamental understanding of Internet of Things (IoT) phenomena and its performance in tactical environments, ranging from sparse, remote settings to complex, dense urban environments. Research will address	-	-	6.020

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 I 1	**R-1 Program Element (Number/Name)** PE 0601104A I *University and Industry Research Centers*	**Project (Number/Name)** AB7 I *Army Collaborative Research and Tech Alliances*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
intelligent resourcing and influence in complex, constrained and uncertain networks (demand from massive numbers of dynamically connected devices, limited and unpredictable connectivity, shared civilian networks, computation at or near the device), heterogeneous sensing and actuation devices (efficient, smart devices with self-organizing/ preservation/directing capabilities), and variable, and unreliable provenance and dynamisms of information and device signals. *FY 2020 Plans:* Will establish theories and insights leading to scalable composition and management of heterogeneous networks of small sensing and/or actuation devices to enable secure information-driven awareness; will build the theoretical foundations, models, and methods for autonomic complex systems that deliver adaptive cyber-physical capabilities and services; will create scientific principles, theories, and methods for predictive processing, analytics, and anomaly detection given heterogeneous and varied autonomic, sensing, and actuation data that may be sparse and voluminous. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE 0601104A University and Industry Research Centers/ Project FF7 Internet of Battlefield Things CTA. Increase will fully fund the university consortium to extend research beyond initial exploratory studies.			
Title: Distributed Analytics and Information Science International Technology Alliance (ITA) *Description:* This research will address the fundamental science underpinning the complex information network issues that are vital to future United States (US) / United Kingdom (UK) coalition military operations and to fully exploit the joint development of emerging technologies necessary to enable coalition operations. These efforts provide enhanced ability to perform adaptive, goal-driven, semantically-aware, distributed analytics for situational understanding in coalition operations. *FY 2020 Plans:* Will model distributed, dynamic, secure coalition communication/information infrastructures that support distributed analytics to derive situational understanding; will create techniques for dynamic self-configuring services "on demand" based on mission needs, context and resource constraints; will model underlying distributed analytics and situational understanding that supports dynamic coalition operations involving complex multi-actor situations. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE 0601104A University and Industry Research Centers/ Project J15 Network Sciences ITA.	-	-	4.151
Title: Materials in Extreme Dynamic Environments and Multiscale Multidisciplinary Modeling of Electronic Material CRA *Description:* Research will focus on two-way multiscale modeling for predicting performance and designing materials; investigating analytical and theoretical analyses to effectively define the interface physics across length scales; advancing experimental capabilities for verification and validation of multiscale physics; and modeling and strategies for the synthesis of	-	-	8.739

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019	
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AB7 *I Army Collaborative Research and Tech Alliances*	

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
high loading rate tolerant materials. The multiscale modeling capability will be applied across multiple disciplines to facilitate revolutionary advances in materials for coupled environments (electromagnetic, high rate, high pressure and other extreme environments).			
FY 2020 Plans: Will implement and integrate basic science tools into a proof-of-concept multiphysics, multiscale capability for Materials by Design that crosses the three electronic materials classes and applications that 1) works across a variety of computational platforms from the desktop to large-scale distributed computing as the problem dictates; 2) allows for uncertainty quantification at scale and moving up and down the scales; and 3) allows assessment of reliability of simulation-predicted outcomes. Will initiate a predictive framework that demonstrates a materials-by-design paradigm suitable for Army applications. Will establish a process that rigorously limits the path in the multiscale space that must be understood for multiscale materials design. Will create newly designed metal, ceramic and composite systems for critical armor applications. Will validate and transition integrated codes for multiscale materials design in each of our chosen material systems, coupling aspects of processing, experiments and modeling with respect to the application space.			
FY 2019 to FY 2020 Increase/Decrease Statement: This work was previously performed in PE 0601104A University and Industry Research Centers / Project VS2 Multi-Scale Materials Modeling Centers.			
Title: Distributed Collaborative Intelligent Systems Technology CTA	-	-	6.131
Description: Establish the underpinning science to extend the reach, situational awareness, and operational effectiveness of intelligent system and soldier teams against dynamic threats in complex and contested environments and provide technical and operational superiority through fast, intelligent, resilient, and collaborative behaviors. Research efforts will enable distributed systems to engage in complex, time-varying, and contested environments to accomplish Army missions by leveraging a mix of online adaptation and system-wide resilience.			
FY 2020 Plans: Will establish the fundamental underpinnings of hierarchical, composable, and adaptable learning for collaborative multi-agent networks; distributed learning, inference and planning; resource aware perception-action-communication loops; autonomous and heterogeneous team formation and tasking; robotic team interaction with human teammates; adaptive and on-line learning for robust behaviors in complex and contested environments; scalable control for distributed heterogeneous multi-agent manned-unmanned teams; resilient situational awareness, communications, and autonomous behaviors in the face of failure and adversarial actions.			
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 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AB7 *I Army Collaborative Research and Tech Alliances*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
This work was previously performed in PE 0601104A University and Industry Research Centers/ Project FF5 Distributed Collaborative Intelligent Systems CTA.			
Title: Neurosciences CRA	-	-	0.654
Description: This effort performs multidisciplinary basic research in the area of neuroscience through collaboration with the University of California at Santa Barbara. *FY 2020 Plans:* Will establish an understanding of the effect of fatigue and stress on cognition and on decision making and will identify neural indicators/biomarkers for optimal decision making; will create neuro-engineering techniques to make inferences about human?s cognitive and attentional states that are particularly relevant to challenges faced by the Soldier. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in a portion of PE 0601104A University and Industry Research Centers/ Project H05 Institute For Collaborative Biotechnologies.			
Title: Army Artificial Intelligence Innovation Institute (A2I2)	-	-	9.338
Description: This effort investigates, designs and matures Artificial Intelligence (AI) and Machine Learning (ML) to address the Army problem of Fully Autonomous Maneuver in a Multi-Domain Battlespace. General AI capabilities are critical to the integration of operations in the contested environment including human-agent teaming for faster and more informed decisions, multi-domain Command, Control, Communications, and Computers (C4) that is resilient to Cyber Electromagnetic Activities (CEMA), and AI-enabled cyber security that is robust to enemy deception. This effort will provide key aspects of Army counter-AI against near-peer adversaries. Army futures command will leverage its existing High Performance Computing (HPC) and network infrastructure, along with its regional laboratory extensions to enable basic research on AI that is open, with top-tier universities, small & large commercial businesses, and established Department of Defense industrial partners. *FY 2020 Plans:* Will establish challenge problems on autonomous ground maneuver in complex off-road terrain as well as intelligent perception in complex urban terrain; will progressively increase problem complexity (from simple to complex terrain and from single to multiple agents), and will steadily increase generality of the AI deceptive actions (from both the Move and Perception standpoints) in order to enable Robotic Autonomous Systems (RAS) that can still maneuver intelligently without human control despite adversarial interference; and will begin data collection efforts to provide initial data base for learning algorithms. *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 I 1	R-1 Program Element (Number/Name) PE 0601104A I *University and Industry Research Centers*	Project (Number/Name) AB7 I *Army Collaborative Research and Tech Alliances*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This work represents an increase in program requirements for Artificial Intelligence Innovation efforts.			
Title: Center for Exploitation of Quantum Effects	-	-	3.000
Description: This work supports needed quantum information science basic research at the Army Futures Command for next generation capabilities in security, decision aids, sensing, and position, navigation, and timekeeping (PNT) for Army dominance on the future battlefield. *FY 2020 Plans:* Will establish methods for efficient light-matter interaction, including the use of optical cavities and materials suitable for nanophotonic integration; will understand unique topological photonic materials for quantum state protection; and will study quantum algorithms and measurement techniques and quantum frequency conversion in atomic and solid-state defect systems to improve quantum sensors. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously performed in PE 0601104A University and Industry Research Centers/ Project VS3 Center For Quantum Science Research. The decrease in funding is due to a change in focus away from creation of an entangled three-node system and towards the understanding of efficient light-matter interaction, topological photonic materials, and quantum algorithms and measurement techniques.			
Title: Neuroergonomics CTA	-	-	1.300
Description: By utilizing fundamental principles that underlie Soldier neurocognitive performance, this effort provides individualized and adaptive technologies that enhance Soldier-agent interaction. *FY 2020 Plans:* Will identify the potential for human behavior and neurophysiological data to be used to dynamically inform an AI agent trained to learn personalized navigation polices in operationally-relevant tasks; will create sensing hardware and signal processing algorithms to enable the acquisition and interpretation of neural activity during ambulation. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work was previously PE 0601104A University and Industry Research Centers/ Project F17 Neuroergonomics Collaborative Technology Alliance. Decreasing scope of effort for final year of CRA to focus on the effect of fatigue and stress on cognition and on decision making, neural indicators/biomarkers for optimal decision making and neuro-engineering techniques to make inferences about human?s cognitive and attentional states that are particularly relevant to challenges faced by the Soldier.			
Title: Identification and characterization of team-level processes for enhancing performance of heterogeneous Soldier-Agent teams CRA	-	-	3.530

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** AB7 / *Army Collaborative Research and Tech Alliances*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: By developing and validating theoretical principles of human-agent team states and processes, this effort defines methods for exploiting individual dynamics and variability to improve team-level properties and performance. *FY 2020 Plans:* Will create novel metrics of team-level states that account for specific roles and characteristics of both humans and intelligent agents as they cooperate to perform complex tasks; Will uncover fundamental relationships between team-level and individualized states and how changes in these states affect team performance over time. *FY 2019 to FY 2020 Increase/Decrease Statement:* This work represents an increase in program requirements for Heterogeneous Soldier-Agent Team issues.			
Accomplishments/Planned Programs Subtotals	-	-	42.863

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 *I* 1				**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*					**Project (Number/Name)** AB8 *I Army Educational Outreach Program*		

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
AB8: *Army Educational Outreach Program*	-	0.000	0.000	10.466	-	10.466	10.675	10.893	11.111	12.225	0.000	55.370

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
PE 0601104A University and Industry Research Centers
* Project J14 Army Educational Outreach Program

A. Mission Description and Budget Item Justification

This Project supports science, technology, engineering, and mathematics (STEM) activities that encourage elementary/middle/high school and undergraduate youths to develop an interest in and pursue education and employment in the STEM fields. These activities are coordinated within the Army Educational Outreach Program (AEOP) that links and networks appropriate components to derive the best synergies to present the Army to a larger pool of technical talent and to provide students with Army-unique practical experiences at Army laboratories, centers, and institutes and expose them to Department of Defense careers. AEOP increases interest and involvement of students and teachers across the nation in STEM at all proficiency levels and backgrounds to include under-represented and economically disadvantaged groups through exposure to Army sponsored research, education, competitions, internships, and practical experiences. This Project utilizes Army STEM assets to contribute to a STEM literate citizenry as well as enhances the national pool of science and engineering personnel that in turn supports defense industry and Army laboratory and research, development, and engineering center needs.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Title: AEOP Coop Agreement	-	-	10.156
Description: The Army Educational Outreach Program Cooperative Agreement encompasses a cohesive and coordinated portfolio of STEM education experiences to develop, enhance, and reward students in pursuit of STEM education. This activity supports a strong partnership with government, academia and industry to leverage assets and provide a broader and deeper STEM experience for students and teachers to address the Department?s, and the nation?s, challenge of acquiring clearable STEM literate talent in positions throughout the workforce and in the industrial base. These activities include Army-sponsored research, education, competitions, apprenticeships, internships, and practical experiences designed to engage and guide students and teachers in Army sponsored STEM programs. AEOP has targeted efforts to reach and engage underserved communities in STEM initiatives to build the pool of diverse STEM competitive talent.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AB8 *I Army Educational Outreach Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
FY 2020 Plans: Will continue Army sponsorship of students and STEM education opportunities; will provide incentives in STEM competitions that include scholarships, experiences and mentorships as well as expose students to DoD career opportunities; will streamline processes, leverage funding and build educational partnerships; and will perform annual comprehensive reviews and educational assessments to support future decisions and best practices. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This work was previously performed in PE 0601104A University and Industry Research Centers/ Project J14 Army Educational Outreach Program in FY19.			
Title: West Point Cadet Program **Description:** The West Point Cadet Research Program provides West Point Cadets an opportunity to work on Army research projects alongside Army and industry scientists and engineers during the summer. ***FY 2020 Plans:*** Will conduct West Point cadet research internship program to enhance cadet training through field experience in Army research labs and engineering centers. Between 40 and 60 cadets will intern for a period of 3 to 6 weeks. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This work was previously performed in PE 0601104A University and Industry Research Centers/ Project J14 Army Educational Outreach Program in FY19.	-	-	0.310
Accomplishments/Planned Programs Subtotals	-	-	10.466

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 I 1				R-1 Program Element (Number/Name) PE 0601104A I *University and Industry Research Centers*					Project (Number/Name) AC6 I *International Science and 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
AC6: *International Science and Technology*	-	0.000	0.000	6.685	-	6.685	7.012	7.140	7.370	7.451	0.000	35.658

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0601104A University and Industry Research Centers
* Project H59 International Tech Centers

A. Mission Description and Budget Item Justification

This Project funds the International Technology Centers (ITCs) and the Foreign Technology (and Science) Assessment Support (FTAS) program. The nine ITCs located in North America, South America, Asia, and Europe support the Army's goals of providing the best technology in the world to our Warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC 'technology finds' are submitted to various Army S&T organizations for evaluation and consideration for further research and development. Highly promising research will be awarded seed funding by the ITC through a grant, contract, or cooperative agreement. The FTAS program also builds upon the technology finds submitted by the ITCs. In some cases the find is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to determine the appropriateness of these technology areas identified as having potential relevance to the Army. These efforts will provide information useful in making early assessments of the technology's potential contributions to the Army's S&T strategy.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: International Technology Centers (ITCs)	-	-	4.501
Description: The nine ITCs located in North America, South America, Asia, and Europe support the Army's goals of providing the best technology in the world to our Warfighters by leveraging the S&T investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC 'technology finds' are submitted to various Army S&T organizations for evaluation and consideration for further research and development through avenues such as the FTAS Program. Highly promising research is awarded seed funding by the ITC through a grant, contract, or cooperative agreement ? typically to a foreign university. *FY 2020 Plans:*			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AC6 *I International Science and Technology*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
The ITCs will continue to seek out foreign science and technology within their geographic areas of responsibility that may have United States (US) Army interest and applicability, In accordance with the Army S&T Strategy, ITCs will connect foreign researchers with US Army scientists and engineers, and ultimately fund promising research through a grant, contract, or cooperative agreement. They will also continue to enhance and refine technology search capabilities using customer feedback to focus on mid- and long-term capabilities. *FY 2019 to FY 2020 Increase/Decrease Statement:* This effort was previously performed in PE 0601104A University and Industry Research Centers/ Project H59 International Tech Centers in FY19.			
Title: Foreign Technology (& Science) Assessment Support (FTAS) *Description:* The FTAS program serves as a catalyst for the US Army Futures Command to assess potentially game-changing technologies discovered in friendly foreign nations by the US Army International ITCs which may meet future Army needs. The technology finds can often times be truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. These efforts will provide information useful in making early assessments of a technology's potential contributions to the Army's S&T strategy. *FY 2020 Plans:* Will solicit proposals and assess scientific quality of candidate projects by utilizing US Army Senior Scientist Corps expertise. Will provide seed funding for approved proposals to US Army laboratories to develop and/or assess these technology areas identified by the Army?s ITCs. *FY 2019 to FY 2020 Increase/Decrease Statement:* This effort was previously performed in PE 0601104A University and Industry Research Centers/ Project H59 International Tech Centers in FY19.	-	-	2.184
Accomplishments/Planned Programs Subtotals	-	-	6.685

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 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** AC6 *I International Science and Technology*

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army										Date: March 2019	

Appropriation/Budget Activity 2040 / 1				R-1 Program Element (Number/Name) PE 0601104A / University and Industry Research Centers				Project (Number/Name) EA6 / Cyber Collaborative Research Alliance			

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
EA6: Cyber Collaborative Research Alliance	-	3.204	4.880	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.084

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601121A Cyber Collaborative Research Alliance
* Project CB5 Cyber Collaborative Research Alliance

A. Mission Description and Budget Item Justification

This Project fosters research performed through the Cyber Security (CSEC) Collaborative Research Alliance (CRA), a competitively selected consortium, formed to advance the theoretical foundations of cyber science in the context of Army networks. This CRA consists of academia, industry and government researchers working jointly with the objective of developing a fundamental understanding of cyber phenomena so that fundamental laws, theories, and theoretically grounded and empirically validated models can be applied to a broad range of Army domains, applications, and environments. This research focuses on three interrelated aspects of cyber security and is conducted using a trans-disciplinary approach that takes into account the human element of the network. The three aspects of cyber that are addressed are: 1) vulnerabilities and risks of cyber networks to malicious activities, 2) anticipating, detecting, and analyzing malicious activities, and 3) agile cyber maneuver to thwart and defeat malicious activities. Overarching goals of cyber security are to significantly decrease the adversary's return on investment when considering cyber attack on Army networks, and minimizing the impact on (Army) network performance related to implementing cyber security. The CRA research creates a framework that effectively integrates the knowledge of cyber assets and potential adversary capabilities and approaches, and provides defense mechanisms that dynamically adjust to changes related to mission, assets, vulnerability state, and defense mechanisms.

Work in this Project supports key Army needs and provides the technical underpinnings to PE 0602782A (Command, Control, Communications Technology) / Project H92 (Communications Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Cyber Security Collaborative Research Alliance	3.204	4.701	-
Description: The CSEC CRA supports basic research to enable capabilities for rapid development and adaptation of cyber tools for dynamically assessing cyber risks, detecting hostile activities on friendly networks, and supporting agile maneuver in cyber space in spite of the continuous evolution and emergence of novel threats.			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019	
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** EA6 *I Cyber Collaborative Research Alliance*	

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
FY 2019 Plans: Enhance fundamental theories and methods to streamline development of new models and algorithms of dynamic cyber threats; develop new approaches and theoretical frameworks needed to provide resilient and automated capabilities for software, network and system components and overall system function; research methods for more agile human behavior models and human-machine agent functionality in increasingly complex adversarial environments; incorporate realistic experimental validation methods for developing new operationally feasible methods.			
FY 2019 to FY 2020 Increase/Decrease Statement: This project will move to PE 0601104A University and Industry Research Centers/ Project CB5 Cyber Collaborative Research Alliance in FY20.			
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	-	0.179	-
Accomplishments/Planned Programs Subtotals	3.204	4.880	-

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 / 1				R-1 Program Element (Number/Name) PE 0601104A / University and Industry Research Centers						Project (Number/Name) F17 / Neuroergonomics Collaborative Technology Alliance		

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
F17: *Neuroergonomics Collaborative Technology Alliance*	-	4.725	4.714	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.439

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project fosters research through the Cognition and Neuroergonomics Collaborative Technology Alliance (CTA), a competitively selected industry and university consortium, to leverage world-class research in support of future force and Army transformation needs. Escalating levels of complexity and uncertainty on the current and future battlefield present conditions which have never existed before now. Solution strategies and approaches must be developed or tailored. The emerging field of neuroergonomics, which seeks to understand the brain at work and to leverage that understanding to optimize system design, offers tremendous potential for providing the solutions needed to meet the needs of Army forces in the future. This CTA addresses the solution strategies and approaches needed to design systems to fully exploit investments in revolutionary technological advances in areas such as robotics, microelectronics, and computer and network information systems. These technologies present significant opportunities to enhance Army mission capabilities, but impose significant burdens on the human brain, which will ultimately limit Soldier-system effectiveness, sustainability, and survivability. The technical barriers associated with this project include: immature knowledge base to guide the neuroergonomic approach to human-system integration; inadequate capabilities to sense and extract information about brain activity in dynamic, operational environments; lack of valid measures to robustly and uniquely characterize operationally-relevant cognitive performance; lack of techniques for integrating advanced understandings of brain activity into systems designs, including real-time use of measures of cognitive behavior as system inputs and the capability to account for individual differences in maximizing Soldier-system performance. This CTA conducts an intensive and accelerated program to formulate, validate, and transition basic research findings through multi-dimensional approaches focused in three areas: understanding fundamental principles underlying Soldier neurocognitive performance in operational environments, advancing computational approaches for the analysis and interpretation of neural functioning, and fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Neurocognitive performance in operational environments	1.747	1.735	-

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** F17 *I Neuroergonomics Collaborative Technology Alliance*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Description: This effort is intended to understand fundamental principles underlying Soldier neurocognitive performance in operational environments. *FY 2019 Plans:* Utilize computational techniques on large-scale heterogeneous datasets to discover robust relationships between complex cognitive states and subsequent performance across a range of Army-relevant tasks; investigate the relationship between individual brain network connectivity profiles and task performance. *FY 2019 to FY 2020 Increase/Decrease Statement:* This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
Title: Computational neural analysis *Description:* This effort advances computational approaches for the analysis and interpretation of neural functioning. *FY 2019 Plans:* Elucidate the underlying components responsible for physiological signal degradation in ambulatory environments via novel multi-layered sensor systems; develop theoretical models and adaptive algorithms for optimal signal acquisition and noise mitigation. *FY 2019 to FY 2020 Increase/Decrease Statement:* This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.	1.418	1.303	-
Title: Neurotechnologies *Description:* This effort provides a fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance. *FY 2019 Plans:* Investigate the application of computation frameworks for the prediction of behavioral performance in operationally-relevant tasks with increased temporal complexity and multifaceted objectives; develop approaches to combine information, derived from brain activity, across individuals to improve situational awareness. *FY 2019 to FY 2020 Increase/Decrease Statement:* This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.	1.560	1.504	-
Title: FY 2019 SBIR / STTR Transfer	-	0.172	-

PE 0601104A: *University and Industry Research Centers*
Army

R-1 Line #4

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019	
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** F17 / *Neuroergonomics Collaborative Technology Alliance*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
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			
Accomplishments/Planned Programs Subtotals	4.725	4.714	-

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 / 1				**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*						**Project (Number/Name)** FF5 / *Distributed Collaborative Intelligent Systems CTA*		
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**
FF5: *Distributed Collaborative Intelligent Systems CTA*	-	4.012	5.813	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	9.825

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project fosters basic research through the highly Distributed and Collaborative Intelligent Systems and Technology (DCIST) Collaborative Research Alliance (CRA), a competitively selected university consortium which leverages world-class research necessary to address future force and Army Transformation needs. The CRA links a broad range of government technology agencies, as well as industrial and academic partners with the Army Futures Command. The DCIST CRA focuses on systems with a large number of heterogeneous intelligent agents, including Soldiers that can be distributed over large areas and are required to move through contested environments and against peer capabilities at op-tempo. To meet these goals innovative research is performed in three main technical areas: distributed intelligence, large heterogeneous group control, and adaptive and resilient behaviors. The payoff to the warfighter will be extended reach, situational awareness, and operational effectiveness against dynamic threats in contested environments, and technical and operational superiority through intelligent, resilient and collaborative behaviors of Soldiers and intelligent systems. The CRA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, and to make available to the Alliance state-of-the-art facilities and equipment at the participating organizations.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Title: Distributed Collaborative Intelligent Systems Technology	4.012	5.600	-

Description: Extend reach, situational awareness, and operational effectiveness against dynamic threats in contested environments through intelligent, resilient and collaborative behaviors of heterogeneous teams of Soldiers, intelligent systems, smart sensors, and knowledge sources.

FY 2019 Plans:
Establish the theoretical foundations of multi-faceted distributed networked intelligent systems combining autonomous agents, sensors, tactical super-computing, knowledge bases in the tactical cloud, and human experts to acquire and apply knowledge to affect and inform decisions of the collective team. Develop theory and algorithms for control of large autonomous teams with

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019		
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** FF5 *I Distributed Collaborative Intelligent Systems CTA*		

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
varying levels of heterogeneity and modularity across sensing, computing, platforms, and degree of autonomy. Develop theory and methods for heterogeneous teams to carry out tasks under dynamic and varying conditions in the physical world. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Project FF5 will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
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	-	0.213	-
Accomplishments/Planned Programs Subtotals	4.012	5.813	-

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 *I* 1				**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*						**Project (Number/Name)** FF7 *I Internet of Battlefield Things CTA*		

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
FF7: *Internet of Battlefield Things CTA*	-	2.946	4.174	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	7.120

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project will foster research performed through the Internet of Battlefield Things (IoBT) Collaborative Research Alliance (CRA), a competitively selected consortium formed to advance the theoretical foundations of the Internet of Things in the context of Army Operations. The CRA will comprise academia, industry and government researchers working jointly with the objective of developing a fundamental understanding of phenomena of Internet of Things (IoT) and cyber-physical systems in tactically relevant environments. The CRA will facilitate collaboration across organizations to provide multi-disciplinary perspectives on basic research challenges, as well as the use of state-of-the-art facilities and equipment at the participating organizations. This research focuses on three interrelated aspects of pervasive and converged cyber- physical complex information systems and is conducted using a trans-disciplinary approach that takes into account the information-theoretic and human elements of Army IoBT interactions. The three aspects of the emergent Internet of Battlefield Things topical areas addressed are: 1) dynamic discovery and adaptation of cyber- physical devices, networks, and information sources, 2) resilient re-purposing and re-tasking of devices and information capabilities, and 3) algorithmic, distributed and centralized information-stream processing. Overarching goals of the basic research on Army IoBT are to investigate foundational cross-cutting theories and methods leading towards a science of heterogeneous, self-adapting, complex cyber-physical systems. This research will lead to optimized real-time adversarial situation estimates in information-enabled warfare and greatly enhance the speed and precision for complex military operations involving converged sensing, communications, and resilient actuation.

Work in this Project builds fundamental knowledge for and accelerates the transition of communications and networks technology to PE 0602783A (Computer and Software Technology).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Internet of Battlefield Things Collaborative Research Alliance (IoBT CRA) *Description:* The Internet of IoBT CRA seeks to gain fundamental understanding of IoT phenomena and its performance in tactical environments, ranging from sparse, remote settings to complex, dense urban environments. To enable an IoBT capability,	2.946	4.021	-

PE 0601104A: *University and Industry Research Centers*
Army

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 I 1	R-1 Program Element (Number/Name) PE 0601104A I *University and Industry Research Centers*	Project (Number/Name) FF7 I *Internet of Battlefield Things CTA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
research needs to address intelligent resourcing and influence in complex, constrained and uncertain networks (demand from massive numbers of dynamically connected devices, limited and unpredictable connectivity, shared civilian networks, computation at or near the device), heterogeneous sensing and actuation devices (efficient, smart devices with self-organizing/preservation/ directing capabilities), and variable, and unreliable provenance and dynamisms of information and device signals. ***FY 2019 Plans:*** Investigate theoretical foundations, models, and methods of autonomic complex systems that deliver adaptive cyber-physical capabilities and services necessary to enable effective command and control across military, adversary, and non-combatant domains; research the scientific principles, theories, and methods and predictive processing, analytics, and anomaly detection of broadly heterogeneous and varied data that may be unknown combinations of sparse and voluminous; investigate methods to augment goal-driven decision-making. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
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	-	0.153	-
Accomplishments/Planned Programs Subtotals	2.946	4.174	-

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 / 1				R-1 Program Element (Number/Name) PE 0601104A / *University and Industry Research Centers*						Project (Number/Name) H04 / *HBCU/MI Programs*	

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
H04: *HBCU/MI Programs*	-	1.475	1.589	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	3.064

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers

A. Mission Description and Budget Item Justification

This Project supports basic research through the Partnered Research Initiative (PRI), the Army's research initiative focused on partnerships with Historically Black Colleges and Universities and Minority Institutions (HBCU/MI). The PRI Program was established as the next phase of what was previously known as Partnership in Research Transition (PIRT) Program that ended in FY16. The focus of this effort is to enhance programs and capabilities of high-interest scientific and engineering disciplines through innovative research performed in collaboration with Collaborative Technology Alliances and Collaborative Research Alliances (CTA/CRAs). The CTA/CRAs work with Army, industry, and other academic partners to transition research to technology demonstration. In addition, the Centers of Excellence (CoEs) and CTA/CRA partnerships provide opportunities to recruit, educate, and train outstanding students and post-doctoral researchers in science and technology areas relevant to the Army.

Work performed in this Project supports key Army needs and is coordinated with one or more Projects in PE 0601104A (University and Industry Research Centers).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Centers of Excellence for Battlefield Capability Enhancements	1.475	1.538	-
Description: Four PRI effortss from HBCUs/MIs joined the CTA/CRA consortia in early FY17: New Mexico Institute of Mining and Technology will collaborate with Multiscale Modeling of Electronic Materials (MSME) CRA by investigating how Uncertainty Quantification techniques and Optimization algorithms can be used to complete the pipeline for robust design of nanoparticles; City College of New York will contribute to Cognition and Neuroergonomics (CaN) CTA by focusing on measuring the relevance of peripheral stimuli to neural reliability via experiments in combined electroencephalogram (EEG) and eye-tracking during passive free viewing of films; University of Texas at El Paso will collaborate with Cyber Security CRA by designing and running behavioral game theory experiments on group decision making; and North Carolina Agricultural & Technical State University will contribute to Materials in Extreme Dynamic Environments (MEDE) CRA with experiments to understand the effects of loading conditions			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019		
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*		**Project (Number/Name)** H04 *I HBCU/MI Programs*	

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
such as temperature (from ambient to 773 Kelvin) and strain rate (from quasi-static to ultra-high) and their coupled effects on the mechanical properties and microstructure evolution of magnesium alloys. ***FY 2019 Plans:*** Continue to conduct research with HBCU/MIs performed in collaboration with Army Research Laboratory?s CTA/CRAs. Projects are within the scope of CTA/CRAs and pursue high quality, collaborative research in areas of strategic importance to the Army. Areas of research include: network science, cognition and neuroergonomics, multiscale modeling of materials, robotics and/or cyber security. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB4 Army Research Centers in FY20.			
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	-	0.051	-
Accomplishments/Planned Programs Subtotals	1.475	1.589	-

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 / 1				**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*						**Project (Number/Name)** H05 / *Institute For Collaborative Biotechnologies*		
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**
H05: *Institute For Collaborative Biotechnologies*	-	5.759	5.992	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.751

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project supports research at the Army's Institute for Collaborative Biotechnologies (ICB), led by the University of California-Santa Barbara, and two major supporting partners, the California Institute of Technology and the Massachusetts Institute of Technology. The ICB was established as a University Affiliated Research Center (UARC) to support leveraging biotechnology for: advanced sensors; new electronic, magnetic, and optical materials; and information processing and bioinspired network analysis. The objective is to perform sustained multidisciplinary basic research supporting technology to provide the Army with biomolecular sensor platforms with unprecedented sensitivity, reliability, and durability; higher-order arrays of functional electronic and optoelectronic components capable of self-assembly and with multi-functions; and new biological means to process, integrate, and network information. These sensor platforms will incorporate proteomics (large scale study of proteins) technology, Deoxyribonucleic Acid (DNA) sequence identification and detection tools, and the capability for recognition of viral pathogens. A second ICB objective is to educate and train outstanding students and post-doctoral researchers in revolutionary areas of science to support Army Transformation. The ICB has many industrial partners, such as International Business Machine (IBM) and Science Applications International Corporation (SAIC), and has strong collaborations with Argonne, Lawrence Berkeley, Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia National Laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army Medical Research and Materiel Command (MRMC) laboratories.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Title: Institute for Collaborative Biotechnologies	5.128	5.139	-
Description: Perform sustained multidisciplinary basic research supporting technology to provide the Army with bio-inspired materials and biomolecular sensor platforms. *FY 2019 Plans:*			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 **/** 1	**R-1 Program Element (Number/Name)** PE 0601104A **/** *University and Industry Research Centers*	**Project (Number/Name)** H05 **/** *Institute For Collaborative Biotechnologies*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Support new set of basic research projects in synthetic and systems biology, bio-inspired materials, and biotechnology tools. The new efforts include creating novel inorganic-organic hybrid materials with novel photo and ion-conducting properties, mechanistic study of infrared detection system of rattlesnakes, and engineering novel biocatalysts for abiological chemistry. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Research effort will move to PE 0601104A University and Industry Research Centers/ Project AB4 Army Research Centers in FY20.			
Title: Neuroscience ***Description:*** Perform multidisciplinary basic research in the area of neuroscience. ***FY 2019 Plans:*** Support a new set basic research projects in cognitive neuroscience including new mapping strategies for the neural systems for planning skills, understanding the cognitive priority control, and development of multiscale hierarchical framework for analysis of dynamic neuroscience data. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY 2020.	0.631	0.634	-
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	-	0.219	-
Accomplishments/Planned Programs Subtotals	5.759	5.992	-

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 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** H05 / *Institute For Collaborative Biotechnologies*

E. Performance Metrics

 N/A

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Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army | | **Date:** March 2019
| |

Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** H09 / *Robotics CTA*

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
H09: *Robotics CTA*	-	3.971	4.235	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.206

Note

This Project concludes after Fiscal Year (FY) 2019.

A. Mission Description and Budget Item Justification

This Project supports a collaborative effort between the competitively selected industry and university consortium, the Robotics Collaborative Technology Alliance (CTA), and the Army Futures Command for the purpose of leveraging world-class research in support of the future force and Army transformation needs. This Project conducts basic research in areas that will expand the capabilities of intelligent mobile robotic systems for military applications with a focus on enhanced, innate intelligence, ultimately approaching that of a dog or other intelligent animal, to permit unmanned systems to function as productive members of a military team. Research is conducted in machine perception, including the exploration of sensor phenomenology, and the investigation of basic machine vision algorithms enabling future unmanned systems to better understand their local environment for enhanced mobility and tactical performance; intelligent control, including the advancement of artificial intelligence techniques for robot behaviors permitting future systems to autonomously adapt, and alter their behavior to dynamic tactical situations; understanding the interaction of humans with machines focusing upon intuitive control by Soldiers to minimize cognitive burden; dexterous manipulation of the environment by unmanned systems; and unique modes of mobility to enable unmanned systems to seamlessly navigate complex or highly constrained three dimensional environments. The program will conduct both analytic and validation studies.

Work in this Project builds fundamental knowledge for and complements the companion applied technology program, Program Element (PE) 0602120A, Project TS2 (Robotics).

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 2018	FY 2019	FY 2020
Title: Autonomous Systems *Description:* Explore opportunities enabling revolutionary, autonomous, and highly mobile systems for the future force. Research focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. *FY 2019 Plans:*	3.971	4.080	-

PE 0601104A: *University and Industry Research Centers*
Army

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019	
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** H09 / *Robotics CTA*	

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Create a framework to demonstrate integrated cognitive, perceptual, motion and manipulation planning, and human multi-modal interface capabilities to assess ability for robots to maneuver in unstructured environments, team with humans to execute complex missions, and perform autonomous mobile manipulation in ad hoc scenarios. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This Project concludes after FY19			
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	-	0.155	-
Accomplishments/Planned Programs Subtotals	3.971	4.235	-

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 / 1	R-1 Program Element (Number/Name) PE 0601104A / University and Industry Research Centers	Project (Number/Name) H50 / Network Sciences Cta

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
H50: Network Sciences Cta	-	6.208	5.821	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.029

Note
 This Project concludes after Fiscal Year (FY) 2019.

A. Mission Description and Budget Item Justification

 This Project supports a competitively selected university and industry consortium, the Network Sciences Collaborative Technology Alliance (NS CTA), formed to leverage commercial research investments to provide solutions to Army's requirements for robust, survivable, and highly mobile wireless communications networks, while meeting the Army's needs for a state-of-the-art wireless mobile communications networks for command-on-the-move. The NS CTA performs foundational, cross-cutting network science research leading to: a fundamental understanding of the interplay and common underlying science among social/cognitive, information, and communications networks; determination of how processes and parameters in one network affect and are affected by those in other networks; and prediction and control of the individual and composite behavior of these complex interacting networks. This research will lead to optimized human performance in network-enabled warfare and greatly enhanced speed and precision for complex military operations. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of-the-art facilities and equipment at the participating organizations. Many of the results of the NS CTA provide a foundation for the Internet of Battlefield Things Collaborative Research Alliance that began in FY18.

 Work in this Project builds fundamental knowledge for and accelerates the transition of communications and networks technology to Program Element (PE) 0602783A (Computer and Software Technology).

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Network Sciences Collaborative Technology Alliance (NS CTA) **Description:** The Network Sciences CTA focuses on four major research areas: Information Networks, Communication Networks, Social/Cognitive Networks, and Interdisciplinary Research to develop a fundamental understanding of the ways that information, social/cognitive, and communications networks can be designed, composed, and controlled to dramatically increase mission effectiveness and ultimately enable humans to effectively exploit information for timely decision-making. Information Networks research develops the fundamental understanding of autonomous network activities and its linkage to the physical and human domains as related to human decision making within the networked command and control (C2) structure. Social/Cognitive Networks research is developing the fundamental understanding of the interplay of the various aspects of the social and cognitive networks with information and communications. Communications Networks research is developing the foundational techniques to model, analyze, predict, and control the behavior of secure tactical communication networks as an enabler for information and C2	6.208	5.608	-

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** H50 *I Network Sciences Cta*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
networks. Integration is focused on achieving an integrated Information Networks, Social/Cognitive Networks, Communications Networks research program that significantly enhances the fundamental understanding of the underlying science of networks. ***FY 2019 Plans:*** Explore machine learning techniques that can classify different types of networks, including social networks, using deep network signatures to identify networks of special interest (e.g. adversarial) in early stages of their growth. Develop techniques to jointly model changes in information streams and multi-genre networks to enable the prediction of the impact of external events and anomalies in dynamic networks; techniques for combining user-oriented multidimensional summarization mechanisms with information-centric networking offers the potential to enable effective analytics in combined communications, information, and social networks. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This Project concludes after FY19.			
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	-	0.213	-
Accomplishments/Planned Programs Subtotals	6.208	5.821	-

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 / 1				R-1 Program Element (Number/Name) PE 0601104A / *University and Industry Research Centers*						Project (Number/Name) H59 / *International Tech Centers*			

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
H59: *International Tech Centers*	-	6.459	6.549	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	13.008

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AC6 International Science and Technology

A. Mission Description and Budget Item Justification

This Project funds the International Technology Centers (ITCs) and the Foreign Technology (and Science) Assessment Support (FTAS) program.

The nine ITCs located in in North America, South America, Asia, and Europe support the Army's goals of providing the best technology in the world to our Warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC 'technology finds' are submitted to various Army S&T organizations for evaluation and consideration for further research and development. Highly promising research will be awarded seed funding by the ITC through a grant, contract, or cooperative agreement. The FTAS program also builds upon the "technology finds" submitted by the ITCs. In some cases the technology is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to determine the appropriateness of these technology areas identified as having potential relevance to the Army. These efforts will provide information useful in making early assessments of the technology's potential contributions to the Army's S&T strategy.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: International Technology Centers (ITC)	6.459	4.311	-
Description: This effort funds the technology search function of the ITCs. Research and/ or technologies that have possible interest to the Army are disseminated to the Army research enterprise. Review of these technologies by the research community provides useful information in making early assessments of the technology's potential contributions to the Army's S&T strategy. Highly promising international basic research will be provided seed funding by the ITC for further evaluation through a grant, contract, or cooperative agreement, typically to a university. *FY 2019 Plans:*			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** H59 *I International Tech Centers*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
The ITCs continue to seek out foreign science and technologies that may have United States Army interest within their area of responsibility. Highly promising international basic research is awarded seed funding for further evaluation through a grant, contract, or cooperative agreement, typically to a university. *FY 2019 to FY 2020 Increase/Decrease Statement:* This Project will move to PE 0601104A University and Industry Research Centers/ Project AC6 International Science and Technology in FY20.			
Title: Foreign Technology (and Science) Assessment Support (FTAS)	-	2.034	-
Description: This effort funds the Foreign Technology (and Science) Assessment Support (FTAS) program. The FTAS program builds upon the ?technology finds? submitted by the ITCs. In some cases a technology is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to determine the appropriateness of technology areas identified to meet Army needs. These efforts will provide information useful in making early assessments of the technology's potential contributions to the Army's S&T strategy. *FY 2019 Plans:* Solicit projects and build on the success of the FTAS Program. Once scientific quality of candidate projects is assessed by the U.S. Army Senior Scientist Corps seed funding will be provided to U.S. Army laboratories to further determine the appropriateness of technology areas identified as having potential relevance to the Army. *FY 2019 to FY 2020 Increase/Decrease Statement:* This Project will move to PE 0601104A University and Industry Research Centers/ Project AC6 International Science and Technology in FY20.			
Title: FY 2019 SBIR / STTR Transfer	-	0.204	-
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			
Accomplishments/Planned Programs Subtotals	6.459	6.549	-

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 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** H59 *I International Tech Centers*

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 *I* 1					**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*					**Project (Number/Name)** H73 *I Automotive Research Center (ARC)*		

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
H73: *Automotive Research Center (ARC)*	-	3.113	3.292	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.405

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers

A. Mission Description and Budget Item Justification

This Project fosters basic research in novel, high payoff technologies that can be integrated into Army ground platforms. The Center of Excellence for Automotive Research is part of the basic research component of the Army Futures Command. The Center of Excellence for Automotive Research is an innovative university/ industry/government consortium leveraging commercial technology for potential application in Army vehicle systems through ongoing and new programs in automotive research, resulting in significant cost savings and performance enhancing technological opportunities. The research performed in this Project contributes to formulating and establishing the basic scientific and engineering principles for these technologies.

Work in this Project complements and is fully coordinated with work under PE 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, Virginia Tech, Wayne State University, University of Iowa, Oakland University, and Clemson University. Key industry partners include all major United States automotive manufacturers and suppliers. The Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies and advances state-of-the-art modeling and simulation for the Army's future ground vehicle platforms.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Automotive Research Center (ARC)	3.113	3.192	-
Description: The ARC is an United States (US) Army Center of Excellence for Modeling and Simulation of ground vehicles. The Center relies on the collaboration of researchers from multiple universities and disciplines in order to bridge fundamental technology gaps in five research thrust areas of strategic importance to the Army, associated with conversion and management of power and energy within vehicles, mobility and survivability of the complete vehicle system, including the human occupants, and vehicle integration/optimization. **FY 2019 Plans:**			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** H73 / *Automotive Research Center (ARC)*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Continue advanced modeling and simulation research on ground vehicle power generation, storage, and distribution while expanding more into autonomy and mobility problems for ground vehicles. Topics include teleoperated, semi-autonomous, fully-autonomous, and multiple autonomous vehicle operation and control, high fidelity simulation environments for operational evaluations of autonomy related technologies, high performance terramechanics models, perception in degraded sensor environments, machine learning, robotic trust, etc. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers Project AB4 Army Research Centers in FY20.			
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	-	0.100	-
Accomplishments/Planned Programs Subtotals	3.113	3.292	-

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 **I** 1					R-1 Program Element (Number/Name) PE 0601104A **I** *University and Industry Research Centers*					Project (Number/Name) J08 **I** *Institute For Creative Technologies (ICT)*		

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
J08: *Institute For Creative Technologies (ICT)*	-	6.057	6.432	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	12.489

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers

A. Mission Description and Budget Item Justification

This Project supports simulation and training technology research at the Army's Institute for Creative Technologies (ICT) at the University of Southern California. The ICT was established as a University Affiliated Research Center (UARC) to support Army training and readiness through research into simulation, mixed and virtual reality, artificial intelligence, computer graphics, and learning sciences. ICT applies the results of this research and proves its value in Army relevant applications such as training, mission rehearsal, leadership development, cultural awareness, negotiation, health and medical, and distance learning. The ICT actively performs research and engages industry and academic institutions internationally to incorporate the latest research results and hardware and software into its research program and application development and exploit dual-use technology. The ICT serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable technologies into military systems. In addition the ICT works with creative talent from the entertainment industry to advance and leverage techniques and capabilities and adapt concepts of story and character to increase the degree of participant immersion in synthetic environments in order to improve the realism and usefulness of these experiences. In developing a true synthesis of the creativity, research, technology, and capability of industry and the research and development community, the ICT is revolutionizing capabilities for the Army by making it more effective in terms of cost, time, range of experiences and the quality of the result and by producing research and applications that will benefit the Army of the 21st century.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Immersive Environments *Description:* Conduct basic research in immersive environments, to include virtual humans, three-dimensional (3D) sound and visual media, to achieve more efficient and affordable training, modeling, simulation and application solutions and tools. Research includes investigation of techniques and methods to address the rapid development of synthetic environments and the study of perception and cognition to help direct the development of new technologies and techniques that evoke more realistic responses	2.299	2.452	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** J08 / *Institute For Creative Technologies (ICT)*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
from users. Perform research into auditory aspects of immersion to provide the sound stimulus for increasing the realism for military training and simulation devices. ***FY 2019 Plans:*** Examine characteristics of virtual humans that promote trust in domains such as persuasion tasks, social dilemmas and interviews (with sensitive questions) and will examine differences between normative influence (emphasizing social norms) and informational influence (e.g. conveying expert information); these areas have potential applications for not only virtual humans but also robotics. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers Project AB4 Army Research Centers in FY20.			
Title: Graphics and Animations ***Description:*** Conduct basic research to identify new computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations. Research innovative methods for automatically generating animations and gestures for virtual humans based on what is being communicated. Research new technologies for scanning real people and rapidly generating virtual humans which look like these people significantly reducing the time, expense and effort required to develop virtual humans and virtual environments. ***FY 2019 Plans:*** Research virtual reality and augmented reality-driven teleportation system that will use detailed 3D models created in prior research to in-person, photo-realistic communication for remote participants; research techniques for rapidly capturing movement and speech animations that are specific to individuals. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers Project AB4 Army Research Centers in FY20.	1.404	1.211	-
Title: Techniques and Human-Virtual Human Interaction ***Description:*** Basic research to investigate methods and techniques for creating virtual human computer-generated characters that look, communicate and behave like real people, meaning the virtual humans will be autonomous, use verbal and non-verbal communication, exhibit emotions, model their own beliefs, desires and intentions as well as those of others, and reason using advanced artificial intelligence. Investigate methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans and explore how people relate to virtual humans. ***FY 2019 Plans:***	2.354	2.533	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** J08 / *Institute For Creative Technologies (ICT)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Study how extended interaction occurs in groups larger than a dyad, investigate how information can span multiple conversations, and research how to endow virtual humans with these capabilities. Develop techniques that will allow virtual humans to automatically identify strategic emotional manipulation and defend against it. Leverage Sigma cognitive architecture?s combined neural and symbolic representations to create a model of question answering. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers Project AB4 Army Research Centers in FY20.			
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	-	0.236	-
Accomplishments/Planned Programs Subtotals	6.057	6.432	-

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 *I* 1				**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*					**Project (Number/Name)** J12 *I Institute For Soldier Nanotechnology (ISN)*		

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
J12: *Institute For Soldier Nanotechnology (ISN)*	-	5.759	5.992	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.751

Note
In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers

A. Mission Description and Budget Item Justification
This Project supports sustained multidisciplinary research at the Army's Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN was established as a University Affiliated Research Center (UARC) to support research to devise nanotechnology-based solutions for the Soldier. The ISN emphasizes revolutionary materials research for advanced Soldier protection and survivability. The ISN works in close collaboration with the United States (US) Army Futures Command as well as several major industrial partners, including Raytheon and DuPont, in pursuit of its goals. This Project emphasizes revolutionary materials research toward an advanced uniform concept. The future uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, biomedical monitoring, performance enhancement, and extremities protection. The objective is to lighten the Soldier's load through system integration and multifunctional devices while increasing survivability. The new technologies will be compatible with other Soldier requirements, including Soldier performance, limited power generation, integrated sensors, communication and display technologies, weapons systems, and expected extremes of temperature, humidity, storage lifetimes, damage, and spoilage.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Nanomaterials and Nanotechnologies for Soldier Application (formerly Nanomaterials) *Description:* Nanomaterials research efforts focus on light-weight, multifunctional nanostructured fibers and materials. *FY 2019 Plans:* Support continuing basic research projects in nanomaterials to improve protection against blast and ballistic threats. Continue to support nano-optoelectronics and novel light-matter interactions for optical sensing and energy conversion platforms. Continue to	5.759	5.773	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** J12 *I Institute For Soldier Nanotechnology (ISN)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
support battlefield medicine through novel strategies for treatment of incompressible wounds, and improved vaccination/infection control strategies by leveraging targeted nano-therapies. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers Project AB4 Army Research Centers in FY20.			
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	-	0.219	-
Accomplishments/Planned Programs Subtotals	5.759	5.992	-

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 / 1				**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*					**Project (Number/Name)** J13 / *UNIVERSITY AND INDUSTRY INITIATIVES (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
J13: *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*	-	20.000	22.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	42.000

Note

Congressional Increase

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for University and Industry Initiatives.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019
Congressional Add: Congressional Program Increase - University and Industry Research Centers	15.000	10.000
FY 2018 Accomplishments: Congressional Program Increase - University and Industry Research Centers		
FY 2019 Plans: Congressional Program Increase - University and Industry Research Centers		
Congressional Add: Congressional Program increase - Materials in Extreme Dynamic Environments	5.000	10.000
FY 2018 Accomplishments: Congressional Program increase - Materials in Extreme Dynamic Environments		
FY 2019 Plans: Congressional Program increase - Materials in Extreme Dynamic Environments		
Congressional Add: Congressional Program Increase - university assisted hypervelocity testing	-	2.000
FY 2019 Plans: Congressional Program Increase - university assisted hypervelocity testing		
Congressional Adds Subtotals	20.000	22.000

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 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** J13 / *UNIVERSITY AND INDUSTRY INITIATIVES (CA)*

E. Performance Metrics

N/A

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army										**Date:** March 2019	
Appropriation/Budget Activity 2040 *I* 1				**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*						**Project (Number/Name)** J14 *I Army Educational Outreach Program*	

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
J14: *Army Educational Outreach Program*	-	9.646	10.259	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	19.905

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB8 Army Educational Outreach Program

A. Mission Description and Budget Item Justification

This Project supports science, technology, engineering, and mathematics (STEM) activities that encourage elementary/middle/high school and undergraduate youths to develop an interest in and pursue education in the STEM fields to support the Army, and the nations, growing dependence on STEM skills. These activities are coordinated within the Army Educational Outreach Program (AEOP) that links and networks appropriate components to derive the best synergies to present the Army to a larger pool of technical talent and to provide students with Army-unique practical experiences at Army laboratories, centers, and institutes and expose them to DoD careers. AEOP increases interest and involvement of students and teachers across the nation in STEM at all proficiency levels and backgrounds to include under-represented and economically disadvantaged groups through exposure to Army sponsored research, education, competitions, internships, and practical experiences. This Project utilizes Army STEM assets to contribute to a STEM literate citizenry as well as enhances the national pool of science and engineering personnel that in turn supports defense industry and Army laboratory and research, development, and engineering center needs.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Title: eCYBERMISSION	3.668	-	-
Description: This program supports a nation-wide, web-based STEM competition for students in grades 6 through 9, designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide.			
Title: Educational Outreach and Workforce Development	2.112	1.924	-
Description: This effort aims to broaden STEM competencies through various outreach and workforce development initiatives at participating Army labs and research centers. *FY 2019 Plans:*			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 I 1	**R-1 Program Element (Number/Name)** PE 0601104A I *University and Industry Research Centers*	**Project (Number/Name)** J14 I *Army Educational Outreach Program*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
Continue AEOP support and outreach to under-represented and economically disadvantaged areas to enhance STEM education through student experiences in Army labs and academic partner institutions, and mentor students to broaden their interest in and their development of STEM education. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort moves to PE 0601104A University and Industry Research Centers / Project AB8 Army Educational Outreach Program in FY20.			
Title: Army Educational Outreach Program (AEOP) Cooperative Agreement *Description:* The Army Educational Outreach Program Cooperative Agreement encompasses a variety of outreach activities under AEOP that includes a comprehensive evaluation and assessment component, a holistic marketing strategy, and an alumni management element. Collectively, this activity supports a strategic partnership with government, academia and industry to address the shortfall of clearable STEM skilled talent preparing for the workforce with a concentration on leveraged partnerships/investments, quality program capabilities with qualitative and quantitative data support, and evidence-based program management. These activities include Army-sponsored research, education, competitions, internships and practical experiences designed to engage and guide students and teachers in Army sponsored STEM programs. AEOP has targeted efforts to reach and engage underserved and underrepresented communities in STEM initiatives to build the pool of diverse STEM competitive talent. Outcomes are reported annually online at https://www.usaeop.com/about/our-impact/. ***FY 2019 Plans:*** Continue Army lab and research center sponsorship of students and STEM education opportunities; provide incentives in STEM competitions that include scholarships, experiences and mentorships as well as expose students to DoD career opportunities; streamline processes, leverage funding and build educational partnerships; and perform annual comprehensive review and educational assessments to support future decisions and best practices. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort moves to PE 0601104A University and Industry Research Centers / Project AB8 Army Educational Outreach Program in FY20.	3.562	7.709	-
Title: West Point Cadet Research *Description:* The West Point Cadet Research Program provides 40 to 60 West Point Cadets an opportunity to work on Army research projects alongside Army and industry scientists and engineers for a period of 3 to 6 weeks during the summer. ***FY 2019 Plans:***	0.304	0.250	-

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019		
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** J14 *I Army Educational Outreach Program*		

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Conduct West Point cadet research internship program to enhance cadet training through field experience in Army research labs and engineering centers. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort moves to PE 0601104A University and Industry Research Centers / Project AB8 Army Educational Outreach Program in FY20.			
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	-	0.376	-
Accomplishments/Planned Programs Subtotals	9.646	10.259	-

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 / 1	R-1 Program Element (Number/Name) PE 0601104A / *University and Industry Research Centers*	Project (Number/Name) J15 / *Network Sciences ITA*

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
J15: *Network Sciences ITA*	-	3.919	4.106	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	8.025

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project supports research at a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science investigations in the areas of network theory, system-of-systems security, sensor processing and delivery, and distributed coalition planning and decision making. The focus is on enhancing distributed, secure, and flexible decision-making to improve coalition operations, and developing the scientific foundations for complex and dynamic networked systems-of-systems to support the complex human, social, and technical interactions anticipated in future coalition operations with the emphasis on integration of multiple technical disciplines in an international arena. The Army Futures Command and the UK Ministry of Defense (MOD) established the jointly funded and managed US and UK consortium, known as the International Technology Alliance (ITA) on Network and Information Sciences, in FY06.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Distributed Analytics and Information Science for U.S./U.K. Coalition Operations Information (formerly Network and Information Science Basic Research for US/UK Coalition Operations Information)	3.919	3.955	-
Description: This research will address the fundamental science underpinning the complex information network issues that are vital to future US/UK coalition military operations and to fully exploit the joint development of emerging technologies necessary to enable coalition operations. These efforts provide enhanced ability to perform adaptive, goal-driven, semantically-aware, distributed analytics for situational understanding in coalition operations. *FY 2019 Plans:* Investigate and formally model new generative policy techniques in which elements can generate their policies under a loose set of guidance from a central coalition commander; investigate algorithms that ensure consistency and coherence in the operation of such a system to enable ad hoc and dynamic coalition formation; investigate fundamental limits and models for agile code and agile data to support distributed analytics in coalitions with mechanisms that dynamically adapt analytics processing in a			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** J15 / *Network Sciences ITA*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
tactical coalition environment as missions and coalitions change; develop deep learning techniques for multi-layer situational understanding with information fusion at varying levels of semantic granularity to obtain situational understanding in complex multi-layer coalition environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
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	-	0.151	-
Accomplishments/Planned Programs Subtotals	3.919	4.106	-

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

D. Acquisition Strategy
 N/A

E. Performance Metrics
 N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019

Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / University and Industry Research Centers	Project (Number/Name) J17 / Vertical Lift Research Center Of Excellence

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
J17: Vertical Lift Research Center Of Excellence	-	3.005	3.182	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	6.187

Note

In Fiscal Year (FY) 2020 this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB4 Army Research Centers

A. Mission Description and Budget Item Justification

This Project fosters research to provide vertical lift capability and engineering expertise for the Army. The focus of the Vertical Lift Research Center of Excellence (VLRCOE) is to couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. Work will provide research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Vertical Lift Research Center of Excellence (VLRCOE) **Description:** VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology to supplement a robust experimental and analytic basic research program in rotorcraft technologies including: Aeromechanics, Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations. **FY 2019 Plans:** Execute the third annual review of the VLRCOE program with a diverse team of Government subject matter experts (SMEs) and organizational leaders from the Army, the Navy, and the National Aeronautics and Space Administration (NASA), to provide technical direction for the research tasks. Execute the cooperative agreement with the Centers of Excellence at Georgia Institute of Technology, Pennsylvania State University, and University of Maryland, incorporating the reviewers' feedback to realign the research tasks with the Army's strategic science and technology plans. The Centers conduct a robust experimental and analytic basic research program in close collaboration with government SMEs in areas relevant to future vertical lift to include	3.005	3.080	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** J17 / *Vertical Lift Research Center Of Excellence*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
nanocomposites to enhance fatigue life of rotorcraft components, optimal control allocation methods, and advanced cueing & flight control algorithms. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers / Project AB4 Army Research Centers in FY20.			
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	-	0.102	-
Accomplishments/Planned Programs Subtotals	3.005	3.182	-

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 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** VS2 *I Multi-Scale Materials Modeling Centers*

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
VS2: *Multi-Scale Materials Modeling Centers*	-	8.686	8.743	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	17.429

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project supports two competitively awarded Collaborative Research Alliances (CRAs) to provide the Army with next generation multi-functional materials for ballistic and electronic applications and to address the extreme challenges associated with understanding and modeling materials subject to Army operational environments. The Materials in Extreme Dynamic Environments consortium, led by Johns Hopkins University partnered with CalTech, Rutgers University, and University of Delaware, focuses on understanding materials under high strain rates. The Multiscale Multidisciplinary Modeling of Electronic Materials consortium, led by University of Utah partnered with Boston University and Rensselaer Polytechnic Institute, focuses on microscale properties to design macroscale behavior for electronics. Research at both CRAs will address the modeling and experimental challenges associated with developing multidisciplinary physics simulations across multiple length scales for materials to include: a limited ability to relate materials chemistry, structure, and defects to materials response and failure under extreme conditions; an inadequate ability to predict the roles of materials structure, processing, and properties on performance in relevant extreme environments and designs; and the lack of experimental capabilities to quantify multiscale response and failure of materials under extreme conditions.

Work in this Project supports key Army needs and is coordinated with work performed in PE 0601102A (Defense Research Sciences) / Project H44 (Adv Sensor Research) and H42 (Materials and Mechanics).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Collaborative Research Alliances in Materials in Extreme Dynamic Environments and Multiscale Multidisciplinary Modeling of Electronic Materials.	8.686	8.423	-
Description: Research will focus on the following areas: two-way multiscale modeling for predicting performance and designing materials, investigating analytical and theoretical analyses to effectively define the interface physics across length scales; advancing experimental capabilities for verification and validation of multiscale physics; and modeling and strategies for the synthesis of high loading rate tolerant materials so that all of the latter lead to the development of a comprehensive set of			

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 *I* 1	**R-1 Program Element (Number/Name)** PE 0601104A *I University and Industry Research Centers*	**Project (Number/Name)** VS2 *I Multi-Scale Materials Modeling Centers*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
metrics that define high loading rate tolerant material systems. The multiscale modeling capability will be applied across multiple disciplines to facilitate revolutionary advances in materials for coupled environments (electromagnetic, high rate, high pressure and other extreme environments). ***FY 2019 Plans:*** Implement data-sharing protocols and processes for sharing fundamental materials research data within the program. Complete integrated multiscale models for high rate deformation and failure in all three material classes: metals, ceramics, and composites. Investigate solid solution strengthening of magnesium and the effects on spall strength, and the design of interface behavior and increased matrix strain in glass epoxy composites. Implement uncertainty quantification techniques across the three materials classes and applications; design and implement algorithms and tools for coupled multiscale modeling capable of enhancing/optimizing the design of individual components and systems across the three electronic materials research areas; develop methodologies for Uncertainty Quantification-driven bridging/mapping between models and simulation techniques and assessment of reliability of simulation-predicted outcomes for polymer membranes and electrode/electrolytes interfaces; and extend the Nonequilibrium Green's function code (inclusion of carrier-carrier scattering and parallel implementation) to evaluate key quantities not accessible to other simulation approaches, e.g. phonon-assisted Auger-induced leakage, trap- and phonon-assisted tunneling for electro-optical materials. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
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	-	0.320	-
Accomplishments/Planned Programs Subtotals	8.686	8.743	-

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

Exhibit R-2A, **RDT&E Project Justification:** PB 2020 Army		**Date:** March 2019
Appropriation/Budget Activity 2040 / 1	**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*	**Project (Number/Name)** VS2 / *Multi-Scale Materials Modeling Centers*

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 / 1				**R-1 Program Element (Number/Name)** PE 0601104A / *University and Industry Research Centers*						**Project (Number/Name)** VS3 / *Center For Quantum Science 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
VS3: *Center For Quantum Science Research*	-	5.013	6.230	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	11.243

Note

In Fiscal Year (FY) 2020, this Project is being realigned to:
Program Element (PE) 0601104A University and Industry Research Centers
* Project AB7 Army Collaborative Research and Tech Alliances

A. Mission Description and Budget Item Justification

This Project supports an extramural research consortium, which will bring together a critical mass of preeminent university and industry researchers to explore and develop critical emerging concepts in Quantum Information Science (QIS). The focus will be on establishing a first of its kind, multi-site distributed quantum network based on quantum memories. The Center for Distributed Quantum Information will study and demonstrate both the physical backbone and network layer for a robust quantum information network that will provide secure and tamper-proof communications and exponentially greater information processing capabilities for the future Army. The Center for Distributed Quantum Information will perform collaborative research with Army in-house scientists and engineers to help accelerate the transition of the research. In addition to providing the required expertise and critical mass to the effort, the consortium will also bring together a broad but unified multi-disciplinary research team needed to accelerate progress in the field of quantum information sciences.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Center for Distributed Quantum Information	5.013	6.002	-
Description: This work supports critical quantum science basic research at the United States (US) Army Futures Command exploiting quantum effects to greatly enhance computing, communications, imaging, sensing, and security, ensuring Army dominance on the future battlefield. *FY 2019 Plans:* Simultaneously entangle three or more physically separate quantum nodes and investigate quantum networking algorithms and protocols. Continue to refine and improve quantum-state transfer, node-to-node entanglement, error protection protocols, and frequency conversion. *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 **/** 1	**R-1 Program Element (Number/Name)** PE 0601104A **/** *University and Industry Research Centers*	**Project (Number/Name)** VS3 **/** *Center For Quantum Science Research*

B. Accomplishments/Planned Programs ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020**
This research effort will move to PE 0601104A University and Industry Research Centers/ Project AB7 Army Collaborative Research and Tech Alliances in FY20.			
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	-	0.228	-
Accomplishments/Planned Programs Subtotals	5.013	6.230	-

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

D. Acquisition Strategy
 N/A

E. Performance Metrics
 N/A