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Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 1: Basic Research</i>	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	118.716	126.267	100.909	-	100.909	103.414	101.736	107.292	122.411	0.000	780.745
AB4: <i>Army Research Centers</i>	-	22.425	22.686	24.586	-	24.586	25.331	25.504	25.928	25.921	0.000	172.381
AB7: <i>Army Collaborative Research and Tech Alliances</i>	-	45.147	52.364	57.673	-	57.673	58.132	55.787	60.911	76.043	0.000	406.057
AB8: <i>Army Educational Outreach Program</i>	-	10.275	10.641	11.244	-	11.244	12.430	12.659	12.664	12.661	0.000	82.574
AC6: <i>International Science and Technology</i>	-	6.869	6.951	7.406	-	7.406	7.521	7.786	7.789	7.786	0.000	52.108
CI9: <i>Strategic University Basic Research Alliance</i>	-	-	0.375	-	-	-	-	-	-	-	0.000	0.375
J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>	-	34.000	33.250	-	-	-	-	-	-	-	0.000	67.250

A. Mission Description and Budget Item Justification

This Program Element (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 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.

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

B. Program Change Summary (\$ in Millions)	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	118.716	94.003	0.000	-	0.000
Current President's Budget	118.716	126.267	100.909	-	100.909
Total Adjustments	0.000	32.264	100.909	-	100.909
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	33.250			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	100.909	-	100.909
• FFRDC Transfer	-	-0.986	-	-	-

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

Project: J13: UNIVERSITY AND INDUSTRY INITIATIVES (CA)

- Congressional Add: *Congressional Program increase - Materials in Extreme Dynamic Environments*
- Congressional Add: *Program increase - biotechnology development*
- Congressional Add: *Program increase - Army artificial intelligence innovation*
- Congressional Add: *Soldier Protection Materials*
- Congressional Add: *Hypervelocity Testing*
- Congressional Add: *The Discovery Center at Waters Edge*

Congressional Add Subtotals for Project: J13

Congressional Add Totals for all Projects

	FY 2021	FY 2022
	10.000	5.000
	4.000	4.000
	20.000	20.000
	-	1.000
	-	3.000
	-	0.250
Congressional Add Subtotals for Project: J13	34.000	33.250
Congressional Add Totals for all Projects	34.000	33.250

Change Summary Explanation

Fiscal Year 2023 (FY23) funding increase reflects the fact that the FY22 President's Budget request did not include out-year funding.

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 1					R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>				Project (Number/Name) AB4 / <i>Army Research Centers</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AB4: <i>Army Research Centers</i>	-	22.425	22.686	24.586	-	24.586	25.331	25.504	25.928	25.921	0.000	172.381

A. Mission Description and Budget Item Justification

This Project encompasses three types of Centers. The first is the Partnered Research Initiative (PRI) which supports Army's research 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 Fiscal Year 2016 (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.

The second is the University Affiliated Research Centers (UARCs). 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 third is the Army Centers of Excellence (COEs). 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.

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 2021	FY 2022	FY 2023
Title: Centers of Excellence for Battlefield Capability Enhancements (BCE)	1.669	1.586	1.774
Description: The focus of the HBCU/MI Research Centers of Excellence Program is to advance innovative basic research leading to potential technology development in areas of strategic importance to the Army by competitively selecting HBCU and MI research teams for grants or cooperative agreements. Awards have five-year periods of performance, with one each awarded in the areas of information, engineering, and physical science in order to support Army goals and broaden the performer base and diversify the research ecosystem.			
FY 2022 Plans:			

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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AB4 / <i>Army Research Centers</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will support three competitively-selected HBCU/MI-led collaborative research centers in the areas of information, engineering, and physical sciences that were competitively-selected and awarded in FY21.</p> <p>FY 2023 Plans: Will advance digital forensic investigative capabilities and improve operational decision-making capabilities, while advancing education and training of minority and underrepresented students in research targeted towards Army modernization needs; focus on developing new models and tools to understand and extract high-value, actionable information from digital data and devices across operational theaters.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Institute for Collaborative Biotechnologies</p> <p>Description: This effort performs sustained multidisciplinary discovery-based research that combines state-of-the-art methods in synthetic biology with novel techniques for biologically-enabled material synthesis and characterization. This fundamental research program provides a firm foundation of biotechnological knowledge that serves as a robust platform for design and development of biologically-enabled materials and technologies for Army-relevant applications and priorities.</p> <p>FY 2022 Plans: Will develop innovative platforms by using the tools of synthetic and systems biology, genetic circuitry, biocatalytic enzymes, and directed evolution to design and engineer new types of multi-functional materials with novel properties; design and assess enabled functionalities that include optical signature management, solar-to-electrochemical energy conversion, mechanical and thermal robustness, self-assembly and healing, highly selective chemical reactivity, sense-and-respond properties, and logging of environmental signals and events. These basic research efforts will combine state-of-the-art methods in synthetic and systems biology with advanced materials synthesis and characterization to provide unique biologically-derived material solutions for the Army's future challenges.</p> <p>FY 2023 Plans: Will develop material-by-design platforms using synthetic biology, genetic circuitry, biocatalytic enzymes, and directed evolution to synthesize, characterize, and engineer novel biologically-enabled materials, including biocatalytically-synthesized heterocyclic strained-ring compounds for use as energetic materials, additive manufacturing strategies for synthetic biological materials and composites, synthetic protein complexes that react to environmental inputs, responsive protein-based materials for optical signature management, solar-to-electrochemical energy conversion, or lenses with refractive-index gradients, and engineered</p>		4.565	4.502	5.009

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
microbial consortia with dynamic properties for modular and programmable biological behaviors, such as event logging or syntheses of reactive materials. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Institute for Creative Technologies Description: This effort focuses on 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 autonomous virtual human computer-generated characters that look, communicate, and behave like real people, 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 2022 Plans: Will explore understanding human behavior to be able to create generators and classifiers at the right level of fidelity in a virtual environment; research Artificial Intelligence-based systems that make it easy to author Army training systems; advance scientific understanding on how technology can assist the performance of individuals within tasks that are assumed to require social and emotional intelligence within a virtual environment; assess whether the effect of the virtual environment itself (e.g., poor vs. affluent neighborhood) on responses during the training or simulation (e.g., training outcomes, stress, impressions of virtual human (VH) characters in the environment, etc.) is significant (i.e., reliable) for simulations with different content (e.g., wayfinding, active shooter simulation, negotiation); build a theoretical and end-to-end framework based on 3D deep learning to enable AI-driven synthesis of dynamic 3D objects from two-dimensional (2D) views. FY 2023 Plans:		4.506	4.458	5.029

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will explore human behavior in small groups and teams, made up of a mixture of software and human agents, to understand conversational patterns as well as use of non-verbal behavior to disambiguate multiple threads of interaction in groups; continue to develop theoretical and end-to-end framework based on 3D deep learning to enable artificial intelligence (AI)-driven synthesis of dynamic 3D objects from 2D view generalizations will be extended to outdoor settings, where topographical information changes very quickly, to drive synthetic training environments that are not restricted to indoor spaces and dyadic relationships; advance scientific and technical support for simulation, for studying emerging sentiments in societies under biased sources of information; advance Learning sciences, in particular, the role of environment in training as well as feedback to trainee in guiding them towards strategies consistent with military rules and culture.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Institute for Soldier Nanotechnologies</p> <p>Description: This effort investigates Nanomaterials and Nanotechnologies for Soldier applications focused on light-weight, multifunctional nanostructured fibers and materials.</p> <p>FY 2022 Plans: Will design a novel, durable, shape-stable metamaterial composite for future high-temperature high Mach Number hypersonic applications; design superelastic granular materials to enable novel ductile (as opposed to current brittle) ceramic plates for greatly improved Soldier armor; design low-power on-chip beam-steering capabilities by exploiting a Luneburg lens design in a nanophotonic platform, to enable efficient directed Soldier comms that cannot be adversary-detected; design rapid and effective treatment of incompressible and internal wounds by systemically injectable hemostasis, based on nanoparticles crosslinked through bio-orthogonal click chemistry, designed to hone-in to location of bleeding even if location cannot be identified.</p> <p>FY 2023 Plans: Will research key areas including: advanced materials for challenging operational environments (e.g., strong, lightweight protective and structural materials for Soldiers, their devices, and platforms); battlefield care to increase Soldier survivability; and innovative optoelectronic, quantum, high-functionality materials and devices for novel sensing, communications, computing devices and systems, and electric power generation capabilities. The work will be in collaboration with Army strategic partners to address critical capability needs in Soldier protection, battlefield care, and sensing, augmenting situational awareness, and transformational nano-optoelectronic Soldier capabilities.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		5.196	4.662	5.173
<p>Title: Vertical Lift Research Center of Excellence (VLRCOE)</p>		3.190	3.152	3.527

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>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.</p> <p>FY 2022 Plans: Will kick-off a new, five year program combining graduate education and university research to explore frontier areas relevant to Future Vertical Lift; assess proposals based on a combination of criteria that requires a critical mass of expertise to form an inter-disciplinary research and education center; individual research tasks will be selected predominantly based on their scientific merit and relevance to Army Science and Technology (S&T) goals; conduct multi-disciplinary experimental, computational, and analytical basic research tasks in vertical lift technology disciplines spanning aeromechanics, structures and materials, flight dynamics and control, Vertical Take-Off and Landing (VTOL) concepts and design, vibration and noise control, propulsion, affordability, and safety and survivability.</p> <p>FY 2023 Plans: Will execute the second year of the five-year VLRCOE cooperative agreements with Georgia Tech, Penn State University, and University of Maryland. Will focus on fundamental research with long-term relevance to Future Vertical Lift such as aeromechanics of high-speed compound and coaxial configurations, interactional aerodynamics of low drag hubs and pylon flows, stability analysis of advanced VTOL configurations and whirl-flutter for tilt-rotor configurations. Will ensure research is highly collaborative with government subject matter experts (SMEs) closely involved in technical interchanges with academia throughout the program to ensure continued relevance.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Automotive Research Center (ARC)</p> <p>Description: The ARC is an United States 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.</p> <p>FY 2022 Plans: Will enhance modeling and simulation (M&S) capabilities for ground systems with a concerted effort in autonomous vehicle off-road mobility M&S in harsh terrains and contested environments; other major ground system M&S focus areas for enhancements</p>		3.299	3.479	4.074

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>include: Vehicle-Level Sensing, Perception and Acting for autonomous vehicles in different situational and teaming environments; Communication, Trust and Cognition between humans and conventional/autonomous vehicles; Intelligence, Off-Road, Resilience for vehicle structures and large-scale computational methods; Adaptability and Self-Awareness for power systems; Fleet Dynamics, Decision-Making, and System of Systems. Will research usage of operational data-driven techniques to analytics models to improve prediction accuracy and efficiency.</p> <p>FY 2023 Plans: Will enhance M&S capabilities for ground systems with a concerted effort in heterogeneous multi-vehicle teams of humans and autonomous vehicles capable of adapting in adversarial environments using advanced materials, structures, and intelligent power systems. Major ground system M&S focus areas for enhancements include: (a) Algorithms for Autonomous Off-road Mobility near vehicle performance limits using planning, perception, and control algorithms scalable to complex off-road environments, tolerant to partial information, uncertainty, and failures, (b) Human-Autonomy Interactions, Collaboration and Control for teams including context-accurate, real-time communication that considers cognitive loads, active information gathering, system anomalies and recovery, and bi-directional transparency of state, (c) Materials and Structures for autonomous vehicles with advanced adaptability, structural perception and multi-functional capabilities, including M&S for Off-road Terramechanics, (d) Intelligent Power Systems with heterogeneous energy sources for management of operational energy and decision-making support, and (e) Dynamic Management, requirements development, and performance evaluations of multiple heterogeneous vehicles in teams to exploit their collective, evolving operational capabilities including System of Systems Integration accounting for design, development, manufacturing, deployment and logistics.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.847	-
Accomplishments/Planned Programs Subtotals		22.425	22.686	24.586
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				

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D. Acquisition Strategy
N/A

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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>AB7: Army Collaborative Research and Tech Alliances</i>	-	45.147	52.364	57.673	-	57.673	58.132	55.787	60.911	76.043	0.000	406.057

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 is 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 (funded in PE 0601121A (Cyber Collaborative Research Alliance)), the internet of battlefield things, distributed and collaborative intelligent systems technology, neuroergonomics and neuroscience, advanced materials, exploitation of quantum effects, semiconductor modeling, convergent manufacturing, autonomous maneuver and machine learning and artificial intelligence.

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 2021	FY 2022	FY 2023
Title: Internet of Battlefield Things CTA (IoBT CTA)	5.856	2.789	3.119
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 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 2022 Plans: Will explore foundational theories and methods for quantifying uncertainty in data and predictive or classifying algorithms given highly heterogeneous and pervasive intelligent systems; create approaches that quantitatively improve the overall dependability/stability of complex, smart command and control systems-of-systems; investigate algorithms that capitalize on ubiquitous sensor/actuators and the ability to derive information outside of their intended/advertised use; investigate theories and algorithms that			

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
enable agile composite systems to have self-awareness and autonomy to reconfigure/react to adversarial battlefield environment and information dynamics. FY 2023 Plans: Will continue to explore foundational theories and methods for quantifying the amount of uncertainty or error in machine learning (ML) algorithms and overall dependability/stability of intelligent systems-of-systems; explore approaches that investigate atypical use of sensing modalities that capitalizes on ubiquitous sensor/actuators and the ability to derive information outside of their intended/advertised use; investigate theories and methods for efficient distributed learning that provides lightweight and/or information-theoretic compression methods and resource provisioning across Command and Control information-networks. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
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 2022 Plans: Will investigate theories, models, and techniques for distributed control of policy-enabled dynamic infrastructures, federated policy learning and management, federated learning for coalition analytics, interpretability of neural networks in distributed and contested coalition environments, understanding internal group behavior and dynamics in complex multi-domain environments, and learning and inferencing for uncertainty-aware human-machine situational understanding, in the context of ad-hoc coalition operations at the tactical-edge. FY 2023 Plans: Will investigate theories, models, and techniques for distributed resource awareness, resource allocation optimizations, and joint orchestration of network slices and analytics microservices to improve the capacity, resilience, and speed of decision of distributed analytics at the tactical edge. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		4.074	2.610	2.950
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		8.363	-	-

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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AB7 / <i>Army Collaborative Research and Tech Alliances</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>experimental capabilities for verification and validation of multiscale physics; and modeling and strategies for the synthesis of 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).</p> <p>Title: Distributed Collaborative Intelligent Systems Technology CTA</p> <p>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.</p> <p>FY 2022 Plans: Will conduct fundamental research in heterogeneous multi-agent situational awareness to explore how a heterogeneous team can collaborate to build shared situational awareness while moving through a contested environment and perform collaborative decision making over long timescales with high operational tempo in complex, dynamic environments; explore dynamic teaming operations, heterogeneous team control and strategy, and synthesis and adaptation of team behaviors with high operational tempo; establish resource aware communication required for coordination and collaboration amongst team members and increase distributed resilience in the team response.</p> <p>FY 2023 Plans: Will conduct fundamental research to explore how heterogeneous teams of humans and autonomous systems collaborate, share large amounts of information, learn, and adapt in complex and dynamic situations and environments; research how teams of autonomous systems efficiently and effectively communicate, tactically engage, and plan against dynamic adversaries; investigate how multi-agent systems collectively understand and exploit terrain and the environment in planning; explore how individual agents, heterogeneous teams, and sub-teams adaptively task and re-task over long duration missions; explore methods to provide resilient multi-agent behaviors in the presence of adversaries.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		6.059	6.009	6.599
<p>Title: Neurosciences CRA</p> <p>Description: This effort performs multidisciplinary basic research in the area of neuroscience through collaboration with the University of California at Santa Barbara.</p>		0.629	0.598	0.680

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AB7 / <i>Army Collaborative Research and Tech Alliances</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p><i>FY 2022 Plans:</i> Will employ state-of-the-art techniques in neuroscience to develop and test neural biomarkers associated with human cognition that track with directed attention, modes of planning and problem solving, memory-guided decision-making, and visual search; characterize the influence of arousal, fatigue, stress, and other demands on cognitive states and their neural biomarkers; assess the potential for biomarkers to inform human-machine interfaces, to accelerate learning, and to enhance integrated human-artificial intelligence system performance.</p> <p><i>FY 2023 Plans:</i> Will conduct fundamental neuroscientific studies aimed at understanding the basic mechanisms that support situational awareness, including cognitive priority control, and how those mechanisms are impacted by changes in physical and cognitive workloads; characterize human neural systems that integrate motor skill learning, route planning, and choice behavior during adaptive planning in complex physical scenarios; uncover the cognitive and neural mechanisms underlying individual decision-making conducted under uncertainty; develop models of visual information processing and neural systems under covert and overt attention. If successful, these basic research studies will support Army efforts to augment Soldier performance, increase situational awareness, lighten cognitive workloads, and integrate humans with autonomous systems employing artificial intelligence.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i> Funding change reflects planned lifecycle of this effort.</p>				
<p><i>Title:</i> Center for Exploitation of Quantum Effects</p> <p><i>Description:</i> This work supports needed quantum information science basic research for next generation capabilities in security, decision aids, sensing, and position, navigation, and timing (PNT) for Army dominance on the future battlefield.</p> <p><i>FY 2022 Plans:</i> Will investigate approaches to solid-state sensing of magnetic fields using Nitrogen-Vacancy (NV) diamond and Silicon Carbide (SiC) defects in solids; investigate long-range atom-atom interactions through optical fiber and solid-state emitters near integrated waveguides; investigate topological light sources for low-loss routing of entangled photon pairs; explore distributed sensing using ion traps; explore methods for using telecom-compatible energy levels in ytterbium (Yb) ions for long-range entanglement distribution.</p> <p><i>FY 2022 to FY 2023 Increase/Decrease Statement:</i></p>		2.888	2.793	-

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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AB7 / <i>Army Collaborative Research and Tech Alliances</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
In FY23, funding administratively realigned within this Project to support the creation of the "Fundamentals for Quantum Technologies" task.				
<p>Title: Identification and characterization of team-level processes for enhancing performance of heterogeneous Soldier-Agent teams CRA</p> <p>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.</p> <p>FY 2022 Plans: Will characterize and model critical individual processes and dynamics in relation to team-level emergence in military-relevant team tasks involving multiple humans and multiple intelligent agents; extend and validate human-based theories of team effectiveness incorporating micro, meso, and macro signatures of emergence to human-agent teams; explore team emergent responses to perturbations; incorporate agent-based learning from humans to improve dynamic teaming.</p> <p>FY 2023 Plans: Will create and validate algorithms to measure how rank and competency status of humans and agents predict emergent multiple human multiple agent team states; measure how stress and the reconfiguration of teammates in a hierarchy impacts predictions of successful team performance; determine the physiological and telemetric processes that predict desirable versus undesirable team states and how changes in the world perturb these processes; measure the emergence of team level trust based on team composition, and develop practices to build teams with strong trust characteristics; create real-time, individualized, and adaptive intervention to improve performance of teams composed of multiple humans and multiple agents in a complex task.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		4.758	4.707	5.253
<p>Title: Army Artificial Intelligence Innovation Institute (A2I2)</p> <p>Description: This effort coordinates, conducts, and accelerates basic research to address Army-specific challenges, with a focus on advancing artificial intelligence (AI) and machine learning (ML) capabilities for autonomous maneuver in multi-domain operations (MDO). A broad-spectrum of 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. The Army Futures Command (AFC) will leverage existing High Performance Computing (HPC) and network infrastructure, along with regional laboratory extensions to enable basic research on AI that is open, with top-tier universities, commercial businesses, and established Department of Defense industrial partners. The A2I2 creates an accessible database of heterogeneous data, a repository of AI and ML algorithms and software tools, and military-relevant challenge problems.</p>		7.202	7.195	7.667

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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AB7 / <i>Army Collaborative Research and Tech Alliances</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>FY 2022 Plans: Will assess current research and combine, re-direct, or initiate efforts to meet progressively harder challenge problems through experimentation and physics based criteria; transition most promising results and models to Army specific applications enabling rapid improvement of ML techniques; increase database accessibility and tools to provide an array of software and processing capabilities to academic, industry, and other Department of Defense partners; provide access to curated, labeled dataset covering a large variety of applications to meet Army requirements.</p> <p>FY 2023 Plans: Will develop methods for increased situation awareness between agents in multi-agent scenarios; enhance learning algorithms to increase the functionality of robots powered by artificial intelligence; create robust and safe planning methods for autonomous mobile robots; increase the use of domain-knowledge use in artificial intelligence; establish human-accessible and understandable machine plan of action; design secure algorithms that can provide probabilistic guarantees on security and latency.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Artificial Intelligence Hub</p> <p>Description: The AI Hub is located at Carnegie Mellon University as a consortium of industry, government, and academia focused on building and optimizing the Army's AI and ML initiatives with the goal of accelerating the fielding of capability. The AI Hub will utilize the A2I2 data and AI/ML algorithms and software tools to investigate AI and ML capabilities to address the Army's unique problems. The AI Hub will focus on research into AI technologies for future application to Army-relevant areas such as predictive maintenance, operations for intelligence in support of Long Range Precision Fires, human relations/talent management; and autonomous threat recognition.</p>		5.318	-	-
<p>Title: Army Radio-Frequency (RF) Electronics Center</p> <p>Description: The Army RF Electronics Center will develop ultra-wide bandgap (UWBG) materials and device concepts designed to enable next generation RF semiconductor technology for the Army. This research will enable advanced, robust, high-power RF electronics for radars, comms, directed energy, and electronic warfare (EW). The resulting robust high power operation will provide longer ranges for sensing and effect-on-target under adverse conditions and improved sized, weight, and power (SWaP) will give small systems (Unmanned Aerial Vehicles, countermeasures, etc.) new capabilities.</p> <p>FY 2022 Plans: Will implement a combination of approaches designed to create a basic research paradigm in UWBG semiconductor materials using data-driven physics informed computer science approaches; undertake research that will understand materials/device</p>		-	4.670	5.110

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>physics and performance limits under extreme conditions; create innovative device concepts and circuit architectures to realize or overcome these limits.</p> <p>FY 2023 Plans: Will synthesize high Aluminum composition devices through theory and modeling, device engineering, and characterization techniques that if successful, will enable devices with performance far exceeding current state-of-the-art wide-bandgap devices in terms of large signal gain, output power density, and power added efficiency at operating frequencies greater than 90 GigaHertz (GHz); create a new paradigm for heat transfer from UWBG materials, surfaces, and interfaces through ballistic thermal injection (BTI) that if successful, will enhance thermal transport across and near UWBG interfaces and mitigate thermal degradation of device performance.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Army Advanced Biological Control Center</p> <p>Description: The Army Advanced Biological Control Center will develop a fundamental knowledge base for precise, reliable control of engineered biological systems for functional effect during military operations. By exploiting fundamental relationships governing the functions and properties of biological systems, the Center will develop advanced control schemes using synthetic biology targeting two key areas: 1) Genetic Control of Material Properties and 2) Biological Control in Competitive Environments.</p> <p>FY 2022 Plans: Will initiate concepts for a comprehensive information pipeline for the creation of new algorithms and scalable computational models that extract the critical genetic parameters driving material properties; develop robust predictive models to inform genetic manipulation using synthetic biology for precision material synthesis with targeted properties across scales; design and assess experimental approaches to measure interactions of engineered microorganisms with the biological, chemical, and physical parameters of the microenvironment and bulk environment compared to naturally occurring microorganisms.</p> <p>FY 2023 Plans: Will determine the parameters required for development of robust predictive tools that enable informed design using synthetic biology to produce biological materials with targeted multifunctional properties; initiate experimentation using high-throughput analytical methods for characterization, screening, and selection of engineered variants with targeted multifunctional material properties; devise relevant surrogate laboratory environment(s) for cellular consortia and methods to effectively target specific organisms within a consortium for genetic modification; analyze the fate of engineered deoxyribonucleic acid (DNA) within a consortium, including gene transfer, persistence, and mutation that if successful, will provide key elements of a synthetic biology</p>		-	4.670	5.110

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
research pipeline enabling the rapid and effective exploration and validation of novel material and cellular systems to protect the Soldier. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: Army Advanced Energetics Center Description: The Army Advanced Energetics Center will develop a fundamental knowledge base for greater than 5x lethality and range of guns and projectiles through the discovery of disruptive energetic materials and exceeding the strategic objectives of current programs. This research focuses on high through-put synthesis and rapid characterization to accelerate discovery of next, next generation materials to enable Army domination of the future battlefield. FY 2022 Plans: Will develop concepts around future energetic materials for tailorable effects which enable increased lethality of warhead fragments and enable new concepts for shape charge weapons; develop energetic materials with higher energy density and enable lighter, smaller, more lethal warheads for smart munitions; design materials for high specific impulse propellants, enable increased range of munition systems, and enable reduced time-of-flight, increased munitions survivability, and end-game maneuverability to avoid threat countermeasures. FY 2023 Plans: Will devise pathways to novel energetic materials, both organic and inorganic, and synthesis methods for increased energy density and improved insensitivity; establish methodologies to focus energy through deliberate design of energetic materials microstructure to enable enhanced effects on target; develop enhanced diagnostics methods that allow testing of minute quantities of novel materials to feed back to synthesis efforts and increase development cycle speed to enable faster future novel energetic materials development; create novel modeling frameworks to enable future virtual assessments of energetic materials, munitions, and propellants. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.		-	4.670	5.110
Title: Tactical Behaviors for Autonomous Maneuver Description: This effort focuses on development of the algorithmic underpinnings of adaptive, resilient, and tactically relevant behaviors for teams of autonomous ground and aerial vehicles, which will enable multi-domain autonomous maneuver. FY 2022 Plans:		-	2.315	2.620

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will conduct fundamental research on planning algorithms that can passively learn tactics from observed data in constrained terrains using limited resources, and predict positions of advantage for area reconnaissance based on external observations.</p> <p>FY 2023 Plans: Will explore foundation theories and methods for autonomous systems that can maneuver and adapt in a tactically relevant manner with limited Soldier intervention, and adapt to changing conditions and adversarial actions; create algorithms and techniques to passively learn tactics from observed data in constrained terrains using limited resources; investigate techniques to predict positions of advantage for area reconnaissance based on external observations.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>				
<p>Title: Materials Discovery for Extreme Environments</p> <p>Description: Research will focus on material discovery for next-generation ballistic materials by using accelerated material-by-design approach to include consideration of nonhomogeneous, anisotropic, and hierarchical material systems. A data-driven material design approach will be developed utilizing high-throughput material processing and characterization, multi-scale modeling, and machine intelligence to produce leap-ahead material solutions.</p> <p>FY 2022 Plans: Will conduct research in data-driven and machine intelligence approaches to correlate material structure, property, and requirements for multiple harsh military environments such as launch and flight, high-temperature and high ablation, and impacts at unprecedented velocity; enable rapid screening of high dimensional material datasets; establish parameter space and methods for synthesis and high-throughput characterization of material classes suitable for high rate applications to produce large variations in properties.</p> <p>FY 2023 Plans: Will continue collaborative research on data-driven and machine intelligence approaches to correlate material structure, property, and requirements for multiple harsh military environments such as launch and flight, high-temperature and high ablation, and impacts at unprecedented velocity; mature rapid screening methods for high dimensional material datasets; continue to mature parameter space and methods for synthesis and high-throughput characterization of material classes suitable for high rate applications to produce large variations in properties; down select most promising seedling efforts for continuation to Army Centers (multi-year, comprehensive anchor programs).</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>		-	5.971	6.530
<p>Title: Fundamentals for Quantum Technologies</p>		-	0.483	4.916

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Description: This work supports quantum information science basic research for next generation capabilities in entanglement-enhanced novel sensors and communications for Army dominance on the future battlefield.</p> <p>FY 2022 Plans: Will investigate foundational approaches to light-matter interfaces to understand how to efficiently store, retrieve, and distribute quantum information between atoms and ions.</p> <p>FY 2023 Plans: Will investigate increased spin coherence in a nanophotonic cavity; explore optimization of charge state ratios in solid-state defect materials for improved sensors; research waveguide-based Faraday rotation for on-chip optical isolation; investigate spin-squeezing protocols for quantum metrology; explore methods for controlling motional states of trapped ion; research arrays of Rydberg atoms for controllable phased array photon emission from atoms.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding administratively realigned from the ?Center for Exploitation of Quantum Effects? task within this Project and from Program Element (PE) 0601104A (University and Industry Research Centers) / Project CI9 (Strategic University Basic Research Alliance) to support the increased focus for this task.</p>				
<p>Title: Convergent Manufacturing for High Performance Material Interfaces</p> <p>Description: This research will address novel additive deposition, high fidelity subtractive methods, and high resolution directed energy processes to investigate complex, non-discrete, high performance, multi-material interfaces with improved adhesion, gradual coefficient of thermal expansion changes, and gradual wavespeed changes to enable high performance under extreme ballistic and thermal conditions.</p> <p>FY 2022 Plans: Will develop a basic convergent manufacturing platform that is capable of depositing two classes of materials (i.e., polymers, metals, or ceramics) and transform those materials into their desired morphology independently; investigate a complex interface, such as a gradient, composed of two classes of materials using convergent processing.</p> <p>FY 2023 Plans: Develop a more complex convergent manufacturing platform to manufacture a material interface with superior properties/performance relative to existing interfaces (e.g., adhesives or fasteners); develop basic capabilities to concurrently manufacture and transform other classes of dissimilar materials.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement:</p>		-	0.955	1.036

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Funding change reflects planned life cycle of effort.				
Title: Semi-Conductor Modeling Consortium		-	-	0.973
Description: As a result of the Army's investment in electronic material modeling and simulation, tools are now available to predict semiconductor material and device performance with high fidelity. Through modeling and simulation, the Center for Semiconductor Modeling of Materials and Devices (CSM) assesses performance, guides improvements, and reduces technology risk for niche Department of Defense (DoD) semiconductor applications before large investment is committed. The intent of the CSM is to simulate real materials and devices in real environments, understand the limits of the technology, understand the parameters that control the performance, eliminate variances to the maximum extent possible, and arrive at a materials and device design which will reproducibly yield the required performance. Doing so at an early stage of innovation will undoubtedly lead to acceleration toward the next disruptive innovation. This acceleration is becoming increasingly important because the environment is changing rapidly and to stay ahead we must innovate faster.				
FY 2023 Plans: Will investigate the physics of blinking pixels and noise that limit the ultimate performance of imagers; support the development of transformational electro-optical devices that use emerging semiconductors; enhance initiatives in new applied materials such as topological insulator; investigate photonic devices for infrared imaging; explore advanced wide band gap devices that address the unique DoD applications challenges in RF and power management.				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding realigned from Program Element (PE) 0601104A (University and Industry Research Centers) / Project CI9 (Strategic University Basic Research Alliance) to support the creation of this task in FY23.				
Title: FY2022 SBIR/STTR Transfer		-	1.929	-
Description: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638				
FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638				
Accomplishments/Planned Programs Subtotals		45.147	52.364	57.673
C. Other Program Funding Summary (\$ in Millions)				
N/A				

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

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 1					R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>				Project (Number/Name) AB8 / <i>Army Educational Outreach Program</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AB8: <i>Army Educational Outreach Program</i>	-	10.275	10.641	11.244	-	11.244	12.430	12.659	12.664	12.661	0.000	82.574

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 nation's 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 Department of Defense (DoD) careers. AEOP increases interest and involvement of students and teachers across the nation in STEM at all proficiency levels and backgrounds to include underserved and economically disadvantaged groups, and military affiliated communities, 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.

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 2021	FY 2022	FY 2023
Title: AEOP Coop Agreement	9.975	10.252	11.244
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 and military affiliated communities in STEM initiatives to build the pool of diverse STEM competitive talent. 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 2022 Plans: Will continue Army 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 reviews and educational			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>assessments to support future decisions and best practices. Continue career development opportunities that support agile human capital needs within laboratories with a concentration on continued STEM education development. Will increase partnerships with like-minded organizations in an effort to increase participation from underserved students and military affiliated communities. Will conduct West Point cadet research internship program to enhance cadet training through field experience in Army research labs and engineering centers</p> <p>FY 2023 Plans: Will continue Army 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 reviews and educational assessments to support future decisions and best practices. Will continue career development opportunities that support agile human capital needs within laboratories with a concentration on continued STEM education development. Will increase partnerships with like-minded organizations in an effort to increase participation from underserved students and military affiliated communities. Will conduct West Point cadet research internship program to enhance cadet training through field experience in Army research labs and engineering centers.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p>			
<p>Title: West Point Cadet Program</p> <p>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.</p>	0.300	-	-
<p>Title: FY2022 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>	-	0.389	-
Accomplishments/Planned Programs Subtotals	10.275	10.641	11.244

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

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
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C. Other Program Funding Summary (\$ in Millions)

Remarks

D. Acquisition Strategy
N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army										Date: April 2022		
Appropriation/Budget Activity 2040 / 1					R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>				Project (Number/Name) AC6 / <i>International Science and Technology</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
AC6: <i>International Science and Technology</i>	-	6.869	6.951	7.406	-	7.406	7.521	7.786	7.789	7.786	0.000	52.108

A. Mission Description and Budget Item Justification

This Project funds: 1) the Combat Capabilities Development Command's (DEVCOM) International Basic Research Mission, 2) the DEVCOM International Technology Centers (ITCs), and 3) the Foreign Technology (and Science) Assessment Support (FTAS) program. The International Basic Research Mission seeks to discover highly promising basic research from the universities of our foreign partners and awards seed funding to discoveries that support the United States Army's Science and Technology (S&T) strategy. The ten 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 international S&T investments of our international partners, thereby increasing our ability to use limited S&T funds on promising research opportunities. The DEVCOM ITCs and DEVCOM's Army Research Laboratory / Army Research Office (ARL / ARO) will identify and assess international technology programs, 'technology finds', to assess their potential impact on the Army's S&T investment strategy and modernization priorities. These 'technology finds' are submitted to various Army S&T organizations for assessment and consideration for further research and development. Highly promising research will be awarded seed funding by ARO and/or the ITC through a grant, contract, or cooperative agreement. The FTAS program also builds upon the 'technology finds' submitted by ARO and 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 or modernization priorities. 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 and 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 2021	FY 2022	FY 2023
Title: International Technology Centers	4.469	4.397	1.716
Description: The ten 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 research investments in Science and Technology (S&T) of our international partners. The ITCs perform identification and assessment of international technology programs to assess their potential impact on the Army's S&T investment strategy and modernization priorities. ITC 'technology finds' are submitted to various Army S&T organizations for assessment and consideration for further research and development through avenues such as the Foreign Technology (and Science) Assessment Support (FTAS) Program. Highly promising research is awarded seed funding by the ITC through a grant, contract, or cooperative agreement - typically to a foreign researcher.			
FY 2022 Plans: Will continue to continue to seek out promising foreign S&T basic research within geographic areas of responsibility that may have interest and applicability to the United States Army's research and development efforts in support of the Army's Modernization			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AC6 / <i>International Science and Technology</i>

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022	FY 2023
<p>Priorities;. In accordance with the Army S&T Strategy and the Combat Capabilities Development Command (CCDC) Global Engagement Plan (GEP), continue to seek -out and connect foreign researchers with United States Army scientists and engineers, with the explicit intent to fund promising and relevant research through a contract or cooperative agreement; continue to enhance and refine technology search capabilities using customer feedback to focus on mid- and long-term capabilities.</p> <p>FY 2023 Plans: Will scout for foreign S&T within geographic areas of responsibility on behalf of AFC and the United States Army DEVCOM Lab and Centers to identify early emerging technologies of interest to the United States Army's research and development efforts in support of the Army's Modernization Priorities. In accordance with the Army S&T Strategy and the DEVCOM GEP; seek and connect foreign technology developers with United States Army science and technology enterprise. The ITCs will support funding of promising and relevant research through grants, contracts, cooperative agreements, or other existing funding mechanisms (e.g., Coalition Warfare Program, Foreign Technology and Science Assessment Support, Foreign Comparative Testing, etc.); will continue to enhance and refine technology search capabilities using customer feedback to focus on mid- and long-term capabilities for the Army enterprise.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding decrease to administratively separate the "International Basic Research" task mission from the "International Technology Center" task mission, both in this same Project.</p>			
<p>Title: Foreign Technology (& Science) Assessment Support</p> <p>Description: The FTAS program serves as a catalyst for the Army Futures Command to assess potentially game-changing technologies discovered in friendly foreign nations by the 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.</p> <p>FY 2022 Plans: Will solicit proposals and assess scientific quality of candidate projects by utilizing United States Army scientific expertise; continue to provide funding for approved proposals to United States Army S&T centers and laboratories to develop and/or assess technology areas identified by the ITCs and S&T community and ARO personnel.</p> <p>FY 2023 Plans: Will continue to solicit proposals, assess scientific quality/alignment to Army priorities of candidate proposals, and fund highly relevant and rigorous projects for potential contribution to the Army's S&T programs. Funds will be used to support research grants, innovation challenges, procurement of foreign technology, partnering with international allies and partners to include non-traditional entities, and enabling efforts for international research and technology collaboration with the Army Modernization</p>	2.400	2.348	2.591

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AC6 / <i>International Science and Technology</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
Enterprise. Will provide funding for approved proposals to support development and/or assessment of foreign technologies by U.S. Army laboratories and foreign partners in topical areas supporting Army priorities. FY 2022 to FY 2023 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.				
Title: International Basic Research Mission Description: ARL/ARO will execute the international basic research mission in support of the ITCs. ARO will create and exploit new international scientific discoveries and technology breakthroughs with foreign universities to improve the Army's transformational capabilities. Highly promising fundamental research finds will be awarded seed funding through a grant, contract, or cooperative agreement. 'Technology finds' are submitted to various Army S&T organizations for assessment and consideration for further research and development. FY 2023 Plans: Will continue to seek promising foreign S&T basic research within geographic areas of responsibility that may have interest and applicability to the United States Army's research and development efforts in support of the Army's Modernization Priorities. In accordance with the Army S&T Strategy and the Army international basic research strategy within the DEVCOM GEP, continue to seek and connect foreign researchers with United States Army scientists and engineers, with the explicit intent to fund promising and relevant research through grants; continue to enhance and refine technology search capabilities using customer feedback to focus on long-term capabilities. FY 2022 to FY 2023 Increase/Decrease Statement: Funding increase to administratively separate the "International Basic Research" task mission from the "International Technology Center" task mission, both in this same Project.		-	-	3.099
Title: FY2022 SBIR/STTR Transfer Description: Funding transferred in accordance with Title 15 USC ?638 FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638 FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638		-	0.206	-
Accomplishments/Planned Programs Subtotals		6.869	6.951	7.406

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) AC6 / <i>International Science and Technology</i>

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

N/A

Remarks

D. Acquisition Strategy

N/A

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 1					R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>				Project (Number/Name) CI9 / <i>Strategic University Basic Research Alliance</i>			
COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
<i>CI9: Strategic University Basic Research Alliance</i>	-	-	0.375	-	-	-	-	-	-	-	0.000	0.375

Note

In Fiscal Year 2023 (FY23), this Project is Terminated and all funding is realigned to Project AB7 (Army Collaborative Research and Tech Alliances) within the same Program Element.

A. Mission Description and Budget Item Justification

The Strategic University Basic Research Alliance, coordinated by the Army Future Command's University Technology Development Division (UTDD), enables enduring strategic academic partnerships focused on providing academia a gateway to identify, propose, and pursue basic research efforts that may lead to unique solutions for Warfighter problems. This Project supports basic research originating in academia in areas with the potential to impact future Army modernization including, but not limited to, autonomy, artificial intelligence and machine learning (AI/ML), robotics, network integration, decisive lethality, soldier performance, resulting in high-value, shared-risk partnerships for the enterprise to influence, leverage, and accelerate Army priorities. The Strategic University Basic Research Alliance exploits state-of-the-art research programs at academic institutions to increase the supply of scientists and engineers to advance and enhance research within Army laboratories. This effort conducts basic research leading to potential emerging technologies in sister Projects of applied research and advanced technology areas of strategic importance pertinent to Army prioritization, by bringing competitively selected Universities into strategic Alliances. This approach enables persistent, competitive partnerships fostering deep awareness, knowledge, and expertise for Warfighter modernization efforts.

This Project is fully coordinated with PE 0602144A (Ground Technology), PE 0602141A (Lethality Technology), PE 0602182A (C3I Applied Research), PE 0602183A (Air Platform Applied Research), and PE 0602184A (Soldier Applied Research).

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

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

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

Title: University Basic Research Strategic Partnerships	FY 2021	FY 2022	FY 2023
Description: Conducts basic research leading to potential emerging technologies in areas of strategic importance to the Army by bringing competitively selected Universities with research teams into strategic alliances. Investigates novel principles, ideas, and theories potentially leading to novel technologies in collaboration with academic entities that might not otherwise collaborate with the DoD, with the end goal of accelerating the adoption of cutting-edge technology for the warfighter.	-	0.361	-
FY 2022 Plans:			

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army		Date: April 2022		
Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) C19 / <i>Strategic University Basic Research Alliance</i>		
B. Accomplishments/Planned Programs (\$ in Millions)		FY 2021	FY 2022	FY 2023
<p>Will conduct fundamental research employing a multidisciplinary research strategy to advance new capabilities in such areas as autonomy, artificial intelligence, machine learning, robotics, all terrain navigation/routing, and novel materials and sensing modalities; discover novel methods for seamless cooperation between intelligent agents and humans; and investigate network resiliency.</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: In Fiscal Year 2023, all funding is realigned to project AB7 (Army Collaborative Research and Tech Alliances) within the same program element.</p>				
<p>Title: SBIR/STTR Transfer</p> <p>FY 2022 Plans: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2022 to FY 2023 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC ?638</p>		-	0.014	-
Accomplishments/Planned Programs Subtotals		-	0.375	-
C. Other Program Funding Summary (\$ in Millions)				
N/A				
Remarks				
D. Acquisition Strategy				
N/A				

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army **Date:** April 2022

Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) J13 / <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>
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COST (\$ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>	-	34.000	33.250	-	-	-	-	-	-	-	0.000	67.250

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 2021	FY 2022
Congressional Add: Congressional Program increase - Materials in Extreme Dynamic Environments	10.000	5.000
FY 2021 Accomplishments: Congressional increase: Accelerated basic research on materials in extreme dynamic environments.		
FY 2022 Plans: Congressional Interest Item funding provided for Materials in Extreme Dynamic Environments		
Congressional Add: Program increase - biotechnology development	4.000	4.000
FY 2021 Accomplishments: Congressional increase: Accelerated basic research on biotechnology development.		
FY 2022 Plans: Congressional Interest Item funding provided for Biotechnology Advancements		
Congressional Add: Program increase - Army artificial intelligence innovation	20.000	20.000
FY 2021 Accomplishments: Congressional Increase: Basic Research supported Army Artificial Intelligence Innovation.		
FY 2022 Plans: Congressional Interest Item funding provided for Army Artificial Intelligence Innovation		
Congressional Add: Soldier Protection Materials	-	1.000
FY 2022 Plans: Congressional Interest Item funding provided for Soldier Protection Materials		
Congressional Add: Hypervelocity Testing	-	3.000

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Exhibit R-2A, RDT&E Project Justification: PB 2023 Army	Date: April 2022
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Appropriation/Budget Activity 2040 / 1	R-1 Program Element (Number/Name) PE 0601104A / <i>University and Industry Research Centers</i>	Project (Number/Name) J13 / <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i>
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2021	FY 2022
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for Hypervelocity Testing		
<i>Congressional Add:</i> The Discovery Center at Waters Edge	-	0.250
<i>FY 2022 Plans:</i> Congressional Interest Item funding provided for The Discovery Center at Waters Edge		
Congressional Adds Subtotals	34.000	33.250

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

N/A

Remarks

D. Acquisition Strategy

N/A