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Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Army **Date:** March 2023

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| 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 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
|--|-------------|---------|---------|--------------|-------------|---------------|---------|---------|---------|---------|------------------|------------|
| Total Program Element | - | 122.521 | 121.160 | 108.946 | - | 108.946 | 109.506 | 118.022 | 124.135 | 127.459 | 0.000 | 831.749 |
| AB4: <i>Army Research Centers</i> | - | 21.839 | 24.359 | 25.443 | - | 25.443 | 25.647 | 26.097 | 26.114 | 26.398 | 0.000 | 175.897 |
| AB7: <i>Army Collaborative Research and Tech Alliances</i> | - | 50.435 | 57.451 | 63.445 | - | 63.445 | 63.273 | 71.312 | 77.394 | 80.208 | 0.000 | 463.518 |
| AB8: <i>Army Educational Outreach Program</i> | - | 10.252 | 11.244 | 12.485 | - | 12.485 | 12.730 | 12.746 | 12.755 | 12.895 | 0.000 | 85.107 |
| AC6: <i>International Science and Technology</i> | - | 6.745 | 7.406 | 7.573 | - | 7.573 | 7.856 | 7.867 | 7.872 | 7.958 | 0.000 | 53.277 |
| J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i> | - | 33.250 | 20.700 | - | - | - | - | - | - | - | 0.000 | 53.950 |

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.

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

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| 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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| B. Program Change Summary (\$ in Millions) | FY 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total |
|---|----------------|----------------|---------------------|--------------------|----------------------|
| Previous President's Budget | 126.267 | 100.909 | 103.414 | - | 103.414 |
| Current President's Budget | 122.521 | 121.160 | 108.946 | - | 108.946 |
| Total Adjustments | -3.746 | 20.251 | 5.532 | - | 5.532 |
| • Congressional General Reductions | - | - | | | |
| • Congressional Directed Reductions | - | - | | | |
| • Congressional Rescissions | - | - | | | |
| • Congressional Adds | - | 20.700 | | | |
| • Congressional Directed Transfers | - | - | | | |
| • Reprogrammings | -3.746 | - | | | |
| • SBIR/STTR Transfer | - | - | | | |
| • Adjustments to Budget Years | - | - | 5.532 | - | 5.532 |
| • FFRDC Transfer | - | -0.449 | - | - | - |

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

Project: J13: UNIVERSITY AND INDUSTRY INITIATIVES (CA)

Congressional Add: *Program Increase - MATERIALS IN EXTREME DYNAMIC ENVIRONMENTS*

Congressional Add: *Program increase - BIOTECHNOLOGY ADVANCEMENTS*

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: *Program Increase - INFUSION OF CYBERSECURITY CONCEPTS INTO NONTECHNICAL HIGH SCHOOL COURSES*

Congressional Add: *Program Increase - NEXT GENERATION SURVIVAL RADIO*

Congressional Add: *Program Increase - QUANTUM COMPUTING TECHNOLOGIES*

Congressional Add: *Program Increase - HYPERSONIC TECHNOLOGY RESEARCH AND TESTING INITIATIVE*

Congressional Add Subtotals for Project: J13

Congressional Add Totals for all Projects

| | FY 2022 | FY 2023 |
|--|----------------|----------------|
| | | |
| | 5.000 | 5.000 |
| | 4.000 | 4.000 |
| | 20.000 | - |
| | 1.000 | - |
| | 3.000 | - |
| | 0.250 | - |
| | - | 2.000 |
| | - | 3.800 |
| | - | 1.400 |
| | - | 4.500 |
| | 33.250 | 20.700 |
| | 33.250 | 20.700 |

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| <u>Change Summary Explanation</u> Increased funding to support basic research enhancements for strategic competition. | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | | | | | | | | | Date: March 2023 | | |
| 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 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
| AB4: <i>Army Research Centers</i> | - | 21.839 | 24.359 | 25.443 | - | 25.443 | 25.647 | 26.097 | 26.114 | 26.398 | 0.000 | 175.897 |

A. Mission Description and Budget Item Justification

This Project encompasses three types of Centers. The first is the Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) Research Centers of Excellence which supports the Army's research partnerships with HBCUs/MIs. The HBCU/MI Research Centers of Excellence were established as the next phase of what was previously known as the Partnered Research Initiative (PRI) Program that ended in Fiscal Year 2020. 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 all supporting the Army's goal of broadening the performer base and diversifying the research ecosystem in the areas of information sciences, engineering, and physical sciences.

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 2022 | FY 2023 | FY 2024 |
|---|----------------|----------------|----------------|
| Title: Centers of Excellence for Battlefield Capability Enhancements (BCE) | 1.586 | 1.674 | 1.803 |
| 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 2023 Plans: | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
| 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 2022 | FY 2023 | FY 2024 |
| <p>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 2024 Plans: Will foster the advancement of remote sensing technologies by focusing on acoustic and seismic sensing capabilities for military movement and maneuver in urban environments while advancing education and training of minority and underrepresented students in research targeted towards Army modernization needs. Acoustic and seismic sensing have promising potentials for passive, non-line-of-sight, detection, localization, and monitoring of natural and human activities. There will be a strong emphasis on undergraduate involvement in addressing this unique-to-Army challenge of sensing in the Dense Urban Environment.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the 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 2023 Plans: 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 microbial consortia with dynamic properties for modular and programmable biological behaviors, such as event logging or syntheses of reactive materials.</p> <p>FY 2024 Plans: Will develop enzymatic systems where activation of diazirines yield highly-strained ring systems and design and implement multi-component synthetic cells for biofilm formation; create and assess ultrasound-actuated multifunctional synthetic biology circuits; combine experimental and computational species translation modeling tests for animal-human study relevance to bridge the</p> | | 4.502 | 4.791 | 5.053 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>biotic-abiotic gap through electrical switching and control of reflectin and other proteins, that if successful will enable the use of synergy between synthetic biology and synthetic chemistry for the scalable synthesis of bioactive natural products.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the effort.</p> <p>Title: Institute for Creative Technologies</p> <p>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.</p> <p>FY 2023 Plans: 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 2024 Plans:</p> | | 4.458 | 4.810 | 5.127 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>Will research dynamics of emotional expression to obtain fine-grained understanding of emotion and human intent during person to person, or person to agent interactions; investigate how individual's information can be used during training and inference time for software agents to effectively communicate with humans without agents being able to personally identify the individual (differential privacy); explore fast three-dimensional (3D) scene generation to aid in synthetic data-generation and in Augmented Reality/Virtual Reality as part of synthetic training environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the 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 2023 Plans: 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 2024 Plans: Will explore fundamental questions in the exploitation, understanding, and ultimate capabilities of nanophotonics including imaging metastructures in conjunction with computational imaging, and novel light sources for stable large area lasers, efficient THz sources, and free-electron lasers; develop computational, data science, and experimental methods to explore the field of superelastic ceramics that exhibits a martensitic transformation that permits large shape change; explore fundamental aspects of radiative thermal emission, in the far field and in the near field regimes, using the unique ability of photonic crystals and metamaterials to tailor the photon densities of states in these systems by developing mesoscale objects with nanoscale feature sizes that if successful, will enable new functional materials, portable power generation, and flexible electronics.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the effort.</p> | | 4.662 | 4.949 | 5.753 |
| <p>Title: Vertical Lift Research Center of Excellence (VLRCOE)</p> <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,</p> | | 3.152 | 3.363 | 3.578 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations. | | | | |
| <p>FY 2023 Plans: Execute the second year of the five-year VLRCOE cooperative agreements with Georgia Tech, Penn State University, and University of Maryland. 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. 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 2024 Plans: Will conduct the second annual review followed by executing the third year of the VLRCOE program. The research conducted will focus on human-intuitable collision avoidance for semi/autonomous aircraft and adaptive pilot modeling for complex environments such as shipboard operations; explore new technologies such as electrified variable speed rotorcraft drivetrain and electric actuators for vibration control; continue research collaborations with a team of multi-agency (Army, Navy, and NASA) government subject matter experts (SMEs) and universities in relevant areas including high-fidelity simulations and wind-tunnel measurements of whirl-flutter and vibrations on advanced geometry tiltrotor configurations.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the 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 2023 Plans: 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</p> | | 3.479 | 3.890 | 4.129 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | FY 2022 | FY 2023 | FY 2024 |
|---|----------------|----------------|----------------|
| <p>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 2024 Plans: The ARC will work towards solving the complex, inter-disciplinary, multiscale problem that is required to develop the advanced modeling and simulation tools needed to assess the performance of off-road autonomous mobility. This research will include off-road autonomy algorithm development, human-machine trust advancement, innovative materials and structures, intelligent power systems, and multisystem coordination; develop the required companion technologies of computation enhancement, verification and validation improvements, and the understanding of uncertainty in unstructured environments.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase supports the planned lifecycle of the effort.</p> | | | |
| <p>Title: SBIR/STTR Transfer</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p> | - | 0.882 | - |
| Accomplishments/Planned Programs Subtotals | 21.839 | 24.359 | 25.443 |

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

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| COST (\$ in Millions) | Prior Years | FY 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
| <i>AB7: Army Collaborative Research and Tech Alliances</i> | - | 50.435 | 57.451 | 63.445 | - | 63.445 | 63.273 | 71.312 | 77.394 | 80.208 | 0.000 | 463.518 |

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 2022 | FY 2023 | FY 2024 |
|--|----------------|----------------|----------------|
| Title: Internet of Battlefield Things CTA (IoBT CTA) | 2.789 | 2.997 | 3.166 |
| <p>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.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2024 Plans:</p> | | | |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>Will research resilient and efficient tactical edge intelligence by exploiting data from large-scale networks to support decision advantage in a set of intelligent systems-of-systems; research and develop algorithms that prioritize and filter information from vast amounts of ubiquitous sensor/actuators; explore methods to quantify uncertainty across uncontrolled resources with denied, degraded, intermittent, or limited characteristics; establish algorithms that expose adjustable system parameters to enable rapid reconfigurability utilizing lightweight and/or information-theoretic compression methods and resource provisioning across Command and Control information-networks; develop foundations for determining required sensing cadence and multi-scale sampling approaches to maintain longevity; investigate algorithms and theoretical foundations of edge node coordination in dynamic and contested networks.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Distributed Analytics and Information Science International Technology Alliance (ITA)</p> <p>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.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2024 Plans: Will investigate theories and techniques to improve the efficiency of distributed resource awareness algorithms to reduce the required bandwidth and improve the freshness of the information; investigate theories and techniques to reduce the complexity and improve scalability of the resource allocation optimizations; investigate theories, models, and techniques for joint allocation and orchestration of networking resources, computational resources, and analytic microservice optimizations to support federated learning at the tactical edge; investigate theories, models, and techniques to automate and optimize neural network algorithms, and the discovery, monitoring, joint orchestration, and dynamic adaption of computational, network, and communication resources, across multiple tasks, to support dynamic, distributed analytics at the tactical edge.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | 2.610 | 2.825 | 3.013 |
| <p>Title: Distributed Collaborative Intelligent Systems Technology CTA</p> | | 6.009 | 6.341 | 6.700 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 |
| 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 2022 | FY 2023 | FY 2024 |
|--|----------------|----------------|----------------|
| <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 2023 Plans: 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 2024 Plans: Will investigate theories and techniques to advance multi-robot collaborative autonomy to overcome the curse of dimensionality, increase robustness in complex and dynamic environments, and provide an understanding of performance guarantees and limitations in multi-agent operations; develop computationally efficient strategies for multi-robot real-time and high-tempo adversarial engagements to include methods for hierarchical planning and control and the development of models for the use of deception and misinformation; establish approaches to enable dynamic and coordinated mission specification task allocation and planning within and across large heterogeneous teams.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | |
| <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> <p>FY 2023 Plans: 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</p> | 0.598 | 0.647 | 0.690 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>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>FY 2024 Plans: Will probe changes in neural task representations during training of complex decision tasks in the novice and mastery domains; develop Machine-Optimized Models of auditory scene perception; explore human and neuro-inspired artificial-intelligence visual reasoning; investigate behavioral and neural optimizations for adaptable decision-making during uncertainty; build a universal translator for neural codes to support cognitive tasks; develop methods for tracking the temporal dynamics of continuous changes in global state and cognition.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Center for Exploitation of Quantum Effects</p> <p>Description: 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> | | 2.793 | - | - |
| <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 2023 Plans: 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 2024 Plans: Will identify preferred human agent teaming futures and how to enable them; uncover the underlying meanings that humans attach to the guidance they provide to agents and explore allowances for agents to understand these implied meanings; research</p> | | 4.707 | 5.044 | 5.333 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>what properties agents possess that human agent teams can use to naturally adapt on-the-fly through situated interactions; describe how human agent team performance is impacted by co-training humans and agents.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <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> <p>FY 2023 Plans: 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 2024 Plans: Will increase artificial intelligence capabilities to process image classifiers for adversarial threat detection; develop autonomous agent skills to traverse rugged terrain through contested environments; identify and implement methods for automatic cyber protection in autonomous, mobile platforms; conduct experiments to refine and extend the ability of autonomous platforms to navigate indoor environments with awareness of adversarial threats and minimal human intervention; create algorithms that can use a robotic shield to deflect incoming projectiles in real time.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | 7.195 | 7.370 | 7.751 |
| <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</p> | | 4.670 | 4.906 | 5.130 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>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 2023 Plans: 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 2024 Plans: Will explore UWBG semiconductor devices for millimeter wave operation and how to achieve a 10x increase in power density; investigate the use of physics-informed multi-scale machine learning to augment the selection of both material parameters and device architectures to improve power density that if successful could enable improved communication systems, sensors, and electronic countermeasures.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the 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 2023 Plans: 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,</p> | | 4.670 | 4.906 | 5.130 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
| 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 2022 | FY 2023 | FY 2024 |
| <p>including gene transfer, persistence, and mutation that if successful, provide key elements of a synthetic biology research pipeline enabling the rapid and effective exploration and validation of novel material and cellular systems to protect the Soldier.</p> <p>FY 2024 Plans: Will expand protein-based functional material discovery by integrating modeling-directed protein designs with metals to emulate fibrous proteins from nature with an expanded tool kit; develop an experimental platform to functionally screen protein-metal composite libraries defined from the modeling, that if successful will enable future, advanced manufacturing methods that leverage synthetic biology to produce Army-relevant materials at a quality and efficiency not possible using existing tools; design and assess a resilient engineered living materials platform for the fabrication of robust biomaterials; develop genetic tools for creating a chassis using biomaterials fabrication; identify the mechanisms for cell surface functionalization and protein secretion, and elucidate the mechanisms and principles for the design of hierarchical, functional living biomaterials, that if successful, will enable the development of future biosensors and functional coatings.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Army Advanced Energetics Center</p> <p>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.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2024 Plans: Will synthesize new high density energetic materials, (organic and inorganic) targeting higher detonation velocities, blast effects, thermal outputs, and for enhancing rocket propellants; create fundamental understanding of the initiation, break-up, and fragmentation of energetic materials during and after detonative energy release; develop advanced models and experimental methodologies to enhance fundamental understanding of polymers in formulations as pertains to stress/strain properties, aging,</p> | | 4.670 | 4.906 | 5.129 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>impact of high temperatures, and understanding the evolution of microstructure during reactive and non-reactive events; develop understanding of how shockwaves interact with material grain boundaries, material interfaces, and material defects.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Tactical Behaviors for Autonomous Maneuver</p> <p>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.</p> <p>FY 2023 Plans: 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 2024 Plans: Will explore foundational theoretical approaches to enable small teams of agents to utilize coordinated, tactically-relevant maneuvers to achieve positions of advantage with respect to adversaries with increasing degrees of complexity and uncertainty; create algorithms which enable the application of learned tactics in novel, adjacent domains; investigate methods and techniques to predict and project future positions of advantage in scenarios with dynamic elements with limited prior information.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | 2.315 | 2.507 | 2.734 |
| <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 2023 Plans: 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</p> | | 5.971 | 6.274 | 6.555 |

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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 2022 | FY 2023 | FY 2024 |
| <p>produce large variations in properties; down select most promising seedling efforts for continuation to Army Centers (multi-year, comprehensive anchor programs).</p> <p>FY 2024 Plans: Will continue to engage in collaborative research with selected Centers and Seedlings, with a focus on aligning internal research efforts with partners; collaborate with down-selected Data Management Seedling to further refine High-Throughput Materials Discovery for Extreme Conditions data management platform; conduct experiments with top candidate materials in relative environment; examine rapid screening methods for high dimensional material datasets; analyze high-throughput synthesis and characterization of material classes suitable for high-rate applications.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Fundamentals for Quantum Technologies</p> <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 2023 Plans: 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 2024 Plans: Will investigate approaches to magnetometry using nitrogen-vacancy (NV) centers in diamond and other defect systems; investigate collective effects in nanofiber; investigate entangled photon pair generation and propagation in topological systems; explore distributed sensing using ion traps; explore methods for using telecom-compatible energy levels for long-range entanglement generation; explore ion traps in optical cavities for increased generation of infrared photons suitable for propagation over fiber networks.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | 0.483 | 4.719 | 5.069 |
| <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,</p> | | 0.955 | 0.981 | 1.039 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| gradual coefficient of thermal expansion changes, and gradual wavespeed changes to enable high performance under extreme ballistic and thermal conditions. | | | | |
| <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 2024 Plans: Will investigate novel transformative manufacturing, including strategies to affect quality of multi-material interfaces; investigate methodologies for development of high-performance interfaces between another set of dissimilar materials (planned as metal-ceramic) and characterize the resulting materials and interfaces; investigate multi-material model development for metal-ceramics to begin to enable digital twin development.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects the planned lifecycle of this effort.</p> | | | | |
| <p>Title: Semi-Conductor Modeling Consortium</p> <p>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.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2024 Plans:</p> | | - | 0.931 | 0.693 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>Will explore and assess new emerging semiconductors for electro-optical devices; apply new material understanding to reduce blinking pixels in imagers; assess diffractive devices for new imaging modalities; augment initiatives in new applied materials including ultra-wide bandgap materials or neuromorphic materials.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding decrease due to reduced research in the area of photonic devices for infrared imaging.</p> | | | | |
| <p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p> | | - | 2.097 | - |
| <p>Title: HBCU/MI Research Partnerships</p> <p>Description: These research partnerships will support basic research focused on partnerships with Historically Black Colleges and Universities and Minority Institutions (HBCUs/MIs). The focus of this effort is to advance innovative basic research in areas of strategic importance to the Army by bringing competitively selected HBCUs and MIs research teams into existing Army Futures Command Collaborative Research Alliances (CRAs), Collaborative Technology Alliances (CTAs), and centers. The Army CRAs, CTAs, and centers work with Army, industry, and other academic partners to transition research to technology demonstration. These new research partnerships will provide opportunities to recruit, educate, and train outstanding students and post-doctoral researchers in science and technology areas relevant to the Army.</p> <p>FY 2024 Plans: Will establish three to five new HBCU/MI research partnerships, each selected to enhance existing research under an individual Army CRA, CTA, or center.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding supports additional research in existing Army CRAs, CTAs, and centers.</p> | | - | - | 2.000 |
| <p>Title: Army Military Academic CRA</p> <p>Description: This CRA provides a framework across the U.S. Army Combat Capabilities Development Command (DEVCOM) to establish and sustain efforts to strengthen the incorporation of the United States Military Academy (USMA) and Senior Military Colleges faculty and cadets into the Army Modernization Enterprise (AME) through research collaborations. This CRA seeks to</p> | | - | - | 1.835 |

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| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| understand the ethical, legal, policy, and operational impacts on emerging technologies, and to build the framework to enhance personnel exchanges between DEVCOM, USMA, and Senior Military Colleges. | | | | |
| <p><i>FY 2024 Plans:</i> Will conduct foundational research through seedling efforts in areas such as photonics, autonomy, power and energy, quantum sensing, cyber operations, materials for hypersonic systems, and recommendations for policy and strategy in ethics, operations, business, and legal domains for Army Modernization.</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding supports increased research into a variety of foundational research areas necessary to support future Army needs.</p> | | | | |
| <p><i>Title:</i> Collective Judgement Formation</p> <p><i>Description:</i> This effort establishes the underpinning science needed to understand how humans receive, process, and ultimately accept and reject information that leads to the formation of judgments. Individual and social constructs, the role of bias, and other cognitive and environmental factors will be incorporated. Research will address synthetic forms of intelligence, the speed and scale of information sharing, and integrating human and machine intelligence.</p> <p><i>FY 2024 Plans:</i> Will develop preliminary models to characterize fundamental mechanisms of how human-technology relationships drive belief formation.</p> <p><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> Funding increase supports additional research in the area of judgement formation for humans.</p> | | - | - | 1.478 |
| Accomplishments/Planned Programs Subtotals | | 50.435 | 57.451 | 63.445 |
| C. Other Program Funding Summary (\$ in Millions) | | | | |
| N/A | | | | |
| Remarks | | | | |
| D. Acquisition Strategy | | | | |
| N/A | | | | |

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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) AB8 / <i>Army Educational Outreach Program</i> | | | |
| COST (\$ in Millions) | Prior Years | FY 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
| AB8: <i>Army Educational Outreach Program</i> | - | 10.252 | 11.244 | 12.485 | - | 12.485 | 12.730 | 12.746 | 12.755 | 12.895 | 0.000 | 85.107 |

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 2022 | FY 2023 | FY 2024 |
| Title: AEOP Coop Agreement | 10.252 | 10.834 | 12.485 |
| 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 2023 Plans: 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 | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
| 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> | | |
| B. Accomplishments/Planned Programs (\$ in Millions) | | FY 2022 | FY 2023 | FY 2024 |
| <p>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. Increase partnerships with like-minded organizations in an effort to increase participation from underserved students and military affiliated communities. Conduct West Point cadet research internship program to enhance cadet training through field experience in Army research labs and engineering centers.</p> <p>FY 2024 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. 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 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p> | | | | |
| <p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding transferred in accordance with Title 15 USC §638</p> | | - | 0.410 | - |
| Accomplishments/Planned Programs Subtotals | | 10.252 | 11.244 | 12.485 |
| C. Other Program Funding Summary (\$ in Millions) | | | | |
| N/A | | | | |
| Remarks | | | | |
| D. Acquisition Strategy | | | | |
| N/A | | | | |

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Exhibit R-2A, RDT&E Project Justification: PB 2024 Army **Date:** March 2023

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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) AC6 / <i>International Science and Technology</i> |
|--|---|---|

| COST (\$ in Millions) | Prior Years | FY 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
|--|-------------|---------|---------|--------------|-------------|---------------|---------|---------|---------|---------|------------------|------------|
| <i>AC6: International Science and Technology</i> | - | 6.745 | 7.406 | 7.573 | - | 7.573 | 7.856 | 7.867 | 7.872 | 7.958 | 0.000 | 53.277 |

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 2022 | FY 2023 | FY 2024 |
|---|---------|---------|---------|
| Title: International Technology Centers | 4.397 | 1.664 | 4.936 |
| Description: The ten International Technology Centers (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 2023 Plans: | | | |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 |
| 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 2022 | FY 2023 | FY 2024 |
|--|----------------|----------------|----------------|
| <p>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 2024 Plans: Will continue to 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 Army Modernization Priorities, 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 award 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 2023 to FY 2024 Increase/Decrease Statement: Funding increase reflects planned lifecycle of this effort and conclusion of International Basic Research Mission within the 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 2023 Plans: 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> | 2.348 | 2.512 | 2.637 |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
| 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 2022 | FY 2023 | FY 2024 |
| <p>Enterprise. 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.</p> <p>FY 2024 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 Enterprise; 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.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned lifecycle of this effort.</p> | | | | |
| <p>Title: International Basic Research Mission</p> <p>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.</p> <p>FY 2023 Plans: 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.</p> <p>FY 2023 to FY 2024 Increase/Decrease Statement: Funding change reflects planned conclusion of this effort</p> | | - | 3.004 | - |
| <p>Title: SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC §638</p> <p>FY 2023 Plans:</p> | | - | 0.226 | - |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | | Date: March 2023 | | |
| 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 2022 | FY 2023 | FY 2024 |
| Funding transferred in accordance with Title 15 USC §638 | | | | |
| <i>FY 2023 to FY 2024 Increase/Decrease Statement:</i> | | | | |
| Funding transferred in accordance with Title 15 USC §638 | | | | |
| Accomplishments/Planned Programs Subtotals | | 6.745 | 7.406 | 7.573 |
| 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 2024 Army **Date:** March 2023

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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> |
|--|---|---|

| COST (\$ in Millions) | Prior Years | FY 2022 | FY 2023 | FY 2024 Base | FY 2024 OCO | FY 2024 Total | FY 2025 | FY 2026 | FY 2027 | FY 2028 | Cost To Complete | Total Cost |
|--|-------------|---------|---------|--------------|-------------|---------------|---------|---------|---------|---------|------------------|------------|
| J13: <i>UNIVERSITY AND INDUSTRY INITIATIVES (CA)</i> | - | 33.250 | 20.700 | - | - | - | - | - | - | - | 0.000 | 53.950 |

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 2022 | FY 2023 |
|--|---------|---------|
| Congressional Add: Program Increase - MATERIALS IN EXTREME DYNAMIC ENVIRONMENTS | 5.000 | 5.000 |
| FY 2022 Accomplishments: Congressional Interest Item funding provided for Materials in Extreme Dynamic Environments | | |
| FY 2023 Plans: Congressional Interest Item funding provided for Materials in Extreme Dynamic Environments | | |
| Congressional Add: Program increase - BIOTECHNOLOGY ADVANCEMENTS | 4.000 | 4.000 |
| FY 2022 Accomplishments: Congressional Interest Item funding provided for Biotechnology Advancements | | |
| FY 2023 Plans: Congressional Interest Item funding provided for BIOTECHNOLOGY ADVANCEMENTS | | |
| Congressional Add: Program increase - Army artificial intelligence innovation | 20.000 | - |
| FY 2022 Accomplishments: Congressional Interest Item funding provided for Army Artificial Intelligence Innovation | | |
| Congressional Add: Soldier Protection Materials | 1.000 | - |
| FY 2022 Accomplishments: Congressional Interest Item funding provided for Soldier Protection Materials | | |
| Congressional Add: Hypervelocity Testing | 3.000 | - |
| FY 2022 Accomplishments: Congressional Interest Item funding provided for Hypervelocity Testing | | |
| Congressional Add: The Discovery Center at Waters Edge | 0.250 | - |

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| Exhibit R-2A, RDT&E Project Justification: PB 2024 Army | Date: March 2023 |
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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> |
|--|---|---|

| B. Accomplishments/Planned Programs (\$ in Millions) | FY 2022 | FY 2023 |
|---|----------------|----------------|
| FY 2022 Accomplishments: Congressional Interest Item funding provided for The Discovery Center at Waters Edge | | |
| Congressional Add: Program Increase - INFUSION OF CYBERSECURITY CONCEPTS INTO NONTECHNICAL HIGH SCHOOL COURSES | - | 2.000 |
| FY 2023 Plans: Congressional Interest Item funding provided for INFUSION OF CYBERSECURITY CONCEPTS INTO NONTECHNICAL HIGH SCHOOL COURSES | | |
| Congressional Add: Program Increase - NEXT GENERATION SURVIVAL RADIO | - | 3.800 |
| FY 2023 Plans: Congressional Interest Item funding provided for Next Generation Survival Radio | | |
| Congressional Add: Program Increase - QUANTUM COMPUTING TECHNOLOGIES | - | 1.400 |
| FY 2023 Plans: Congressional Interest Item funding provided for Quantum Computing Technologies | | |
| Congressional Add: Program Increase - HYPERSONIC TECHNOLOGY RESEARCH AND TESTING INITIATIVE | - | 4.500 |
| FY 2023 Plans: Congressional Interest Item funding provided for HYPERSONIC TECHNOLOGY RESEARCH AND TESTING INITIATIVE | | |
| Congressional Adds Subtotals | 33.250 | 20.700 |

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

N/A

Remarks

D. Acquisition Strategy

N/A