Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army											Date: May 2021	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602183A *I Air Platform Applied Research*							
COST ($ in Millions)	**Prior Years**	**FY 2020**	**FY 2021**	**FY 2022 Base**	**FY 2022 OCO**	**FY 2022 Total**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**Cost To Complete**	**Total Cost**
Total Program Element	-	-	-	6.597	-	6.597	-	-	-	-	-	-
CL5: *Air Platform Enabling University Applied Research*	-	-	-	0.698	-	0.698	-	-	-	-	-	-
CL8: *Aviation Teaming Autonomy Concepts & Technologies*	-	-	-	3.945	-	3.945	-	-	-	-	-	-
CN1: *Disruptive Countermeasure Concepts for Aviation*	-	-	-	1.954	-	1.954	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, this Program Element (PE) is created to focus on longer-term, far-reaching applied research efforts in the Air portfolio.

A. Mission Description and Budget Item Justification

This PE undertakes applied research efforts that support and enable the overall Army Aviation portfolio in general, and the Army's modernization priority for future vertical lift (FVL). Vital and enduring applied research is conducted in the air portfolio that supports mid-to-long term requirements in contested operational environments and technologies that have broad application to FVL modernization, as well as overall Army and specific DoD aviation needs.

Work in this PE contributes to the Army Science and Technology (S&T) air systems portfolio and is fully coordinated with efforts in PE 0602148A (Future Vertical Lift Technology), PE 0603465A (Future Vertical Lift Advanced Technology) and PE 0603043A (Air Platform Advanced Technology).

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

Work in this PE is performed by the United States Army Futures Command (AFC).

Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Army					Date: May 2021
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*		R-1 Program Element (Number/Name) PE 0602183A / *Air Platform Applied Research*			
B. Program Change Summary ($ in Millions)	**FY 2020**	**FY 2021**	**FY 2022 Base**	**FY 2022 OCO**	**FY 2022 Total**
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	6.597	-	6.597
Total Adjustments	0.000	0.000	6.597	-	6.597
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	6.597	-	6.597

Change Summary Explanation

In FY2022, this is a new PE with two Projects realigned from PE 0602148A (Future Vertical Lift Technology) and one new FY22 Project.

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army			Date: May 2021
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / *Air Platform Applied Research*	Project (Number/Name) CL5 / *Air Platform Enabling University Applied Research*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL5: *Air Platform Enabling University Applied Research*	-	-	-	0.698	-	0.698	-	-	-	-	-	-

Note

This is a new start in FY 2022.

In Fiscal Year (FY) 2022, this is a New Project.

A. Mission Description and Budget Item Justification

This Project focuses on applied research originating from extramural applied research in academia pertaining to navigation/routing, autonomous robotic vehicles, artificial intelligence and machine learning as applied to aerial mobility and maneuver, holistic survivability, teaming, integrated mission systems, air-launched effects, and other innovative air enabling applied research technologies that will accelerate the Army modernization in next generation aerial vehicles. This Project will perform discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies fundamental to the modernization priorities. This effort conducts applied research and development leading to all the potential emerging technologies in areas of strategic importance to Army Aviation in AI/ML, autonomous systems, Advanced Teaming, Survivability, air-launched effects/payloads, coordinated air-ground maneuvering, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances. The project will continuously experiment with methods to identify, demonstrate and transition novel technology from entities that might not otherwise collaborate with the DoD, with the end goal of accelerating the adoption of cutting-edge applied research technology for the warfighter in the Army aviation portfolio.

Work in this Project supports the Army Modernization Priority Future Vertical Lift and the overall aviation portfolio.

The cited work is consistent with 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 (US) Army Futures Command.

This work is done in coordination with and transitions to PE 0602148A (Future Vertical Lift Technology), PE 0603465A (Future Vertical Lift Advanced Technology Development) and PE 0603043A (Air Platform Advanced Technology) and is also coordinated with its sister project in PE 0602144A (Ground Technology).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Teaming	-	-	0.333

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602183A / *Air Platform Applied Research*	**Project (Number/Name)** CL5 / *Air Platform Enabling University Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Description: Develop capabilities to self-organize and coordinate large teams of unmanned vehicles participating in long-term reconnaissance operation using distributed command/control architectures despite communication delays and/or failures and showcasing resilience to wide-area jamming. ***FY 2022 Plans:*** Will investigate and develop decentralized self-organization AI/ML algorithms among large team of unmanned heterogeneous autonomous assets deployed inside contested environments that are robust to emerging threats, lost links, or change in mission priorities. Will develop decentralized interactions that will provide knowledge bases, reasoning, planning, sensing and control tools that reside inside the entire vehicle team and mobile computational resources. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding for this new effort is realigned from PE 0602145A / Project BF8 Artificial Intelligence & Machine Learning Tech			
Title: Coordinated Air-Ground Vehicle Maneuvering ***Description:*** Develop the technology for a fleet of ground and air vehicles to have the capabilities required to perform an autonomous reconnaissance mission in a relevant environment. ***FY 2022 Plans:*** Will investigate level coordinated landing/take off of unmanned aerial system from stationary platform near ground vehicle in simulations. Will develop software algorithms for air-ground coordination software support autonomous reconnaissance. Will perform applied research on developing coordination strategies for autonomous ground and air vehicles to perform tactical reconnaissance mission. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding for this new effort is realigned from PE 0602145A / Project BF8 Artificial Intelligence & Machine Learning Tech	-	-	0.365
Accomplishments/Planned Programs Subtotals	-	-	0.698

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army			Date: May 2021
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / *Air Platform Applied Research*	Project (Number/Name) CL8 / *Aviation Teaming Autonomy Concepts & Technologies*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CL8: *Aviation Teaming Autonomy Concepts & Technologies*	-	-	-	3.945	-	3.945	-	-	-	-	-	-

Note

This Project has been administratively realigned in Fiscal Year 2022 from Program Element (PE) 0602148A FVL Technology / Project AK9 Adv Teaming for Tactical Aviation Operations Tech

A. Mission Description and Budget Item Justification

This Project establishes multi-level simulations, physics-based models, and artificial intelligence/machine learning (AI/ML) algorithms and methods to inform and advance capabilities for heterogeneous advanced teaming concepts to support operations in complex and peer contested environments. Innovative solutions, knowledge, and understanding generated from this effort informs Project AK9 Advanced Teaming for Tactical Aviation Operations in PE 0602148A FVL Technology.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology) and PE 0603465A (Future Vertical Lift Advanced Technology Development).

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Intelligent Unmanned Aerial System Teaming Technologies	-	-	3.945
Description: Enables the establishment of component technologies to support resilient, multi-modal, survivable Unmanned Aircraft System (UAS) teams that can plan and act on time-scales beyond human capability and have a robust shared understanding of contested and dynamic environments to support effective tactical engagement. Specific topics include 1) novel artificial-intelligence algorithms and methods for adaptive team composition and control, 2) increased team knowledge base and understanding of local and global world models, 3) hierarchical, composable, and adaptive learning methods for increased mission resilience, and 4) understanding interaction and scalability between, amongst, and across heterogeneous team members and the environment.			
FY 2022 Plans: Will develop methods and technologies to provide heterogeneous unmanned teams increased endurance; enable unmanned air and ground vehicle teams to adapt energy usage in dynamic situations; develop algorithms to help predict energy demand			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602183A / *Air Platform Applied Research*	**Project (Number/Name)** CL8 / *Aviation Teaming Autonomy Concepts & Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
between unmanned teams; expand simulation hardware and software to client and server model to enable concurrent simulations; integrate simulation environments with established DoD terrain modeling data; investigate techniques to achieve robust unmanned aerial system homing performance in Global Positioning System (GPS)-denied environment; develop simulated agent-level behaviors that achieve coordinated multi-agent target homing through emergent multi-agent interactions; develop threat resilient autonomous tactical behaviors contextualized in perimeter defense and pursuit-evasion, accounting for team maneuver relative to defending agents and anticipated attrition. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Effort was administratively realigned in FY2022 from PE 0602148A Project AK9.			
Accomplishments/Planned Programs Subtotals	-	-	3.945

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army			Date: May 2021
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602183A / *Air Platform Applied Research*	Project (Number/Name) CN1 / *Disruptive Countermeasure Concepts for Aviation*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
CN1: *Disruptive Countermeasure Concepts for Aviation*	-	-	-	1.954	-	1.954	-	-	-	-	-	-

Note

This Project has been administratively realigned in Fiscal Year 2022 from Program Element (PE) 0602148A FVL Technology / Project AK2 Aviation Survivability Technology

A. Mission Description and Budget Item Justification

This Project investigates advanced technologies to reduce Future Vertical Lift (FVL) platform susceptibility and vulnerability to damage from guided and unguided threats, as well as technologies to defeat small arms, rocket, and missile threats. This project performs research and develops innovative detect and defeat technologies against next -generation threats to the FVL. Areas of research include new laser materials and designs for in-band, low size, weight, power, and cost (SWaP-C) precision laser soft-kill countermeasures operating in the mid- and long-wave infrared, lethality effects of ultrashort pulsed lasers, and sensitive radio frequency (SeRF) detection modality for use as aircraft survivability equipment (ASE).

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift Technology) and PE 0603465A (Future Vertical Lift Advanced Technology Development).

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

Work in this project is performed by the United States Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Cognitive Countermeasures Technology Development	-	-	1.954
Description: This effort investigates and matures novel materials, components, and techniques to counter legacy and emerging threats to Future Vertical Lift (FVL) platforms. Emphasis will be placed on technologies and approaches to enable a robust, holistic countermeasure capability for target defeat, regardless of threat characteristics or guidance mode.			
FY 2022 Plans: Will investigate dual-wavelength pumping, enabling beyond quantum defect limit efficiency, towards a diode pumped, in-band Midwave Infrared (MWIR) laser source for infrared countermeasures; conduct experiments exploring Ultra-Short Pulse Laser (USPL) out-of-band optical and electro-optical lethality effects; identify necessary USPL power/intensity/wavelength requirements			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Army		Date: May 2021
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602183A / *Air Platform Applied Research*	**Project (Number/Name)** CN1 / *Disruptive Countermeasure Concepts for Aviation*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
for effective counter-threat lethality capability; design and develop research sensor for detection of specific targets and validate models against select targets. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Effort has been administratively realigned from PE 0602148A Project AK2 Aviation Survivability Technology in FY 2022.			
Accomplishments/Planned Programs Subtotals	-	-	1.954

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A