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 0602148A / *Future Verticle Lift Technology*							
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	-	94.888	169.536	91.411	-	91.411	-	-	-	-	-	-
AI5: *Next Gen Tactical UAS TD Technology*	-	-	7.518	-	-	-	-	-	-	-	-	-
AI7: *Alternative Concept Engine Technology*	-	3.507	-	-	-	-	-	-	-	-	-	-
AI9: *Future UAS Engine Technology*	-	2.769	2.939	3.153	-	3.153	-	-	-	-	-	-
AJ2: *Next Generation Rotorcraft Transmission Technology*	-	3.879	3.971	4.153	-	4.153	-	-	-	-	-	-
AJ4: *Digital Vehicle Management and Control Technology*	-	4.618	6.222	-	-	-	-	-	-	-	-	-
AJ6: *Advanced Rotors Technology*	-	2.265	2.377	2.447	-	2.447	-	-	-	-	-	-
AJ8: *Experimental and Computational Aeromechanics Techn*	-	4.972	5.076	6.135	-	6.135	-	-	-	-	-	-
AK1: *UAS Survivability Technology*	-	0.959	-	-	-	-	-	-	-	-	-	-
AK2: *Aviation Survivability Technology*	-	20.895	21.158	2.177	-	2.177	-	-	-	-	-	-
AK4: *Multi-Role Small Guided Missile Technology*	-	5.853	7.463	3.736	-	3.736	-	-	-	-	-	-
AK6: *Advanced Rotorcraft Armaments Protection System Te*	-	5.094	-	-	-	-	-	-	-	-	-	-
AK9: *Adv Teaming for Tactical Aviation Operations Tech*	-	13.024	13.531	13.978	-	13.978	-	-	-	-	-	-

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 0602148A / *Future Verticle Lift Technology*							
AL2: *High Performance Computing for Rotorcraft App Tech*	-	1.121	1.148	1.200	-	1.200	-	-	-	-	-	-
AL4: *High Speed and Efficient VTOL Vehicle Technology*	-	1.438	1.444	1.466	-	1.466	-	-	-	-	-	-
AL5: *Air Vehicle Structures and Dynamics Technology*	-	2.652	2.792	2.823	-	2.823	-	-	-	-	-	-
AL8: *Holistic Situational Awareness and Dec Making Tech*	-	1.673	1.757	0.889	-	0.889	-	-	-	-	-	-
AM2: *Aircraft and Aircrew Protection Technology*	-	1.459	-	-	-	-	-	-	-	-	-	-
AM4: *Opt Energy Stg & Therm Mgmt for FVL Survivability*	-	4.710	8.531	-	-	-	-	-	-	-	-	-
BP7: *Future Vertical Lift Air Platform Tech (CA)*	-	14.000	75.000	-	-	-	-	-	-	-	-	-
BZ7: *Future Vertical Lift Medical Technologies*	-	-	7.911	7.818	-	7.818	-	-	-	-	-	-
CC3: *FVL Radar Technologies*	-	-	0.698	0.444	-	0.444	-	-	-	-	-	-
CG9: *Adapt & Resilnt Tact Autnmy Cont & Struct Tech*	-	-	-	6.507	-	6.507	-	-	-	-	-	-
CH2: *Air Launched Effects Technology*	-	-	-	7.567	-	7.567	-	-	-	-	-	-
CH3: *Holistic Team Survivability Technology*	-	-	-	11.217	-	11.217	-	-	-	-	-	-
CH4: *Power & Thermal Management for FVL Tech*	-	-	-	7.175	-	7.175	-	-	-	-	-	-
CI5: *High Speed Maneuverable Missile (HSMM) Tech*	-	-	-	8.526	-	8.526	-	-	-	-	-	-

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 0602148A / *Future Verticle Lift Technology*

A. Mission Description and Budget Item Justification

This PE conducts air vehicle and mission system component design, fabrication, and evaluation to enable Army Future Vertical Lift. Emphasis is on developing aviation platform and mission system technologies to enhance manned and unmanned air vehicle combat and combat support operations for attack, reconnaissance, air assault, survivability, logistics, and command and control missions.

Work in this PE contributes to the Army Science and Technology (S&T) air systems portfolio and is fully coordinated with efforts in PE 0603465A (Future Vertical Lift Advanced Technology Development), PE 0602183A Air Platform Applied Research 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) and the Army Engineering Research and Development Center (ERDC).

B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	98.359	96.484	96.734	-	96.734
Current President's Budget	94.888	169.536	91.411	-	91.411
Total Adjustments	-3.471	73.052	-5.323	-	-5.323
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	75.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-3.471	-1.948			
• Adjustments to Budget Years	-	-	-5.323	-	-5.323

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Project: BP7: *Future Vertical Lift Air Platform Tech (CA)*		
Congressional Add: *Flight Control Technology Safety and Survivability*	3.000	-
Congressional Add: *Rotary Wing Adaptive Flight Control Technology*	6.000	-
Congressional Add: *Technology Transfer and Innovation*	5.000	-
Congressional Add: *Program increase - high strength functional composites*	-	5.000
Congressional Add: *Program increase - additive manufacturing of multifunctional composite aerospace components*	-	5.000
Congressional Add: *Program increase: Advanced rotary wing materials and structures*	-	5.000

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 0602148A *I Future Verticle Lift Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2020	FY 2021
Congressional Add: *Program increase: Adaptive flight control technology*	-	4.000
Congressional Add: *Program increase: Lightweight hybrid composite medium caliber barrels*	-	20.000
Congressional Add: *Program increase: Technology transfer and innovation*	-	5.000
Congressional Add: *Program increase - self-sealing fuel tanks technology*	-	6.000
Congressional Add: *Program increase - high density eVTOL power source*	-	15.000
Congressional Add: *Program increase - individual blade and higher harmonic control*	-	10.000
Congressional Add Subtotals for Project: BP7	14.000	75.000
Congressional Add Totals for all Projects	14.000	75.000

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AI5 / *Next Gen Tactical UAS TD Technology*	

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
AI5: *Next Gen Tactical UAS TD Technology*	-	-	7.518	-	-	-	-	-	-	-	-	-

Note

In FY22, funding in this Project is realigned to:
Program Element (PE) 0602148A Future Vertical Lift Technology
* Project CH2 Air Launched Effects Technology

A. Mission Description and Budget Item Justification

This Project utilizes improved computer modeling fidelity to investigate the effects that potential Future Unmanned Aircraft System (FUAS) capabilities could have on air vehicle design considerations and operational concepts. This project improves government capability to design and assess novel Unmanned Aircraft System (UAS) concepts. This Project develops and investigates the ability to launch a UAS from a manned or unmanned future vertical lift aircraft at tactical altitudes and to control the UAS from the cockpit or a crew station. This Project will assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Systems Concepts Studies for Air Launched Effects	-	7.518	-
Description: Investigates and models air vehicle concepts to understand the effects that potential operational Air Launched Effects capabilities will have on air vehicle properties.			
FY 2021 Plans: Investigate and model the effect that overwatch, decoy, and electronic warfare capabilities will have on unmanned air vehicle designs including size, weight, system performance, power, survivability, and unit cost; will develop and assess concept air and ground launch vehicle designs to support reconnaissance, surveillance, electronic warfare, and lethal attack.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AI5 / *Next Gen Tactical UAS TD Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Funds are realigned in FY22 to PE 0602148A (Future Vertical Lift Technology) / CH2 (Air Launched Effects Technology).			
Accomplishments/Planned Programs Subtotals	-	7.518	-

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AI7 / *Alternative Concept Engine Technology*	

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
AI7: *Alternative Concept Engine Technology*	-	3.507	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project develops Future Vertical Lift (FVL) engine component technologies that could significantly improve platform performance, reliability, and operational capability.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Alternative Concept Engine Technology ***Description:*** Design and evaluate advanced turboshaft engine component technologies to support goals of reduced fuel consumption, engine size, weight, and cost, as well as improved reliability and maintainability.	3.507	-	-
Accomplishments/Planned Programs Subtotals	3.507	-	-

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AI9 / *Future UAS Engine Technology*	

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
AI9: *Future UAS Engine Technology*	-	2.769	2.939	3.153	-	3.153	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project designs and evaluates current and Future Unmanned Aircraft Systems (FUAS) advanced engine/power system component technologies to support the goals of multi-fuel capability, reduced fuel consumption, engine size, weight, and cost, as well as improved reliability, survivability, and maintainability.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Multi-fuel Capable Hybrid Electric Propulsion	2.769	2.939	3.153
Description: Applied research to enable intelligent and robust propulsion performance and noise signature reduction via multi-fuel and optimized hybrid electric capability for small engines (20kW to 150kW) powering future aircraft systems. The research focuses on the establishment of concepts to enable reduced fuel consumption, engine size, weight, and cost as well as improved group 3 and 4 FUAS reliability, survivability, and maintainability.			
FY 2021 Plans: Design and develop robust energy assistance probe and controls, and real-time fuel property detection technology. The energy assistance probe will assist with combustion instability derived from low ignition quality fuels. Validate improved turbocharger designs to minimize identified resonances and thrust oil-less bearing. Investigate thermal and power management module in the hybrid-electric tool for the optimization and integration of engine power plants and high-performance electric machines to enable efficient delivery and management of power in Army unmanned air vehicles.			
FY 2022 Plans: Will combine robust ignition assistant, non-intrusive ignition sensing method, and real-time fuel property sensor to prove the concept of external energy assisted ignition of low ignition quality jet fuels; will complete reduced-order design tool for aviation			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AI9 / *Future UAS Engine Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
turbocharger and design of aviation turbocharger, will investigate the major components for lightweight compact aviation electrified turbocharger; will validate the hybrid-electric optimization tool with experimentally obtained data. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding increase reflects planned lifecycle of this effort to focus on concept proveout of external energy-assisted ignition of low ignition quality jet fuels			
Accomplishments/Planned Programs Subtotals	2.769	2.939	3.153

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AJ2 / *Next Generation Rotorcraft Transmission Technology*			
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**
AJ2: *Next Generation Rotorcraft Transmission Technology*	-	3.879	3.971	4.153	-	4.153	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) advanced drive train technologies that increase performance and double current drivetrain life cycles while improving their reliability and maintainability.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Next Generation Rotorcraft Transmission Technology	3.879	-	-
Description: Design and evaluate advanced drive system component technologies to support Variable multi-speed (50-100%), while doubling current transmission life cycles and improving platform reliability and maintainability.			
Title: High Reduction Ratio Transmission Components	-	3.971	4.153
Description: Effort investigates advanced materials and component designs that allow a 60:1 reduction ratio two-stage gearbox design that provides significant weight and volume reduction for extended range and component life for manned and unmanned applications.			
FY 2021 Plans: Investigate new materials that allow higher contact stresses to enable high-reduction ratio gears that operate at high speeds. Use the materials selected for development of component designs for HRT.			
FY 2022 Plans: Will develop and fabricate corrosion resistant steel transmission components and advanced seals that improve reliability for High Reduction Ratio Transmission (HRT) design. Will begin testing of components to verify material performance under high loads, high speeds, and corrosive environments			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ2 / *Next Generation Rotorcraft Transmission Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	3.879	3.971	4.153

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AJ4 / *Digital Vehicle Management and Control Technology*	

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
AJ4: *Digital Vehicle Management and Control Technology*	-	4.618	6.222	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates potential manned Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) fly-by-wire & fly-by-light rotor/flight control and autonomy for active rotor and compound concepts. It also investigates, matures, and harmonizes leap-ahead autonomy, structures, controls technologies, concepts, and capabilities which enable combat mission success across the family of manned/unmanned FVL platforms.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Digital Vehicle Management & Control Technology ***Description:*** Investigate manned and unmanned advanced rotor/flight control concepts and vehicle management technologies focused on advanced aircraft configurations and complex missions. This effort will develop handling qualities requirements, mature simulation and optimization methods, and support goals of improved robustness, reduced weight, and collaborative teaming of FVL and FUAS platforms.	4.618	-	-
Title: Adaptive and Resilient Tactical Autonomy, Controls, and Structures Tech ***Description:*** Develop autonomy, controls, and structures technologies to ensure mission success for manned/unmanned, multiple capability set Future Vertical Lift platforms in the contested environment of multi-domain operations. ***FY 2021 Plans:*** Develop structural dynamics analytical tool enhancements based on more accurate analytical prediction of rotorcraft internal structural loads. Develop adaptive, weight-efficient structural concepts enabling on-the-fly configuration adaptation for near-optimal performance across various flight conditions. Apply validated, full-flight-envelope simulation methods to Future Vertical Lift configurations. Develop mission-adaptive and damage tolerant control technologies aimed at advanced configurations with redundant controls. Develop agility and maneuverability criteria, response types, and mission task elements for high speed.	-	6.222	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ4 / *Digital Vehicle Management and Control Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Improve the functionality and robustness of autonomy algorithms and develop machine-learning-augmented technologies to enhance autonomous and optionally piloted flight operations, including the preservation of vehicle and mission capability. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** This effort is administratively realigned in FY22 to PE 0602148A (Future Vertical Lift Technology) / CG9 Adaptive & Resilient Tactical Autonomy Controls & Structures Tech.			
Accomplishments/Planned Programs Subtotals	4.618	6.222	-

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AJ6 / *Advanced Rotors Technology*			
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**
AJ6: *Advanced Rotors Technology*	-	2.265	2.377	2.447	-	2.447	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates Future Vertical Lift (FVL) technologies that mature high speed and highly efficient rotor and hub system designs.

Work in this Project is fully coordinated with 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Rotors Technology	2.265	2.377	-
Description: Investigate advanced rotor blade and hub technologies to support goals of increased speed and reduced drag by developing low weight rotors and hub configurations that increase hover and cruise efficiency. ***FY 2021 Plans:*** Conduct individual blade control actuator performance and thermal management testing. Investigate durability performance of Unmanned Aerial Systems (UAS) rotors to determine robustness ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY22, this effort is realigned to the Advanced Hubs effort (622148/AJ6) within this project to focus more on rotor hubs.			
Title: Advanced Hubs	-	-	2.447
Description: Investigate advanced rotor system and hub technologies to support goals of increased speed and lift by developing configurations and technologies that reduce drag and enable more efficient rotor system performance. ***FY 2022 Plans:*** Will conduct design trades to start technology down-selection for advanced rotor system hubs; and will commence conceptual design studies. ***FY 2021 to FY 2022 Increase/Decrease Statement:***			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ6 / *Advanced Rotors Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
In FY22, this effort is realigned from the Advanced Rotors Technology (622148/AJ6) effort within this project.			
Accomplishments/Planned Programs Subtotals	2.265	2.377	2.447

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AJ8 / *Experimental and Computational Aeromechanics Techn*	

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
AJ8: *Experimental and Computational Aeromechanics Techn*	-	4.972	5.076	6.135	-	6.135	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates new high fidelity computational methods to simulate aerodynamic effects and test methods of emerging rotorcraft lift technologies that could be incorporated into Future Vertical Lift (FVL) designs.

Work in this Project is fully coordinated with 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 effort is performed by the United States (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Experimental Aeromechanics for FVL	2.942	2.909	3.873
Description: Develop and explore new methods to simulate aerodynamic effects for future FVL configurations. ***FY 2021 Plans:*** Leverage results from FY20 research to perform interactional aerodynamic investigation of winged-compound configurations incorporating auxiliary propulsion. Investigate interactional aerodynamic effects of multi-rotor configurations. Continue experimental efforts aimed at extending the state of the art for measurement & diagnostics techniques for rotor blade structural deformation using embedded sensor networks and digital image correlation, wake flow measurements using advanced optical techniques. ***FY 2022 Plans:*** Will conduct test of new winged compound rotorcraft configurations at high speed with auxiliary propulsion to provide fundamental understanding and validation data for computational tools; will investigate state of the art of measurement & diagnostics techniques for rotorcraft; will test rotor blade structural deformation and boundary layer transition using embedded sensor. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding increase in FY22 will support increased testing of rotor blade and new winged compound rotorcraft.			
Title: Computational Aeromechanics for FVL	2.030	2.167	2.262

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ8 / *Experimental and Computational Aeromechanics Techn*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Description: Investigate experimental aeromechanics technologies and test methods for FVL. ***FY 2021 Plans:*** Verify and validate high-fidelity computational tools for full-vehicle aeromechanics analysis of FVL rotorcraft engineering problems. Use these computational tools to help reduce expensive and time-consuming flight testing to rectify unforeseen deficiencies in new FVL aircraft. ***FY 2022 Plans:*** Will verify and validate new high-fidelity computational tools for aeromechanics analysis of FVL rotorcraft with a focus on interactional aerodynamics problems that are seen in these new FVL designs. Will automate the application of these computational tools in order to maximize their impact on FVL aircraft development. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	4.972	5.076	6.135

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK1 / *UAS Survivability Technology*	

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
AK1: *UAS Survivability Technology*	-	0.959	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates Future Unmanned Aircraft System (FUAS) with mission tailored survivability capabilities that enable operations in contested environments against future peer/near peer threats.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Unmanned Aerial Systems Survivability ***Description:*** Investigate innovative methods to design FUAS with tailored signature management and enhanced survivability.	0.959	-	-
Accomplishments/Planned Programs Subtotals	0.959	-	-

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK2 / *Aviation Survivability Technology*	

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
AK2: *Aviation Survivability Technology*	-	20.895	21.158	2.177	-	2.177	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, funding was partially realigned from this Project administratively to Program Element (PE) 0602183A Air Platform Applied Research / Project CN1 Disruptive Countermeasure Concepts for Aviation

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. It also investigates and develops an integrated team-based system of systems survivability approach for Integrated Air Defense

Systems breaching through purpose driven mix of improved survivability situational awareness, signature management, vulnerability reduction, route and maneuver optimization, expendables, advanced sensors, and Electro-optical (EO) & Radio Frequency (RF) jamming across distributed platforms.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Signature Reduction for Advanced Threat ***Description:*** Investigate advanced technologies to reduce susceptibility and vulnerability of aircraft to damage from threats or accidents, as well as technologies to defeat small arms, rocket, and missile threats.	3.887	-	-
Title: Cognitive Countermeasures Technology Development ***Description:*** This effort investigates and matures novel materials, components, and techniques to counter legacy and emerging threats to FVL platforms. Emphasis will be placed on technologies and approaches to enable a robust, holistic countermeasure (CM) capability for target defeat, regardless of threat characteristics or guidance mode. ***FY 2021 Plans:***	1.802	1.991	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Develop preliminary sensor model for detection of specific targets studied from FY18 - FY20 and validate its performance against select targets; characterize ultra-short pulse Laser Induced Direct Damage (LIDD) of optical materials and detectors for physical and electronic damage/disruption; investigate the previously developed (in FY20) in-band MWIR laser source with surrogate-diode pumping and conduct the required research and development towards major performance optimization. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY 2022, this effort is administratively realigned to PE 0602183A Project CN1.			
Title: Reconfigurable Transformational Optics/Task based Display ***Description:*** This effort will deliver reconfigurable micro- and nano-scale filtering devices enabling frequency agile multi-task sensors. This will permit enhanced survivability of the FVL platforms with restored visual overmatch in any (day/night) environment. This will allow visual penetration of natural obscurants (e.g. brownout, white out) or custom man-made obscurants (e.g. engineered smokescreens) from a single sensor, as well as narrowband filtering for active imaging through obscurants. Improved detection and identification capability will result from filtering out scattered light and enabling 3-dimensional ranging through environmental obscurants. Wavelength agile imaging systems will be delivered that are capable of penetrating and imaging through a variety of obscurants and that are compatible with the FVL platforms. ***FY 2021 Plans:*** Design and develop tunable filter designs in the midwave and longwave infrared for simultaneous on/off filter switching between broad and narrow bands, and tunability of the filter center wavelength. Down select filter designs that maintain sufficient throughput. Validate pulsed infrared laser illumination and ranging sources that will be incorporated into filter designs. Design and develop new optical material design concepts to increase damage resistance and minimize lens count. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** This effort is administratively realigned in FY22 to PE 0602148A Project AK9 Advanced Teaming for Tactical Aviation Operations Tech.	5.955	5.283	-
Title: Multispectral Threat Warning and Countermeasures ***Description:*** This effort investigates and evaluates software and warning sensor/counter measure components to increase probability to detect and defeat current and evolving small arms and man-portable air defense system (MANPADS) type threats for FVL platforms using modeling and simulation (M&S) and hardware in the loop (HWIL) simulations. ***FY 2021 Plans:***	6.949	0.997	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Investigate the incorporation of distributed sensor data into the threat declaration algorithm; assess the optimal combination of sensors to perform high detection of multiple classes of unexploited threats; analyze impact of threat progression on measured performance. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** This effort is administratively realigned in FY22 to PE 0602148A Project CH3 Holistic Team Survivability Technology.			
Title: Tunable Pyrotechnics Technologies ***Description:*** Develop and investigate technologies for nano, reactive, and advanced/novel materials to enable, customize and ? tune? a family of Countermeasure Decoys for FVL platforms. ***FY 2021 Plans:*** Investigate novel countermeasure designs and miniaturize component technologies for Radio Frequency performance in the EM spectrum to address emerging threats for current and future aviation platforms; develop and assess the performance of new pyrotechnic formulations for Advanced Seeker Countermeasures through static and functional experiments. ***FY 2022 Plans:*** Will design and develop novel miniaturized Radio Frequency Countermeasure (CM) components. Will conduct experiments to verify radio frequency output from pyrotechnic sub-component. Will design and develop new pyrotechnic formulations, validate existing models through simulations, and update models as required for Advanced Seeker Countermeasures. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding decrease due to realignment to PE 0602141A Lethality Technology/Project AH9 Advanced Warheads Technology for exploration of novel pyrotechnics technologies for application across all Army priorities.	2.302	2.612	2.177
Title: Advanced Survivability Concepts ***Description:*** This effort will provide analysis of the rapidly evolving and emerging threat environment and impacts to FVL platforms. This effort will also provide advanced teaming algorithms for survivability. ***FY 2021 Plans:*** Define integrate team survivability capability requirements. Perform preliminary research on full spectrum susceptibility and vulnerability reduction technologies that enhance team based survivability. Begin investigation into team based algorithms and behaviors for survivability. ***FY 2021 to FY 2022 Increase/Decrease Statement:***	-	4.148	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
This effort is administratively realigned in FY22 to PE 0602148A Project CH3 Holistic Team Survivability Technology.			
Title: Electronic Warfare Air Sensors / Countermeasure ***Description:*** This effort investigates and develops Electronic Warfare (EW) survivability technologies to enable the detection and defeat of advanced threats. It provides algorithms, sensors, and effectors that are robust to advanced threat characteristics and operate effectively across the distributed team of FVL aircraft. ***FY 2021 Plans:*** Research technical approaches to detect and defeat advanced threat characteristics; develop technical design for detection and defeat technology incorporating advanced signal processing features; create digital and hybrid hardware models of advanced sensor and countermeasure (CM) payload and analyze functionality. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** This effort is administratively realigned in FY22 to PE 0602148A Project CH3 Holistic Team Survivability Technology.	-	6.127	-
Accomplishments/Planned Programs Subtotals	20.895	21.158	2.177

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK4 / *Multi-Role Small Guided Missile Technology*	

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
AK4: *Multi-Role Small Guided Missile Technology*	-	5.853	7.463	3.736	-	3.736	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

The Project investigates, designs, and evaluates modular missile component technologies compatible with Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) aviation platforms in a Multi-Domain Battle/Cross-domain Maneuver operational environment. Also investigates critical component technologies and designs for future missiles that can be launched simultaneously, can operate autonomously and/or under human supervision, and can form advanced, cooperative teams to defeat one or more hard/soft targets which are stationary and/or moving.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Modular Missile Technology ***Description:*** Evaluate critical technology and designs components compatible with Manned and Unmanned Aviation environments to provide scalable and tailorable improved lethality. Provides open architecture external and internal interfaces.	1.565	-	-
Title: Multi-Role Guided Missile - Extended Range Technology ***Description:*** Identify, demonstrate, analyze, and assess key component technologies to support non-line-of-sight missile development providing man-in-the-loop situational awareness, targeting, and high value target defeat for Aviation platforms that can successfully operate in A2AD/IADS environments. ***FY 2021 Plans:*** Develop form factors and interfaces for critical components including navigation sensors, warheads, fire control, and digital missile datalinks. Complete preliminary integrated missile system design; perform stand-alone experiments with component technology hardware and software to verify performance; perform experiments to determine adequate operation in a lab environment. ***FY 2021 to FY 2022 Increase/Decrease Statement:***	4.288	4.362	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK4 / *Multi-Role Small Guided Missile Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Beginning in FY22 funding has been realigned into PE 0602148A/CI5 to support acceleration of the High Speed Maneuverable Missile effort.			
Title: Multiple Simul Engagement Technologies (MSET) ***Description:*** Investigate critical missile and fire control component technologies and designs for future missiles that can be launched simultaneously, can operate autonomously and/or under human supervision, and can form advanced, cooperative teams to defeat one or more hard/soft targets which are stationary and/or moving targets. ***FY 2021 Plans:*** Perform detailed design of target detection and tracking algorithms, multi-missile communications datalink, and multi-missile command and control algorithms; develop laboratory environment for component experimentation and perform investigations of component technical performance. ***FY 2022 Plans:*** Will combine lower-level component simulations to form system-level simulation. Will verify component performance predictions to aid in design refinement and overall performance predictions. Will mature component designs based on simulation results. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding change reflects planned lifecycle for this effort for increased focus on performing higher-level simulation.	-	3.101	3.736
Accomplishments/Planned Programs Subtotals	5.853	7.463	3.736

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK6 / *Advanced Rotorcraft Armaments Protection System Te*	

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
AK6: *Advanced Rotorcraft Armaments Protection System Te*	-	5.094	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates holistic lethality technologies for Future Vertical Lift (FVL) offensive and defensive applications. Develops components for use in multi-role armament solutions for fire control, armament systems, munitions, and integration of threat agnostic countermeasures.

Work in this Project is fully coordinated with 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 effort is performed by the United States (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Rotorcraft Armament & Protection System (ARAPS)	5.094	-	-
Description: The ARAPS effort designs and develops FVL technologies for lightweight armament systems and multi-role munitions with enhanced lethality at extended ranges. The effort investigates and determines the feasibility of a holistic fire control system that integrates all aspects of offensive and defensive capabilities for advanced protection and enhanced survivability.			
Accomplishments/Planned Programs Subtotals	5.094	-	-

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK9 / *Adv Teaming for Tactical Aviation Operations Tech*	

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
AK9: *Adv Teaming for Tactical Aviation Operations Tech*	-	13.024	13.531	13.978	-	13.978	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022, funding was partially realigned from this Project administratively to Program Element (PE) 0602183A Air Platform Applied Research / CL8 Aviation Teaming Autonomy Concepts & Technologies

A. Mission Description and Budget Item Justification

This Project investigates and develops subsystem and component level technologies that enable advanced teaming behaviors for mixed platform formations in combined arms operations. Primary component technologies to develop are in the areas of resilient autonomy algorithms, team-based communications and situational awareness management, decision aiding for weapons systems engagement, autonomous terrain and collision avoidance, and human autonomy interface design.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Teaming Concepts	9.525	9.643	8.357
Description: Investigates and develops subsystem and component level technologies that enable advanced manned and unmanned teaming behaviors for mixed air and ground platform formations in combined arms operations.			
FY 2021 Plans: Develop mission systems teaming architectures and subsystem technologies focused on collaborative mission planning and execution, enhanced own-ship autonomy, shared team situational awareness using distributed sensor systems, and advanced effector employment; enhance simulation models for evaluation of multi-Unmanned Aircraft System (UAS) coordinated attack and decoy behaviors in Global Positioning System (GPS) denied conditions.			
FY 2022 Plans:			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK9 / *Adv Teaming for Tactical Aviation Operations Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Will further develop and enhance technologies that provide UAS team of teams coordinated mission planning and execution, fused team situational awareness for autonomous mission adaptation, and electronic warfare employment all while operating in GPS denied and communications degraded conditions. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort with reduced development of simulation models.			
Title: Micro/Small Scale Unmanned Aerial Systems ***Description:*** Enables micro/small Future Unmanned Aircraft System (FUAS) concepts for experimental prototypes to discover behaviors that can be scaled up to group 3 platforms to support advanced manned and unmanned air and ground teaming, and the maturation of basic research in the area of intelligent unmanned air systems. This includes controls that can adapt to damage or environmental conditions, models to perform aggressive maneuver in complex environments, reduction of noise signature, and adaptive structures.	3.499	-	-
Title: Intelligent Unmanned Aerial System Teaming Technologies ***Description:*** Enables the establishment of component technologies to support resilient, multi-modal, survivable 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 2021 Plans:*** Investigate and develop novel control schemes that will enable homogeneous and heterogeneous groups of UAS to perform advanced teaming operations in complex environments; investigate and mature higher fidelity methods into computationally efficient physics-based modeling tools to enhance the understanding and effectiveness of tactical group behaviors against a capability-matched adversarial force utilizing game theoretic principles; perform research to progress methods for advanced teaming simulation environments to fully incorporate full vehicle flight dynamics models for a single platform and investigate methods for multi-agents. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY 2022, this effort is administratively realigned to PE 0602183A Project CL8 Aviation Teaming Autonomy Concepts & Technologies.	-	3.888	-
Title: Enhanced Optics for Long Range Targeting	-	-	5.621

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK9 / *Adv Teaming for Tactical Aviation Operations Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Description: This effort will deliver advanced airborne optics and reconfigurable filtering devices to enable agile, multi-task sensors for compact, long-range targeting, enhanced survivability and lethality of the Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS). This effort will restore visual overmatch in any (day/night) environment through visual penetration of all obscurants (e.g. brownout, white out, engineered smokescreens) from a single sensor, as well as narrowband filtering for active imaging through obscurants while maintaining advanced target acquisition. Improved detection and identification and long range target acquisition capability will result from filtering out scattered light and enabling 3-dimensional ranging through environmental obscurants. ***FY 2022 Plans:*** Will investigate materials and efficiency of non-traditional off-axis style optical systems for range performance; will design and develop field-selectable spectral bandpass filters for operation near cryogenic dewars to penetrate obscurants while minimizing photon noise, enabling multi-task sensing (e.g. long range targeting, brownout penetration, disturbed earth detection) from a single sensor; will investigate active sensor components for 3-D Imaging; will conduct experiments on the material growth process for a new optical lens for multi-band targeting sensors to enable greater sensitivity and range performance. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** This research effort was administratively realigned from PE 0602148A (Aviation Technology) / Project AK2 (Aviation Survivability Technology) in FY22			
Accomplishments/Planned Programs Subtotals	13.024	13.531	13.978

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL2 / *High Performance Computing for Rotorcraft App Tech*			
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**
AL2: *High Performance Computing for Rotorcraft App Tech*	-	1.121	1.148	1.200	-	1.200	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates and validates aeromechanics modeling and simulation tools for Future Vertical Lift (FVL) platforms. Research efforts in this Project are also applicable to the family of FVL manned and unmanned platforms.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: High Performance Computing for Rotorcraft App Tech	1.121	1.148	1.200
Description: Investigate new high performance and parallel computing efforts in support of FVL platforms. ***FY 2021 Plans:*** Develop and demonstrate new automated high-fidelity computational tools for full-vehicle rotorcraft aeromechanics analysis and design. Automate the setup and execution of these computational models to improve turnaround and to build in best practices for consistently accurate results. ***FY 2022 Plans:*** Will develop new computational software tools for rotorcraft aeromechanics analysis that leverage the power of high-performance computers to produce high-accuracy results for vehicles with complex aerodynamic interactions among their component parts. Will improve the computational speed of these high-fidelity simulations so that they can be routinely used in rotorcraft design and optimization processes for FVL vehicles. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.121	1.148	1.200

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL2 / *High Performance Computing for Rotorcraft App Tech*

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL4 / *High Speed and Efficient VTOL Vehicle Technology*			
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**
AL4: *High Speed and Efficient VTOL Vehicle Technology*	-	1.438	1.444	1.466	-	1.466	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project establishes component technologies in the area of materials, design, and dynamic models to enable next generation capability for Future Vertical Lift (FVL) platforms. Objectives of this Project are focused on improving both performance (i.e. range, payload, endurance) and reliability/maintainability metrics, where outcomes from these efforts are applicable to the Family of Future Vertical Lift manned and unmanned platforms.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: High Speed & Efficient Vertical Take-off and Landing	1.438	1.444	1.466
Description: This research effort establishes concepts in vertical take-off and landing in the area of propulsion to enable improved, efficient hover and high-speed cruise at longer range without added weight. ***FY 2021 Plans:*** Investigate lightweight materials and designs for transmission gears; establish, by experimental means, the bounds at oil-out conditions for lightweight gear designs. Characterize and validate the dynamics of candidate hybrid gears. ***FY 2022 Plans:*** Will apply deep learning methods to build a diagnostic analytical tool for UH-60 Black Hawk; will select materials and design for a half-weight hybrid transmission gear. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding decrease reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	1.438	1.444	1.466

C. Other Program Funding Summary ($ in Millions)

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL4 / *High Speed and Efficient VTOL Vehicle Technology*

C. Other Program Funding Summary ($ in Millions)

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL5 / *Air Vehicle Structures and Dynamics Technology*			
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**
AL5: *Air Vehicle Structures and Dynamics Technology*	-	2.652	2.792	2.823	-	2.823	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project establishes validated modeling tools needed to develop aeroelastically stable rotor technologies to enable high speed flight and longer flight envelopes in Future Vertical Lift (FVL) platforms. Efforts in this Project are also applicable to the family of FVL manned and unmanned platforms.

Work in this Project is fully coordinated with 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 effort is performed by the United States (US) Army Futures Command

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Air Vehicle Structures and Dynamics Technology ***Description:*** Establish improved experimentally validated modeling tools and methodologies that can be used to understand the physics of aeroelastic stability and design in next generation rotorcraft platform configurations for FVL platforms. This involves the development of an experimental capability, the Tiltrotor Aeroelastic Stability Test-bed (TRAST), which would be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort mitigates risk for the Joint Multi-Role Technology Demonstrator (JMR-TD) effort and informs FVL requirement definition and technology maturation. The experimentally validated models will also be used to investigate concepts to reduce the vibration and improve stability of future aircraft.	1.715	-	-
Title: Probabilistic and Damage Tolerance Methodologies ***Description:*** Advancement of probabilistic analytical algorithms and methods to enable air platform performance and availability. Probabilistic analytical methodologies resulting from this effort are expected to impact a broad range of air structure vehicle and dynamic technologies including enhanced damage tolerance.	0.937	-	-
Title: Aeromechanics and Aeroelasticity of Future Air Vehicle Platforms ***Description:*** Establish improved experimentally validated modeling tools and methodologies that can be used to understand the physics of aeroelastic stability and design in next generation rotorcraft platform configurations for FVL platforms. This involves	-	2.792	2.823

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL5 / *Air Vehicle Structures and Dynamics Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
the development of an experimental capability, (TRAST), which will be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort will inform FVL requirement definition and technology maturation. This effort also establishes low noise rotor concepts and investigates the intersection of artificial intelligence and classical mechanics to enable novel mechanics and new approaches in structural dynamics for FVL applications to enable higher Operating Tempo (OPTEMPO) operations. ***FY 2021 Plans:*** Conduct wind tunnel experiments of idealized tiltrotor configurations to understand the effects of rotor, wing, control parameters, and dynamic and aerodynamic coupling on aircraft stability to enable faster, more efficient, and sustainable tiltrotor aircraft. Increase understanding of aerodynamic and acoustic interactions through simulation and experiments; validate modeling capabilities for multi-rotor and compound vertical lift concepts to enable quieter operations. Advance knowledge of underlying mechanics through exploration of materials for vibrational damping, actuation, and sensing through experiments and artificial intelligence/machine learning to enable the development of massively reconfigurable air vehicle configurations. ***FY 2022 Plans:*** Will investigate fluid-structure interaction models to inform the structural design of an adaptive unmanned aerial system (UAS) with enhanced aerodynamic performance; will develop tools and methods for multi-disciplinary and multi-dimensional design optimization of future and non-traditional UAS and assessment of emergent technologies; will conduct wind tunnel experiments to investigate the effects of hinge-less rotor and control parameters on tiltrotor aircraft stability to enable faster, more efficient, and sustainable tiltrotor aircraft; will perform analysis and wind-tunnel experimentation to assess passive and active whirl-flutter mitigation technologies; will perform high-fidelity computational aeromechanics modeling of novel blade concepts to enable rotor with improved performance and noise characteristics; will couple acoustics prediction models with the comprehensive analysis codes to enable acoustics characterization of rotorcraft configurations at conceptual design stage. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding increase reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	2.652	2.792	2.823

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL8 / *Holistic Situational Awareness and Dec Making Tech*			
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**
AL8: *Holistic Situational Awareness and Dec Making Tech*	-	1.673	1.757	0.889	-	0.889	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project focuses on modeling and simulation of pilotage and decision aiding system technology that allows for care free operations in complex and hostile environments.

Work in this Project is fully coordinated with 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 effort is performed by the United States (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Radar Sensing and Phenomenology ***Description:*** This effort develops the technical underpinnings of radar and other active and passive radio frequency (RF) sensing modalities for several key Army requirements. Focus in on cost effective radar concepts to enhance the situational awareness and navigation capabilities of US Army rotorcraft, allowing safe operation in Degraded Visual Environment (DVE). This research uses a combination of advanced computational electromagnetic models and algorithms, radar measurements, active and passive RF sensing technologies, and advanced signal processing.	1.673	-	-
Title: Wideband RF Sensors ***Description:*** This effort develops the technical underpinnings of radar and other active and passive RF sensing modalities for several key Army requirements, with a focus on cost effective radar concepts to enhance the situational awareness and navigation capabilities of US Army rotorcraft to operate safely in DVE. This research uses a combination of advanced computational electromagnetic models and algorithms, radar measurements, active and passive RF sensing technologies, and advanced signal processing. ***FY 2021 Plans:***	-	0.892	-

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL8 / *Holistic Situational Awareness and Dec Making Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Investigate and explore FLSAR design options and develop instrumentation to collect outdoor data. Implement fast 3-D SAR imaging algorithm for signal processor that leverages the architecture and capability of advanced Graphics Processor Units (GPUs). ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY 2022, effort is realigned to PE 0602141/CG4 Advanced Radar Concepts and Technologies for consolidation of efforts across the modernization priorities			
Title: Situational Awareness Radar for DVE mitigation ***Description:*** This effort investigates technologies and algorithms for compact radars that will provide a hazard warning capability to airborne platforms in all environmental conditions, including those with zero visibility. This hazard warning capability will detect collision threats and specific projectile hazards around the entire aircraft using a suite of small form-factor radars. Algorithms are created to interpret the data produced by these radars and distinguish threats from benign clutter. Innovative radar architectures and device technologies are investigated and demonstrated to enhance and extend performance. ***FY 2021 Plans:*** Investigate waveforms to minimize interference between the radars on different platforms and reduce their susceptibility to detection and electronic attack. ***FY 2022 Plans:*** Will investigate forward looking synthetic aperture radar (FLSAR) technology to assess capabilities for terrain navigation in Degraded Visual Environments (DVE); will conduct experiments in relevant field conditions using laboratory radar testbed; develop and implement signal processing for creating 3-D imagery of ground obstacles. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort to focus on experiments using laboratory radar testbed.	-	0.865	0.889
Accomplishments/Planned Programs Subtotals	1.673	1.757	0.889

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AM2 / *Aircraft and Aircrew Protection Technology*	

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
AM2: *Aircraft and Aircrew Protection Technology*	-	1.459	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project investigates and develops leap-ahead structures technologies, concepts, and capabilities that enable break-through improvements in weight efficiency, performance, and extreme-environment operational durability, as well as enhanced platform design, qualification, and fleet structural integrity management for application to Future Vertical Lift (FVL) platforms. Technologies also have applicability to Future Unmanned Aircraft Systems (FUAS).

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Aircraft & Aircrew Protection	1.459	-	-
Description: Enables survivable, sustainable rotorcraft configurations by conceiving of and evaluating critical aviation technologies using design and analysis methods with greater modeling fidelity with an ultimate goal of reducing the timelines associated with overall design of FVL and FUAS platforms. Introduces high fidelity methodology for improved performance and design predictions earlier in the development and acquisition process. Use physics of failure modeling and coupled discipline analysis to drastically improve component and system reliability.			
Accomplishments/Planned Programs Subtotals	1.459	-	-

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AM4 / *Opt Energy Stg & Therm Mgmt for FVL Survivability*			
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**
AM4: *Opt Energy Stg & Therm Mgmt for FVL Survivability*	-	4.710	8.531	-	-	-	-	-	-	-	-	-

Note

In FY22, this Project is administratively realigned under PE 0602148A (Future Vertical Lift Technology / CH4 (Power and Thermal Management for FVL Tech)

A. Mission Description and Budget Item Justification

This Project investigates emerging power generation, energy storage, and thermal management technologies needed for future Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR), and survivability equipment that could be incorporated onto Future Vertical Lift (FVL) and other Army platforms. Provides power capability for advanced electric aeromechanical effectors, advanced mission systems algorithms for route planning and teaming and advanced electronic warfare devices.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Optimized Energy for C5ISR Platforms	4.710	4.867	-
Description: This effort investigates power and thermal management associated with high power C5ISR capabilities on ground and air platforms enabling enhanced mobility and mission flexibility. This effort funds research to improve FVL aircraft and other Army platforms power efficiency through the use of on-demand hybrid power architectures, while also researching ways to eliminate platform thermal constraints. This effort will also investigate very high density power sources and energy storage for high rate pulsed power, power management, and thermal management for dynamic high rate pulsed power.			
FY 2021 Plans: Investigate power requirements for emerging C5ISR. Explore use of models based on size, weight, and power requirements and aircraft platform constraints, which include architectures and intelligent control variants for management of these loads. Conduct experiments on the modularization of the storage technology needed to support high power, short duration burst loads. Investigate thermal implications of waste heat generated from inefficiencies in power conversion and its impact on the aircraft. Conduct			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AM4 / *Opt Energy Stg & Therm Mgmt for FVL Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
experiments on hybrid energy storage technologies to support cyclical loads such as hybrid batteries or ultra-capacitor technology. Validate models of intelligent controls for platform-integrated power systems to conduct experiments on control strategies. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY22 the work for this project is administratively realigned under PE 0602148A (Future Vertical Lift Technology / CH4 (Power and Thermal Management for FVL Tech)			
Title: Power & Thermal Management Components ***Description:*** This effort develops power and thermal management component technologies to meet the power and thermal demands of Future Vertical Lift aircraft while minimizing system size and weight. Technology will be validated through component level test. ***FY 2021 Plans:*** Develop and perform component level validation testing on advanced power generation technologies such as lightweight, efficient turbo-generators and advanced thermal management technologies specifically designed for application to FVL aircraft. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY22 the work for this project is administratively realigned under PE 0602148A (Future Vertical Lift Technology / CH4 (Power and Thermal Management for FVL Tech)	-	3.664	-
Accomplishments/Planned Programs Subtotals	4.710	8.531	-

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 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) BP7 / *Future Vertical Lift Air Platform Tech (CA)*			
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**
BP7: *Future Vertical Lift Air Platform Tech (CA)*	-	14.000	75.000	-	-	-	-	-	-	-	-	-

Note

Congressional Interest Item funding provided for Future Vertical Lift Air Platform Technology.

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Future Vertical Lift Platform 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 2020	FY 2021
Congressional Add: Flight Control Technology Safety and Survivability ***FY 2020 Accomplishments:*** Conducted applied research in Flight Control Technology Safety and Survivability. Work executed by Army Futures Command.	3.000	-
Congressional Add: Rotary Wing Adaptive Flight Control Technology ***FY 2020 Accomplishments:*** Conducted applied research in Rotary Wing Adaptive Flight Control Technology. Work executed by Army Futures Command.	6.000	-
Congressional Add: Technology Transfer and Innovation ***FY 2020 Accomplishments:*** Conducted Technology Transfer and Innovation activities of high potential applied research outcomes. Work executed by Army Futures Command.	5.000	-
Congressional Add: Program increase - high strength functional composites ***FY 2021 Plans:*** Conduct applied research in High Strength Functional Composites.	-	5.000

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** BP7 / *Future Vertical Lift Air Platform Tech (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - additive manufacturing of multifunctional composite aerospace components ***FY 2021 Plans:*** Conduct applied research in Additive Manufacturing of Multifunctional Composite Aerospace Components. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase: Advanced rotary wing materials and structures ***FY 2021 Plans:*** Conduct applied research in Advanced Rotary Wing Materials and Structures. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase: Adaptive flight control technology ***FY 2021 Plans:*** Conduct applied research in Adaptive Flight Control Technology. Work executed by Army Futures Command.	-	4.000
Congressional Add: Program increase: Lightweight hybrid composite medium caliber barrels ***FY 2021 Plans:*** Conduct applied research in Lightweight Hybrid Composite Medium Caliber Barrels. Work executed by Army Futures Command.	-	20.000
Congressional Add: Program increase: Technology transfer and innovation ***FY 2021 Plans:*** Conduct applied research in Technology Transfer and Innovation. Work executed by Army Futures Command.	-	5.000
Congressional Add: Program increase - self-sealing fuel tanks technology ***FY 2021 Plans:*** Conduct applied research in Self-Sealing Fuel Tanks Technology. Work executed by Army Futures Command.	-	6.000
Congressional Add: Program increase - high density eVTOL power source ***FY 2021 Plans:*** Conduct applied research in High Density eVTOL Power Source.	-	15.000

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** BP7 / *Future Vertical Lift Air Platform Tech (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021
Work executed by Army Futures Command.		
Congressional Add: Program increase - individual blade and higher harmonic control	-	10.000
FY 2021 Plans: Conduct applied research in Individual Blade and Higher Harmonic Control. Work executed by Army Futures Command.		
Congressional Adds Subtotals	14.000	75.000

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) BZ7 / *Future Vertical Lift Medical 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
BZ7: *Future Vertical Lift Medical Technologies*	-	-	7.911	7.818	-	7.818	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project involves research to prevent injury and performance degradation in Aviators, Unmanned Arial System (UAS) Operators and other Warfighters in training and operations; refines risk assessment and performance models based on operational stressors, e.g., sleep deprivation, work load, fatigue; and delivers biomedical-based spinal injury criteria and assessment methodologies. This research provides medical information important to the design and operational use of future vertical lift aircraft, and when appropriate, ground vehicles.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Medical Standards to Support Future Vertical Lift	-	7.911	7.818
Description: This effort develops and delivers medical guidelines and strategies to assure optimal Soldier performance and protection on the future technologically-intensive battlefield. Key elements of the program include: 1) tailored medical selection and retention standards for FVL; 2) medical strategies to maintain and enhance human performance in Multi-domain operations (MDO); 3) human-centered technology design guidance to accommodate the range of aircrew; 4) improved protection standards to reduce FVL occupant injury; and 5) operator state monitoring tools to enable scalable autonomy in FVL aircraft.			
FY 2021 Plans: Develop advanced visual display guidelines to assist aviators in maintaining situational awareness during extreme degraded visual environment (DVE) conditions. Develop aviator composite risk assessment and performance model based on DVE and other operational stressors. Deliver to the Aviation and Missile Center (AvMC) for FVL, and when appropriate, to the Ground Vehicle Systems Center (GVSC) for the Next Generation Combat Vehicle (NGCV), provisional biomedical-based spinal injury criteria and assessment methodologies for two types of vertebral body fractures that seated occupants experience during vertical exposures.			
FY 2022 Plans: Will develop the holistic medical aspects of a Situational Awareness and Decision-Making (HAS-DM) Program. Will evaluate transcranial stimulation to enhance alertness and situational awareness in extended operations. Will determine medical optimal feedback modes to FVL operators for use in scalable autonomy. Will assess medical impacts of FVL scalable autonomy			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** BZ7 / *Future Vertical Lift Medical Technologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
at system level in degraded operator modes. Will evaluate composite workload for real time operator state monitoring. Will develop aircraft and human medical indicators of operator workload and state. Will develop helmet stability and dynamic retention standards for aviation helmets. Will evaluate aviation survivability development and tactics (ASDAT) in a retrospective study on combat-related injury. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding realigned to PE 0602787A Project MM4 (Cbt Casualty Care Applied Rsch Technology).			
Accomplishments/Planned Programs Subtotals	-	7.911	7.818

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CC3 / *FVL Radar 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
CC3: *FVL Radar Technologies*	-	-	0.698	0.444	-	0.444	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

This Project develops underlying technologies applicable to next generation radar apertures used for detection, tracking and precision targeting, navigation and fire control for multiple modalities.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Battlefield Surveillance & Targeting Radar Technology	-	0.698	0.444
Description: Advanced Reconnaissance, Surveillance and Target Acquisition Waveform Designs for advanced multi-beam Ground Moving Target Indicator (GMTI) and Synthetic Aperture Radar (SAR) systems. ***FY 2021 Plans:*** Investigate modeling and simulation of subsystem and component level designs for advanced GMTI and SAR systems. Investigate standards and interface requirements necessary to facilitate integration of scalable Radio Frequency (RF) components at the sub aperture level; conduct experiments to determine optimal techniques for waveform optimization to mitigate spectrum challenges. Investigate multi-function RF modes and waveforms external to traditional SAR and GMTI radar collection. ***FY 2022 Plans:*** Will conduct radar functionality study to investigate frequency, power/duty cycle, timing and aperture allocation requirements to inform and prioritize radar mode development strategy ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding decrease in FY22 reflects decrease in testing needs for more study of radar utilization.			
Accomplishments/Planned Programs Subtotals	-	0.698	0.444

C. Other Program Funding Summary ($ in Millions)

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** CC3 / *FVL Radar Technologies*

C. Other Program Funding Summary ($ in Millions)

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CG9 / *Adapt & Resilnt Tact Autnmy Cont & Struct Tech*	

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
CG9: *Adapt & Resilnt Tact Autnmy Cont & Struct Tech*	-	-	-	6.507	-	6.507	-	-	-	-	-	-

Note

In Fiscal Year 2022 (FY22) this Project was administratively realigned from:
Program Element (PE) 0602148A / Future Vertical Lift Technology
* Project AJ4 "Digital Vehicle Management and Control Technology".

A. Mission Description and Budget Item Justification

This Project develops methodologies for advanced flight dynamics models, robust flight controls for superior handling qualities, and improved survivability, redundancy management with reduced structural loads on the aircraft. Designs algorithms for autonomy, optionally piloted operations and manned-unmanned teaming. This project directly supports FVL modernization priority capabilities by investigating, maturing, and harmonizing leap-ahead autonomy, structures, and controls technologies, concepts, and capabilities which enable combat mission success across the family of manned/unmanned FVL platforms.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Adaptive and Resilient Engineered Structures (ARES) Technologies	-	-	1.558
Description: Develop structures technologies providing performance, survivability, and sustainment benefits with broad applicability across platform scale and role, enabling mission success for manned/unmanned FVL platforms in the contested environment of multi-domain operations.			
FY 2022 Plans: Will develop weight-efficient unitized structural assembly concepts. Will develop innovative weight-efficient blast-tolerant structural concepts. Will apply advanced material systems to develop strong, resilient rotor blade spar designs. Will develop weight-efficient multifunctional structural concepts with integral electromagnetic shielding.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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 0602148A / *Future Verticle Lift Technol ogy*	**Project (Number/Name)** CG9 / *Adapt & Resilnt Tact Autnmy Cont & Struct Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Funding realigned in FY22 from PE 0602148A, Project AJ4 ?Digital Vehicle Management and Control Technology?.			
Title: Adaptive Tactical Autonomy and Control (ATAC) Technologies	-	-	4.949
Description: Develop vehicle management, flight control, and autonomy technologies that enable FVL aircraft to achieve superior maneuverability and agility at all speeds, effectively exploit extreme/degraded environmental conditions as a force multiplier, fight and win in presence of failure or damage, and operate on a cognitive-loading-spectrum from piloted to fully autonomous. ***FY 2022 Plans:*** Will collaborate with Original Equipment Manufacturers (OEM) using flight data from extended Joint Multi-Role Technology Demonstrator (JMR-TD) flight tests to validate Army?s flight-dynamics modeling techniques for modern configurations. Will apply lessons learned to improve Army models of Future Attack Reconnaissance Aircraft (FARA) and Future Long Range Assault Aircraft (FLRAA) and help validate/improve OEM models. Will correlate JMR-TD flight and simulation data with new and existing handling qualities criteria to expand requirements to high speed. Will continue developing Damage Tolerant Control (DTC) technologies and state-of-the-art autonomy algorithms for advanced configurations and military Unmanned Aerial Vehicles (UAV) / Air-Launched Effects (ALE). ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funding realigned in FY22 from PE 0602148A, Project AJ4 ?Digital Vehicle Management and Control Technology?.			
Accomplishments/Planned Programs Subtotals	-	-	6.507

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CH2 / *Air Launched Effects Technology*	

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
CH2: *Air Launched Effects Technology*	-	-	-	7.567	-	7.567	-	-	-	-	-	-

Note

Funding for this project is realigned in FY22 from PE 0602148A, Project AI5 Next Gen Tactical UAS TD Technology.

A. Mission Description and Budget Item Justification

This Project utilizes improved analytic modeling to investigate the effects that potential unmanned system capabilities could have on air vehicle design considerations and operational concepts. This project improves government capability to design and assess novel Unmanned Aircraft System (UAS) concepts. This Project develops and investigates the ability to launch a UAS from a manned or unmanned future vertical lift aircraft at tactical altitudes and to control the same after launch from nearby FVL aircraft, as well as development of the associated payloads (recon, BDA, targeting, comms, decoy). This Project will assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Systems Concepts Studies for Air Launched Effects	-	-	7.567
Description: Investigate potential air vehicle configurations and capabilities to develop and refine the design trade space enabling Future Vertical Lift. Models air vehicle concepts to understand the effects that potential operational Air Launched Effects capabilities will have on air vehicle properties.			
FY 2022 Plans: Will conduct configuration trade and analysis studies to develop novel UAS concepts that will serve to inform Air Launched Effects system specification. Will investigate critical design attributes to inform UAS system performance, weight, and cost. Will develop analytic modeling capabilities to improve timeliness, accuracy, and detail of conceptual design for unmanned systems.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** CH2 / *Air Launched Effects Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Funding increase due to this effort being realigned in FY22 from PE 0602148A, Project AI5 Next Gen Tactical UAS TD Technology.			
Accomplishments/Planned Programs Subtotals	-	-	7.567

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CH3 / *Holistic Team Survivability Technology*	

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
CH3: *Holistic Team Survivability Technology*	-	-	-	11.217	-	11.217	-	-	-	-	-	-

Note

In Fiscal Year 2022 (FY22) this Project was realigned from:
Program Element (PE) 0602148A / Future Vertical Lift Technology
* Project AK2 (Aviation Survivability Technology).

A. Mission Description and Budget Item Justification

This project will investigate and design advanced survivability technologies to develop a holistic team-based solution that delivers advanced sensing and EW effects across a family of aircraft to optimally penetrate and survive in the A2AD environment. This project will take an integrated team-based system of systems survivability approach through a purpose-driven mix of improved survivability situational awareness, signature management, vulnerability reduction, route and maneuver optimization, expendables, advanced sensors, and electro-optics (EO) & radio frequency (RF) jamming for existing and future air platforms. This project will also provide advanced teaming algorithms for survivability. This Project develops and evaluates multi layered survivability concepts and supporting technologies for increased survivability of Future Vertical Lift Family of Systems (FVL FoS) in an advanced and evolving integrated air defense systems environment.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Advanced Survivability Concepts	-	-	4.189
Description: This effort will provide analysis of the rapidly evolving and emerging threat environment and impacts to Future Vertical Lift Family of Systems FVL FoS platforms, developing and evaluating full spectrum survivability concept, collaborative team based survivability algorithms and behaviors			
FY 2022 Plans:			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** CH3 / *Holistic Team Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Will begin development of full spectrum susceptibility and vulnerability reduction component technologies that enhance holistic end-to-end survivability. Development of algorithms, behaviors, and human machine interface for team-based survivability. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funds for this effort are realigned in FY22 from PE 0602148A (FVL Technology), Project AK2 (Aviation Survivability Technology).			
Title: Distributed Electronic Warefare Effects ***Description:*** This effort investigates and develops critical Electronic Warfare (EW) components and techniques to enable the FVL capability to operate and survive in Anti-Access/Area-Denied environments. It provides scalable low size, weight, power, and cost (SWaP-C) signal processing components and decision-making algorithms that adapt and counter the characteristics of advanced and emerging threats. ***FY 2022 Plans:*** Will develop novel algorithms to incorporate distributed sensor data into threat declaration algorithms; will develop methodology to optimize decision-making behaviors of sensor and countermeasure technologies to counter advanced threats; will investigate novel methods to adaptively update behavior of sensor and countermeasure technologies to react to changing threats and environmental conditions; will analyze impact of threat progression on measured performance. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Funds for this effort are realigned in FY22 from PE 0602148A (FVL Technology), Project AK2 (Aviation Survivability Technology).	-	-	7.028
Accomplishments/Planned Programs Subtotals	-	-	11.217

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CH4 / *Power & Thermal Management for FVL Tech*	

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
CH4: *Power & Thermal Management for FVL Tech*	-	-	-	7.175	-	7.175	-	-	-	-	-	-

Note

In Fiscal Year (FY) 2022 this Project was administratively realigned from:
Program Element (PE) 0602148A Future Vertical Lift Technology
* Project AM4 Opt Energy Stg & Therm Mgmt for FVL Survivability Tech

A. Mission Description and Budget Item Justification

This Project directly supports Future Vertical Lift (FVL) Modernization Priority capabilities by investigating and developing power and thermal management technologies to provide significantly higher electrical power capability to FVL aircraft while addressing consequential size, weight, and thermal issues. This effort provides power capability for advanced electric aeromechanical effectors, advanced mission systems algorithms for route planning and teaming, and advanced electronic warfare devices. This Project investigates emerging electrical power generation and distribution, energy storage, and thermal management technologies needed for future Command, Control, Communications, Computers, Cyber, Intelligence, Surveillance and Reconnaissance (C5ISR) and survivability equipment for application to Future Vertical Lift (FVL) and other Army platforms. Enables significantly increased aircraft electrical power capability for advanced electric aeromechanical effectors, advanced mission systems to include algorithms for route planning and teaming, and for advanced electronic warfare devices while minimizing size and weight.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Optimized Energy for C5ISR Platforms	-	-	4.905
Description: This effort investigates electrical power and thermal management associated with high power C5ISR capabilities on ground and air platforms enabling enhanced mobility and mission flexibility. This effort funds research to improve FVL aircraft and other Army platforms power efficiency through the use of on-demand hybrid electrical power architectures, while also researching ways to eliminate platform thermal constraints. This effort will also investigate safer battery chemistries which enable very high density electrical power sources and energy storage to be flight certified for high rate pulsed power, electrical power management, and thermal management for dynamic high rate pulsed power.			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** CH4 / *Power & Thermal Management for FVL Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
FY 2022 Plans: Will apply models based on size, weight, and power requirements of air platforms to inform design and development of energy storage components needed to support high power, short duration bursts. Will design and develop phase change material and pumped two-phase based thermal management components to support rejection of waste heat due to inefficiencies in power conversion. Will conduct experiments on both energy storage and thermal management components to determine performance against advanced C5ISR devices such as advanced radars and sensors. Will conduct experiments to determine the effectiveness of power electronic components and power management strategies. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY22 this effort is administratively realigned from PE 0602148A (Future Vertical Lift Technology /AM4 (Opt Energy Stg & Therm Mgmt for FVL Surv Tech)			
Title: Power & Thermal Management Components ***Description:*** This effort develops electrical power and thermal management component technologies to meet the power and thermal demands of Future Vertical Lift aircraft while minimizing system size and weight. Technology will be validated through component level test. ***FY 2022 Plans:*** Will perform design and fabrication of efficient, distributed, and adaptable cooling systems enabling increased electrical power capability while reducing weight and cost to Future Vertical Lift aircraft electrical power and thermal management systems. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In FY22 this effort is administratively realigned from PE 0602148A (Future Vertical Lift Technology /AM4 (Opt Energy Stg & Therm Mgmt for FVL Surv Tech)	-	-	2.270
Accomplishments/Planned Programs Subtotals	-	-	7.175

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 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) CI5 / *High Speed Maneuverable Missile (HSMM) Tech*	

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
CI5: *High Speed Maneuverable Missile (HSMM) Tech*	-	-	-	8.526	-	8.526	-	-	-	-	-	-

Note

This is a new start Project in Fiscal Year 2022, and was realigned from PE 0602148A Future Vertical Lift Technology/ Project AK4 Multi-Role Small Guided Missile Technology.

A. Mission Description and Budget Item Justification

The Project investigates, designs, and evaluates missile component technologies compatible with Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) aviation platforms in a Multi-Domain Battle/Cross-domain Maneuver operational environment. Efforts provide technologies to support a smaller, faster, maneuverable missile capable of long range non-line-of-sight attack in contested/degraded environments. Technology development increases aviation lethality and platform survivability by increasing missile standoff range, speed, and maneuverability, a faster rate of fire, shorter times of flight, and multi-threat lethal effects. Enables cross domain applications for aviation and ground vehicle platforms, including handoff capability, to engage threats in dead zones, and to operate in contested environments.

Work in this Project is fully coordinated with 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 (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: High Speed Maneuverable Missile (HSMM) Technology	-	-	8.526
Description: Efforts provide technology development to support a maneuverable missile capable of both short range direct attack and long range non-line-of-sight attack with reduced time to target; reduced size and weight for increased load-out; capable of air and ground launched missions in degraded/contested environments.			
FY 2022 Plans: Will continue component maturation based on PE 0602148A Future Vertical Lift Technology/ Project AK4 Multi-Role Small Guided Missile Technology efforts. Will investigate options for multi-mode propulsion to increase range and speed with desired trajectory for effectiveness and survivability. Will determine appropriate missile test bed. Will validate preliminary design accurately reflects			

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 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** CI5 / *High Speed Maneuverable Missile (HSMM) Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
platform interfaces and requirements to include maneuverability, long range precision strike capability in degraded/contested environments, and reduced time to target. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** In Fiscal Year 2022, this Project was realigned from PE 0602148A Future Vertical Lift Technology/ Project AK4 Multi-Role Small Guided Missile Technology.			
Accomplishments/Planned Programs Subtotals	-	-	8.526

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A