Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
Total Program Element	-	0.000	174.892	156.194	-	156.194	190.050	230.431	219.801	220.586	0.000	1,191.954
AI4: *Joint Multi-Role (JMR) Demonstration Advanced Tech*	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000
AI6: *Next Gen Tactical UAS TD Advanced Technology*	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000
AI8: *Alternative Concept Engine Advanced Technology*	-	0.000	2.929	2.602	-	2.602	1.735	0.000	0.000	0.000	0.000	7.266
AJ1: *Future UAS Engine Advanced Technology*	-	0.000	1.730	2.827	-	2.827	4.420	4.508	4.513	4.558	0.000	22.556
AJ3: *Next Generation Rotorcraft Transmission Adv Tech*	-	0.000	1.098	1.393	-	1.393	1.421	4.289	4.337	4.337	0.000	16.875
AJ5: *Digital Vehicle Management & Control Advanced Tech*	-	0.000	1.153	6.761	-	6.761	6.897	8.034	9.112	9.113	0.000	41.070
AJ7: *Advanced Rotors Advanced Technology*	-	0.000	2.500	2.498	-	2.498	2.508	2.558	2.575	2.601	0.000	15.240
AJ9: *Integ Mission Equip for Vert Lift Systems Adv Tech*	-	0.000	15.820	22.381	-	22.381	24.360	25.996	21.569	21.787	0.000	131.913
AK3: *Aviation Survivability Advanced Technology*	-	0.000	20.836	11.370	-	11.370	15.806	20.243	20.701	20.703	0.000	109.659
AK5: *Multi-Role Small Guided Missile Advanced Tech*	-	0.000	2.426	2.997	-	2.997	10.406	26.621	24.524	24.651	0.000	91.625
AK7: *Adv Rotorcraft Armaments Protection Sys Adv Tech*	-	0.000	3.139	6.344	-	6.344	10.671	9.361	2.997	0.000	0.000	32.512
AK8: *Air Launched Effects Advanced Technology*	-	0.000	3.215	29.419	-	29.419	29.262	28.144	27.157	27.159	0.000	144.356
AL1: *Adv Teaming for Tactical Aviation Oper Adv Tech*	-	0.000	20.964	41.328	-	41.328	40.580	40.284	46.770	46.774	0.000	236.700

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army													Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 3: *Advanced Technology Development (ATD)*					R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*								
AL3: *HPC for Rotorcraft Applications Adv Tech*	-	0.000	4.958	5.046	-	5.046	5.136	5.301	5.360	5.414	0.000	31.215
AL6: *Degraded Vis Environ Mitigation (DVE-M) Adv Tech*	-	0.000	29.151	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	29.151
AL7: *Full Spectrum Targeting Advanced Technology*	-	0.000	5.425	9.907	-	9.907	10.115	10.317	10.432	10.537	0.000	56.733
AL9: *Holistic Sit Awareness and Dec Making Adv Tech*	-	0.000	0.000	4.995	-	4.995	17.783	31.670	19.908	20.108	0.000	94.464
AM3: *Aircraft and Aircrew Protection Advanced Tech*	-	0.000	4.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.548
AM5: *Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech*	-	0.000	0.000	1.998	-	1.998	3.537	5.348	5.391	5.391	0.000	21.665
BP8: *Future Vertical Lift Air Platform Adv Tech (CA)*	-	0.000	35.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000
CA8: *Adv Rotocraft Armaments Protection Sys*	-	0.000	0.000	0.999	-	0.999	1.249	2.797	9.298	12.296	0.000	26.639
CC4: *FVL Radar Advanced Technologies*	-	0.000	0.000	3.329	-	3.329	4.164	4.960	5.157	5.157	0.000	22.767

Note

In Fiscal Year (FY) 2020 this Program Element (PE) continues efforts previously funded in the following PEs:
* PE 0603003A (Aviation Advanced Technology)
* PE 0603004A (Weapons and Munitions Advanced Technology)
* PE 0603270A (Electronic Warfare Technology)
* PE 0603313A (Missile and Rocket Advanced Technology)
* PE 0603710A (Night Vision Advanced Technology)
* PE 0603734A (Military Engineering Advanced Technology)
* PE 0603772 (Advanced Tactical Computer Science and Sensor Technology)

A. Mission Description and Budget Item Justification

This PE matures and demonstrates manned and unmanned air vehicle and mission system technologies as well as advanced teaming capabilities to enable Army Future Vertical Lift. Emphasis is on 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. Within this PE, aviation technologies are advanced and integrated into realistic and robust demonstrations.

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

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

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense 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 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	151.640	145.543	-	145.543
Current President's Budget	0.000	174.892	156.194	-	156.194
Total Adjustments	0.000	23.252	10.651	-	10.651
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-11.748			
• Congressional Rescissions	-	-			
• Congressional Adds	-	35.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	10.651	-	10.651

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Project: BP8: *Future Vertical Lift Air Platform Adv Tech (CA)*		
Congressional Add: *Joint Tactical Aerial Resupply Vehicle*	-	6.000
Congressional Add: *Advanced Helicopter Seating System*	-	5.000
Congressional Add: *Adhesive Technology*	-	3.000
Congressional Add: *Helicopter Emergency Oil Systems*	-	2.000
Congressional Add: *UAV Fuel Systems Enhancements*	-	2.000
Congressional Add: *Surface Tolerant Advanced Adhesives*	-	5.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Army	Date: February 2020
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army I* BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603465A *I Future Vertical Lift Advanced Technology*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2019	FY 2020
Congressional Add: *Ferrium Steels for Improved Drive Systems*	-	4.000
Congressional Add: *Stretch Broken Composite Material Forms*	-	8.000
Congressional Add Subtotals for Project: BP8	-	35.000
Congressional Add Totals for all Projects	-	35.000

Change Summary Explanation

FY2020 funding change due to $35.000 M in Congressional adds, and -$11.748M in Congressional Rescissions

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AI4 / *Joint Multi-Role (JMR) Demonstration Advanced Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AI4: *Joint Multi-Role (JMR) Demonstration Advanced Tech*	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology
* Project 313 Adv Rotarywing Veh Tech

In FY21, this Project is Eliminated.

A. Mission Description and Budget Item Justification

This Project demonstrates transformational advanced rotary-wing configurations and open systems architectures to prepare the Department of Defense (DoD) for decisions regarding Future Vertical Lift (FVL).

Work in this Project is fully coordinated with PE 0602148A (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.

All FY 2020 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Joint Multi-Role (JMR) Technology Demonstration	-	10.000	-
Description: Provide demonstration of Future Vertical Lift (FVL) platform configurations that address multi domain battle capability needs. Determine optimum vehicle attributes that meet future force capability needs for increased system speed, range, payload, and reduced operating costs in order to inform and reduce future aviation materiel acquisitions. Flight demonstrate operational capabilities of technology demonstrators.			
FY 2020 Plans: Will complete the Mission Systems Architecture Capstone Demonstration, which includes development of processes, tools, and standards necessary to specify, analyze, design, implement and qualify a Mission Systems Architecture for future programs using a Model-Based development approach. Will continue development of the Joint Common Architecture (JCA), including a functional model, data model, supporting documentation, and tools. Will continue final design, integration, and assessment of a notional			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AI4 / *Joint Multi-Role (JMR) Demonstration Advanced Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Open Systems Architecture (OSA) that implements the Future Airborne Capability Environment (FACE) Technical Standard and Hardware Open Systems Technologies (HOST). Will deliver architectural models and technical reports from vendors participating in the demonstration of the architectures. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** JMR TD flight demonstration completed.			
Accomplishments/Planned Programs Subtotals	-	10.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AI6 / *Next Gen Tactical UAS TD Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AI6: *Next Gen Tactical UAS TD Advanced Technology*	-	0.000	10.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	10.000

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology
* Project 313 Adv Rotarywing Veh Tech

In Fiscal Year 2021 (FY21) this Project is realigned to:
Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
* Project AK8 Air Launched Effects Advanced Technology

The FY20 funding requested in this Project was reduced in the FY20 Appropriation Conference Report.

A. Mission Description and Budget Item Justification

This Project matures and demonstrates conceptual designs and enabling technologies to support the development of technically feasible and achievable requirements for the Future Unmanned Aircraft Systems (FUAS) Program of Record. The Project will also reduce the developmental risk of critical technologies for FUAS.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY 20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

Work in this effort is performed by the U.S. Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Next Gen Tactical UAS Technology Demonstration	-	10.000	-
Description: This Project will develop and demonstrate conceptual designs and enabling technologies to support the development of technically feasible and achievable requirements for the Future Unmanned Aircraft Systems (FUAS) Program of Record.			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AI6 / *Next Gen Tactical UAS TD Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
FY 2020 Plans: Air vehicle conceptual designs will be assessed against refined requirements for continuation to detailed design, fabrication, and demonstration in 2023. Proposed technology insertions will be prioritized to enable advanced UAS. Experiments will inform concepts of operation for future vertical lift family of systems within the ecosystem. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This work is divested and funds are reallocated to a higher priority in FY 21, PE 0603465A (Future Vertical Lift Advanced Technology) / AK8 (Air Launched Effects Advanced Technology).			
Accomplishments/Planned Programs Subtotals	-	10.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AI8 / *Alternative Concept Engine Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AI8: *Alternative Concept Engine Advanced Technology*	-	0.000	2.929	2.602	-	2.602	1.735	0.000	0.000	0.000	0.000	7.266

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology, Project:
* 447 ACFT Demo Engines

A. Mission Description and Budget Item Justification

This Project provides demonstration of adaptable, fuel efficient, and high power to weight engine technologies for potential application to Future Vertical Lift platforms. Efforts include development of alternative, adaptive and smart engine technologies to provide improved performance, readiness and affordability across the engine operating envelope for increased operational capability.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Alternative Concept Engine (ACE)	-	2.929	2.602
Description: This effort demonstrates alternative, adaptive, and intelligent engine technologies to provide improved / mission-optimized performance, readiness and affordability across an expanding engine envelope for increased operational capability for Future Vertical Lift (FVL) platforms. The alternative concept engine technology demonstrations planned for this effort are applicable to current and future platforms.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AI8 / *Alternative Concept Engine Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Alternative concept engine component fabrication and component validation testing will be completed and engine testing will be initiated. ***FY 2021 Plans:*** Will complete ACE fabrication. Will conduct engine performance demonstration and testing. Engine test metrics will include variable output speed, fuel efficiency, high power to weight ratio, and durability. Engine technologies will be demonstrated to Technology Readiness Level (TRL) 6 for Future Vertical Lift applications. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	2.929	2.602

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AJ1 / *Future UAS Engine Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ1: *Future UAS Engine Advanced Technology*	-	0.000	1.730	2.827	-	2.827	4.420	4.508	4.513	4.558	0.000	22.556

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A (Aviation Advanced Technology) / 447 (ACFT Demo Engines)

A. Mission Description and Budget Item Justification

This Project provides full system demonstration of a JP8-fueled, reliable, fuel-efficient and high power-to-weight engine concept for Future Unmanned Aircraft Systems (FUAS).

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Reliable Advanced Small Power Systems	-	1.730	2.827
Description: This effort demonstrates adaptive and intelligent engine technologies to provide improved / mission- optimized performance, readiness, and affordability across an expanding engine envelope for increased operational capability for group 3 and 4 FUAS platforms.			
FY 2020 Plans: Reliable Advanced Small Power System component fabrication and component validation testing will be completed and engine testing will be initiated.			
FY 2021 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ1 / *Future UAS Engine Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will perform Reliable Advanced Small Power System engine design optimization. Will complete fabrication and integration of engine components, hardware and assembly for engine test. Engine test metrics will include Horsepower to Weight ratio, Specific Fuel Consumption and Noise Signature. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	1.730	2.827

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AJ3 / *Next Generation Rotorcraft Transmission Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ3: *Next Generation Rotorcraft Transmission Adv Tech*	-	0.000	1.098	1.393	-	1.393	1.421	4.289	4.337	4.337	0.000	16.875

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology, Project:
* 313 Adv Rotarywing Veh Tech

A. Mission Description and Budget Item Justification

This Project develops and ground demonstrates variable-speed transmission technologies that can be matured and integrated into the development of Future Vertical Lift (FVL) platforms.

Work in this Project is fully coordinated with PE 0602148A (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 2019	FY 2020	FY 2021
Title: Next Generation Rotorcraft Transmission	-	1.098	1.393
Description: This effort demonstrates advanced rotorcraft drive technologies with the potential to increase the horsepower-to-weight ratio; reduce drive system noise; reduce production, operating and support costs; and provide automatic component impending-failure detection. The drive system demonstrators for this effort will be applicable to Future Vertical Lift (FVL) platforms.			
FY 2020 Plans: Variable speed transmission hardware fabrication and full scale transmission stand testing will be completed. Integration into ground test aircraft will be initiated.			
FY 2021 Plans: Variable speed transmission and controls will be integrated into an iron-bird ground test facility. The integrated system will go through endurance testing to demonstrate functionality and reliability consistent with project goals.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ3 / *Next Generation Rotorcraft Transmission Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	1.098	1.393

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army											Date: February 2020	
Appropriation/Budget Activity 2040 / 3					R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*				Project (Number/Name) AJ5 / *Digital Vehicle Management & Control Advanced Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2019**	**FY 2020**	**FY 2021 Base**	**FY 2021 OCO**	**FY 2021 Total**	**FY 2022**	**FY 2023**	**FY 2024**	**FY 2025**	**Cost To Complete**	**Total Cost**
AJ5: *Digital Vehicle Management & Control Advanced Tech*	-	0.000	1.153	6.761	-	6.761	6.897	8.034	9.112	9.113	0.000	41.070

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology, Project:
* 313 Adv Rotarywing Veh Tech

A. Mission Description and Budget Item Justification

This Project designs, integrates, and demonstrates Future Vertical Lift (FVL) flight control and Vehicle Management Systems (VMS) technologies. Technologies demonstrated include: advanced flight control laws and autonomy; automatic reconfiguration for speed/damage; coupled cockpit symbology and haptic cueing; and handling qualities requirements for new platform concepts. Develops and demonstrates structures technologies and mission-adaptive autonomy and control algorithms that provide level 1 handling qualities, resilience to extreme and hostile environments, damage-mitigation by reconfiguration of redundant controls, increased agility and speed with minimal fatigue, increased payload and weight efficiency, optional pilotage and manned-unmanned teaming capabilities, cognitive off-loading, and reduction of structural maintenance burden.

Work in this Project is fully coordinated with Program Element (PE) 0602148A (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 2019	FY 2020	FY 2021
Title: Digital Vehicle Management and Control	-	1.153	-
Description: This effort demonstrates integrated Future Vertical Lift (FVL) capable flight controls and advanced sensors to satisfy future capability needs to fly in any visual environment, adapt to degradation and damage to complete the mission and support autonomous operations and manned-unmanned teaming (MUM-T). Technologies demonstrated include: advanced flight control laws and autonomy; automatic reconfiguration for speed/damage; coupled cockpit symbology and haptic cueing; and handling qualities requirements for new platform concepts.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ5 / *Digital Vehicle Management & Control Advanced Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will complete North Atlantic Treaty Organization (NATO) working group research on rotorcraft simulation modeling fidelity assessment and improvement and publish lessons learned. Will develop unmanned FVL handling quality testing methods and requirements for flying in mission-relevant turbulent environments; Will validate and publish new response types for high-speed and mission task elements for a FVL design standard. Will analyze Joint Multi-Role Technology Demonstrator (JMR-TD) handling qualities flight test results for validation of simulation models and inclusion of new JMR-relevant requirements in a FVL design standard. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 to the Adaptive and Resilient Tactical Autonomy, Controls, and Structures (ARTACS) Adv Tech effort in this Project.			
Title: Adaptive and Resilient Tactical Autonomy, Controls, and Structures (ARTACS) Adv Tech ***Description:*** Develop, integrate, and demonstrate autonomy, controls, and advanced structures technologies to ensure mission success for manned/unmanned, multiple capability set FVL platforms in the contested environment of multi-domain operations. ***FY 2021 Plans:*** Will develop, integrate, and demonstrate autonomy, structures, and controls technologies that enable multi-domain operations performance, efficiency, and versatility, and enhance extreme environment reliability and availability. Will conduct trade studies to optimize the synergy of applicable technologies that will include weight-optimized, fatigue-tolerant, multifunctional, structural configurations, advanced modeling techniques for Future Vertical Lift platforms, advanced flight controls for configurations with redundant effectors at high speed, and state-of-the-art algorithms for autonomy, optional pilotage, and teaming. Will complete the development of the Rotorcraft Aircrew Systems Concept Airborne Laboratory (RASCAL) Version 2.0 in-flight laboratory to enable demonstration of relevant technologies in load alleviation, component life extension, damage tolerance, advanced flight controls, autonomy, optional pilotage, manned/unmanned teaming, and air-launched effects. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from 0603465A (Future Vertical Lift Advanced Technology) / AM3 (Aircraft and Aircrew Protection), and the Digital Vehicle Management and Control effort in this Project.	-	-	6.761
Accomplishments/Planned Programs Subtotals	-	1.153	6.761

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ5 / *Digital Vehicle Management & Control Advanced Tech*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AJ7 / *Advanced Rotors Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ7: *Advanced Rotors Advanced Technology*	-	0.000	2.500	2.498	-	2.498	2.508	2.558	2.575	2.601	0.000	15.240

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology, Project:
* 313 Adv Rotarywing Veh Tech

A. Mission Description and Budget Item Justification

This Project demonstrates and integrates new technologies that enable global and highly efficient/reliable operations for Future Vertical Lift (FVL) aircraft and Future Unmanned Aircraft Systems (FUAS) throughout the flight envelope.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Advanced Rotors Technology	-	2.500	2.498
Description: This effort demonstrates full scale, integrated rotor system technologies through the assessment of alternative designs aimed to satisfy future capability needs for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) increased system durability, efficiency, speed, range, and payload. Technologies include: integrated high speed, low drag rotor technologies for high speed configurations; interactional aero tailoring between rotor and body & auxiliary lift/ propulsors; light weight, low volume, efficient and high authority electro- mechanical actuators (EMAs); reliable and safety critical actuators/hubs/ controls for Independent Blade Control (IBC)/swash plateless rotors; damage compensation/load alleviation; active/passive flow control; and automated track and balance.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ7 / *Advanced Rotors Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will conduct advanced low drag rotor wind tunnel testing. Will conduct individual blade control actuator testing. Will conduct design and testing of robust, efficient UAS rotors and propulsion systems for FUAS platforms. ***FY 2021 Plans:*** Will conduct detailed design of high speed, highly efficient rotor system for FUAS platforms. Will complete component technology bench testing. Will conduct planning for fabrication of demonstration hardware. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	2.500	2.498

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AJ9 / *Integ Mission Equip for Vert Lift Systems Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AJ9: *Integ Mission Equip for Vert Lift Systems Adv Tech*	-	0.000	15.820	22.381	-	22.381	24.360	25.996	21.569	21.787	0.000	131.913

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology
* Project 313 Adv Rotarywing Veh Tech

A. Mission Description and Budget Item Justification

This Project develops and demonstrates a mission systems architecture to support Future Vertical Lift (FVL) through utilization of a reconfigurable and flexible tiered architectural approach.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Integrated Mission Equipment for Vertical Lift Systems	-	15.820	22.381
Description: Develops and demonstrates a mission systems architecture to support Future Vertical Lift (FVL) through utilization of a reconfigurable and flexible tiered architectural approach. The approach will consist of the following: Maturing and implementing Model Based Engineering methods and Modular Open Systems Architecture strategies; instantiating an architecture verification environment and developing an agile and resilient digital backbone to support the rapidly changing threat environment including the digital battleground.			
FY 2020 Plans: Publish baseline requirements for both a representative mission package and instrumented architecture laboratory. Document detailed design of the Architecture Verification Environment (AVE). Instantiate initial AVE capabilities which will include architecture requirements validation processes, methods and tools for validating Future Attack Reconnaissance Aircraft (FARA)			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AJ9 / *Integ Mission Equip for Vert Lift Systems Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
and Future Long Range Assault Aircraft (FLRAA) architecture requirements. Establish AVE experimental framework to collect the body of knowledge necessary to effectively verify architecture implementations against specifications. Conduct initial development and testing of the IME software infrastructure to support representative mission packages. Document the Digital Backbone (DBB) specification for power, mechanical, thermal, hardware, software and data. Publish specific guidance documentation to assist the Government and Industry partners in the development of open architecture capabilities. Create a model based specification for documentation of the flying testbed mission system. ***FY 2021 Plans:*** Will develop the initial verification process and conduct experiments for the Architecture Verification Environment (AVE). Will complete mechanization of the AVE validation process to achieve TRL 5 and will use to validate FVL architecture for the Future Long Range Assault Aircraft (FLRAA) Mid-Tier Acquisition Request for Proposal and Contract Award. Will begin laboratory testing of digital backbone candidate technologies, testing core software infrastructure in a laboratory, continuing safety accreditation process of infrastructure, and beginning acquisition of core mission capabilities. Will complete Mission System Flying Testbed (FTB) requirements and design, identifying initial demonstration mission systems, acquiring FTB components and beginning aircraft modifications. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The funding increase is required to begin laboratory testing of candidate digital backbone technologies, and acquisition of core FTB components.			
Accomplishments/Planned Programs Subtotals	-	15.820	22.381

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AK3 / *Aviation Survivability Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK3: *Aviation Survivability Advanced Technology*	-	0.000	20.836	11.370	-	11.370	15.806	20.243	20.701	20.703	0.000	109.659

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology, Project:
* 313 Adv Rotarywing Veh Tech
PE 0603270A Electronic Warfare Technology, Project:
* K16 Non-Commo Ecm Tech Dem
PE 0603710A Night Vision Advanced Technology, Project:
* K86 Night Vision, Abn Sys

A. Mission Description and Budget Item Justification

This Project matures and demonstrates increased Future Vertical Lift (FVL) survivability through the integration and demonstration of technologies that reduce platform signatures, improve threat warning and countermeasures against integrated networked air and ground threat systems. Also matures and demonstrates UAS survivability technologies to enable manned/unmanned team based approaches to enable operation in contested peer/near peer environments
Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Survivability Against Integrated Networked Threats	-	4.802	3.720
Description: This effort increases rotorcraft survivability by reducing platform signatures, providing the means to more efficiently counter enemy detection and tracking systems			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK3 / *Aviation Survivability Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will mature and demonstrate Aircraft Survivability Correlator algorithms. Will improve and validate own-ship and team based survivability behaviors. Will mature and demonstrate holistic survivability technologies to enhanced FVL survivability. ***FY 2021 Plans:*** Will continue the development and refinement of Aircraft Survivability Correlator algorithms. Will develop and refine own-ship and team-based survivability behaviors. Will integrate holistic technologies to enhance Future Vertical Lift survivability. Will integrate components in preparation for System Integration Laboratory experimentations. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Title: Digital Dual Use Sensors (DDUS) ***Description:*** This effort will mature and demonstrate dual band infrared sensor technologies to enable future multi-function sensing concepts suitable for both manned and unmanned aviation platforms. Effort will combine recent advances in digital readout technologies and large (megapixel) infrared detector fabrication to develop a dual band infrared proof-of-principle demonstrator and assess the feasibility of the sensor to support both pilotage and aircraft survivability functions. ***FY 2020 Plans:*** Will mature sensor optics; will complete fabrication of focal plane array (FPA) packages into cooled assemblies. Will integrate components into proof-of principle camera system; will demonstrate camera systems in laboratory and airborne field environments; will validate sensor to enable both pilotage and aircraft survivability functions. Will complete final technical report capturing lessons learned and recommendations. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This Effort ends in FY 2020.	-	9.500	-
Title: Multispectral Threat Detection and Countermeasure Technologies ***Description:*** This effort matures and demonstrates countermeasure technologies that provide platform protection and integrated cueing against electro-optical (EO), infrared (IR) and radio frequency (RF) guided threats. ***FY 2020 Plans:*** Will continue sensor system development and perform unit testing on sensor components; will document and publish sensor component and subsystem performance results; will collect and analyze clutter and threat data in a relevant environment with sensor subsystem and incorporate that data into modeling and simulation infrastructure; will perform an assessment of the sensor subsystem architectural approaches and the viability of each approach to operate against unknown/unexploited and emerging threats; will demonstrate agile radio frequency (RF) components in a relevant environment and assess the viability of meeting RF	-	6.534	-

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK3 / *Aviation Survivability Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
countermeasure requirements using those components; will characterize RF components and produce models for modeling and simulation integration. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 to the efforts Cognitive Countermeasures Maturation and Demonstration, and EW Air Sensors / CM efforts within this same Project to better address technological challenges.			
Title: Cognitive Countermeasures Maturation and Demonstration ***Description:*** This effort matures and demonstrates adaptive countermeasure technologies that provide platform protection against guided threats. It provides countermeasure electronics for adaptive decision making and countermeasure components that enable systems to counter the characteristics of agile threats. ***FY 2021 Plans:*** Will mature electronic countermeasure module and measure initial performance; will demonstrate countermeasure components to detect, identify, and locate threats; will mature supporting RF electronics and components for electronic countermeasure demonstration. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from the Multispectral Threat Detection and Countermeasure Technologies effort in this Project.	-	-	2.000
Title: EW Air Sensors / CM ***Description:*** This effort matures and demonstrates sensor and countermeasure technologies that provide platform protection and integrated cueing against advanced and emerging threats to aviation platforms. It provides advanced sensors and effectors capable of detecting and responding to threats with diverse signatures. ***FY 2021 Plans:*** Will mature hardware and supporting components for demonstration; will complete proof-of-concept hardware; will perform data collection with hardware to verify functionality. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from the Multispectral Threat Detection and Countermeasure Technologies effort in this Project.	-	-	4.606
Title: UAS Survivability Demonstration ***Description:*** UAS Survivability Technology (UST) addresses the evolving threat environment to support the Maneuver Force within the Multi-Domain Battle concept. UST will develop and demonstrate increased UAS Survivability in a peer / near-peer	-	-	1.044

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK3 / *Aviation Survivability Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
environment with minimal impacts to aircraft performance. This work supports Future Vertical Lift and Advanced Unmanned Aircraft Systems. ***FY 2021 Plans:*** Will develop UAS Survivability behaviors and mission profiles. Will develop UAS susceptibility and electromagnetic vulnerability reduction technologies. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding realigned in FY21 from PE 0602148A (Future Vertical Lift Technology) / AK1 (UAS Survivability Technology).			
Accomplishments/Planned Programs Subtotals	-	20.836	11.370

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AK5 / *Multi-Role Small Guided Missile Advanced Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK5: *Multi-Role Small Guided Missile Advanced Tech*	-	0.000	2.426	2.997	-	2.997	10.406	26.621	24.524	24.651	0.000	91.625

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603313A Missile and Rocket Advanced Technology, Project:
* 704 Advanced Missile Demo

A. Mission Description and Budget Item Justification

This Project matures and demonstrates a holistic lethality solution for current Army Aviation and Future Vertical Lift (FVL) Modernization Priority. This effort matures and demonstrates critical technology and designs component for future affordable rockets and missiles to provide overwhelming defeat of conventional and asymmetrical threats in all environments. Matures and demonstrates component technologies to enable an expeditionary short-to-medium range loitering missile with man-in-the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets.

Work in this Project is fully coordinated with PE 0602148A (Future Vertical Lift 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 2019	FY 2020	FY 2021
Title: Modular Missile Advanced Technology	-	2.426	-
Description: This effort matures and demonstrates armament solutions adaptable to current aviation and Future Vertical Lift (FVL) applications in small caliber, medium caliber, counter measure technologies with a focus on light lethal aerodynamic systems.			
FY 2020 Plans: Will complete the integration of modular missile technology subsystems into the guided forward firing missile configuration and perform laboratory testing and simulation evaluations. Will demonstrate in a ground-launched flight test series, which includes			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK5 / *Multi-Role Small Guided Missile Advanced Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
guidance and control performance of the guided forward firing missile configuration, payload, guidance electronics unit, control actuation subsystem, propulsion subsystem and subsystem interface bus. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort ends in FY20 as planned.			
Title: Single Multi-Mission Attack Missile ***Description:*** Matures and demonstrates component technologies for an expeditionary short-to- medium range loitering missile with man-in- the-loop capability for situational awareness, targeting, and lethal effects against hard and soft targets. ***FY 2021 Plans:*** Will demonstrate component technologies in a surrogate flight testbed; will evaluate performance of datalink, navigation, fire control, and warhead hardware and software in representative flight environment. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from PE 0603464A (Long Range Precision Fires Advanced Technology) / AH3 (Single Multi-mission Attack Missile Adv Tech).	-	-	2.997
Accomplishments/Planned Programs Subtotals	-	2.426	2.997

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AK7 / *Adv Rotorcraft Armaments Protection Sys Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK7: *Adv Rotorcraft Armaments Protection Sys Adv Tech*	-	0.000	3.139	6.344	-	6.344	10.671	9.361	2.997	0.000	0.000	32.512

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603004A (Weapons and Munitions Advanced Technology) / 232 (Advanced Lethality & Survivability Demo)

A. Mission Description and Budget Item Justification

This Project investigates and demonstrates a holistic lethality solution for Future Vertical Lift (FVL) offensive and defensive applications, focused on but not limited to Future Attack Reconnaissance Aircraft. Develop 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 0602148A (Future Vertical Lift 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 2019	FY 2020	FY 2021
Title: Aviation Armament System Technologies	-	3.139	-
Description: This effort matures and demonstrates armament solutions adaptable to current aviation and future vertical lift applications in small caliber, medium caliber, counter measure technologies with a focus on light lethal aerodynamic systems. ***FY 2020 Plans:*** Will improve performance of medium caliber ammunition in 20mm and 30mm for a multi-role armaments solution on the Future Vertical Lift aircraft system. Effort will optimize lightweight 20mm and 30mm munitions for air combat systems and provide multi-purpose fuze and warhead functionalities. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 to the efforts ARAPS-FARA and ARAPS-Dispenser in this Project.			
Title: ARAPS-FARA	-	-	5.744

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK7 / *Adv Rotorcraft Armaments Protection Sys Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Description: This effort matures and demonstrates a holistic medium caliber lethality solution for Future Vertical Lift offensive applications. Develops components for use in multi-role armament solutions for fire control, software, armament systems, and munitions. ***FY 2021 Plans:*** Will mature and demonstrate a 20mm medium caliber armament system for integration onto Future Vertical Lift. Will demonstrate a novel 20mm multi-purpose munition with advanced capabilities versus current air launched munitions. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from the Aviation Armament System Technologies effort in this Project.			
Title: ARAPS-Dispenser ***Description:*** This effort matures and demonstrates a component of the holistic survivability solution for Future Vertical Lift defensive applications. Develop components for use in multi-role countermeasure solutions for fire control, software, and countermeasure systems. ***FY 2021 Plans:*** Will mature a countermeasure dispenser solution that provides increased survivability for current and future aviation platforms. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 from the Aviation Armament System Technologies effort in this Project.	-	-	0.600
Accomplishments/Planned Programs Subtotals	-	3.139	6.344

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AK8 / *Air Launched Effects Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AK8: *Air Launched Effects Advanced Technology*	-	0.000	3.215	29.419	-	29.419	29.262	28.144	27.157	27.159	0.000	144.356

Note

This Project is not a new start in Fiscal Year (FY) 2020. In FY19, Program Element (PE) 0603465A (Future Vertical Lift Advanced Technology) / AK8 (Air Launched Effects Advanced Technology) was previously funded within PE 0603003A (Aviation Advanced Technology) / 313 (Adv Rotarywing Veh Tech).

A. Mission Description and Budget Item Justification

This project develops and demonstrates the ability to launch an Unmanned Aircraft System (UAS) from a manned or unmanned Future Vertical Lift (FVL) aircraft at tactical altitudes and to control the UAS from the cockpit or a crew station; and assesses the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios.

Work in this Project is fully coordinated with Program Element (PE) PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Air Launched Effects	-	3.215	29.419
Description: Develop and demonstrate the ability to launch a Future Unmanned Aircraft Systems (FUAS) from FVL platform at tactical altitudes, and to control the UAS from the cockpit or a crew station. Assess the enabled capabilities and determine their relevance to current Army Aviation engagement and survivability portfolios. These air-launched FUAS will employ a variety of non-lethal effects including: electronic attack, decoy, and communications relay.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AK8 / *Air Launched Effects Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will demonstrate the ability to launch a UAS from a manned rotorcraft at tactical altitudes, and to control the UAS from an onboard crew station; integrate reconnaissance, surveillance, targeting, and communications relay payloads into the UAS; evaluate the mission effectiveness of organic UAS assets in support of the manned aircraft?s mission. ***FY 2021 Plans:*** Will integrate mission payloads and behaviors into an air launched UAS and demonstrate reconnaissance, surveillance, electronic warfare, and decoy multi-domain operational concepts; demonstrate and evaluate modular open system architecture approaches for attainable air and ground launched unmanned air vehicles; assess mission effectiveness of individual and teamed organic UAS assets in support of the manned aircraft. Will develop and integrate advanced autonomy algorithms to decrease operator workload. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** FY21 funding increase is due to realignment of PE 0603465A (Future Vertical Lift Advanced Technology) / AI6 (Next Gen Tactical UAS TD) effort in accordance with FVL Cross Functional Team (CFT) guidance/re-prioritization.			
Accomplishments/Planned Programs Subtotals	-	3.215	29.419

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AL1 / *Adv Teaming for Tactical Aviation Oper Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL1: *Adv Teaming for Tactical Aviation Oper Adv Tech*	-	0.000	20.964	41.328	-	41.328	40.580	40.284	46.770	46.774	0.000	236.700

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology
* Project 436 Rotarywing MEP Integ
PE 0603710A Night Vision Advanced Technology
* Project K86 Night Vision, Abn Sys

A. Mission Description and Budget Item Justification

This Project develops, demonstrates and drafts frameworks for certifiable autonomy of teaming behaviors and autonomous decision making for Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platform formations in combined arms operations.

Work in this Project is fully coordinated with PE 0602148A (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 United States Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Advanced Teaming Demonstration	-	20.964	33.543
Description: Develop and demonstrate teaming behaviors and autonomous decision making for mixed FVL and FUAS platform formations in combined arms operations that are beyond Manned-Unmanned Teaming (MUM-T) technologies. Focus areas include: resilient autonomous algorithms; self-organizing unmanned formations; distributed command and control; and navigation. This effort will also demonstrate multi-platform distributed apertures of multispectral sensors for threat detection and awareness and improved reliability through adaptation in autonomous systems.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL1 / *Adv Teaming for Tactical Aviation Oper Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will mature and integrate advanced teaming technologies into mission systems packages for test and evaluation; simulate autonomous teaming behaviors and operations in foundational mission based vignettes; draft frameworks for certifiable autonomy. ***FY 2021 Plans:*** Will mature and demonstrate advanced teaming technologies focused on collaborative lethal attack in GPS denied conditions; integrate attack teaming hardware and software into mission systems packages for test and evaluation; simulate autonomous team attack behaviors in foundational mission based vignettes; and test and evaluate modular open systems based frameworks for certifiable team autonomy. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The funding increase is required to integrate hardware and software into mission systems packages for demonstration and evaluation of modular open systems based frameworks for team autonomy.			
Title: Sensors / Multi-Function Imagers for Future Aviation ***Description:*** Mature and demonstrate multi-function sensing system concepts suitable for both manned and unmanned aviation platforms. The goal is to enable tactical operations in complex environments (e.g. high threat, degraded visuals, and urban) while reducing system cost/complexity through the use of sensing modules suitable for multiple tactical applications. Effort includes system-level integration and demonstration of state-of-the-art digital readout (DROIC), dual band infrared imaging technology. ***FY 2021 Plans:*** Will optimize tactical packaging design for universal multispectral sensor modules leveraging state-of-the-art digital readout dual band infrared sensor technologies developed within the Digital Dual Use Sensors effort for demonstration of multifunction sensing concepts. Will demonstrate the suitability of the sensor module to support both pilotage and threat warning applications. Will optimize sensor placement locations for both the Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) variants of FVL based on currently available designs ***FY 2020 to FY 2021 Increase/Decrease Statement:*** FY21 funding increase required for maturation effort of sensors and electronics to meet Advanced Teaming for Tactical Aviation Operations? needs and is realigned from the Advanced Teaming Demonstration in this project.	-	-	7.785
Accomplishments/Planned Programs Subtotals	-	20.964	41.328

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL1 / *Adv Teaming for Tactical Aviation Oper Adv Tech*

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AL3 / *HPC for Rotorcraft Applications Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL3: *HPC for Rotorcraft Applications Adv Tech*	-	0.000	4.958	5.046	-	5.046	5.136	5.301	5.360	5.414	0.000	31.215

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0603734A (Military Engineering Advanced Technology) / T08 (Combat Eng Systems)

A. Mission Description and Budget Item Justification

This effort develops and demonstrates the use of high-fidelity computational fluid dynamics for Future Vertical Lift platforms through the utilization of DoD High-Performance Computing (HPC) and software tools for cutting-edge modeling and simulation, as well as adding software capabilities for workflow automation and design space exploration. Efforts in this project are also applicable to the family of Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platforms.

Work in this Project is fully coordinated with Program Element (PE) PE 0602148A (Future Vertical Lift 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 is performed by the United States (US) Army Engineer Research and Development Center and coordinated with US Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Engineered Resilient Systems for Future Vertical Lift	-	4.958	-
Description: This effort matures and demonstrates capabilities (tools and methodologies) to rapidly create high-fidelity computational modeling to support the simulation of system performance for different Army missions in various geographic settings worldwide; provide input to and obtain output from combat simulations for different echelons pertaining to system performance; and conduct system trades that consider system performance in different operational environments and mission contexts. This effort focuses on Future Vertical Lift and Next Generation Tactical Unmanned Aircraft System platforms.			
FY 2020 Plans: Support Future Vertical Lift through the advancement of workflow automation processes for rotorcraft platforms; integrate mission effectiveness into the resulting trade spaces; will leverage emerging data analytics techniques and machine learning algorithms			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL3 / *HPC for Rotorcraft Applications Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
to optimize insight prior to acquisition decision points; and mature novel methodologies that incorporate the use of high-fidelity, physics-based simulations to enable multi-disciplinary design and optimization. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort ends in FY20 and is realigned to Engineered Resilient Systems (ERS) Capabilities for Army Aviation within this Project.			
Title: Engineered Resilient Systems (ERS) for Army Aviation ***Description:*** This effort supports Future Vertical Lift by exploiting advancements in physics-based software tools to provide rapid engineering analysis of proposed rotorcraft platforms, providing high-fidelity computational modeling of candidate Future Attack Reconnaissance Aircraft (FARA) platforms during the FARA down-selection, increasing the speed of simulations by automating simulation setup and execution on DoD HPC systems, and maturing and demonstrating the use of advanced machine learning techniques for aviation datasets to inform both the development of FVL systems and current operations. ***FY 2021 Plans:*** Will optimize the execution of high-fidelity computational modeling of candidate Future Attack Reconnaissance Aircraft (FARA) platforms during the next phase of FARA down-selection. Will improve the engineering analysis of FARA systems through the inclusion of mission effectiveness modeling and increased simulation fidelity. Will demonstrate the use of physics-informed machine learning techniques to increase the accuracy of design software for future FVL lines of effort. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding for this effort realigned within the scope of this project in FY21 from Engineered Resilient Systems for Future Vertical Lift effort within this Project.	-	-	5.046
Accomplishments/Planned Programs Subtotals	-	4.958	5.046

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AL6 / *Degraded Vis Environ Mitigation (DVE-M) Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL6: *Degraded Vis Environ Mitigation (DVE-M) Adv Tech*	-	0.000	29.151	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	29.151

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology:
* Project 313 Adv Rotarywing Veh Tech
PE 0603710A Night Vision Advanced Technology
* Project K86 Night Vision, Abn Sys

In Fiscal Year 2021 (FY21) this Project is eliminated.

A. Mission Description and Budget Item Justification

This Project develops, matures, and demonstrates advanced sensors, cueing, and flight controls to provide the ability to maintain terrain and obstacle situational awareness during all Degraded Visual Environment Mitigation (DVE-M) environments on current Army Aviation and Future Vertical Lift (FVL) platforms. The program provides an opportunity for DoD, North Atlantic Treaty Organization (NATO) nations, global industry, and academia to participate with their own assets in order to foster information exchange and collaboration.

Work in this Project is fully coordinated with PE 0602148A (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 U.S. Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Degraded Visual Environment Mitigation (DVE-M)	-	16.855	-
Description: Develop and mature advanced sensor cueing and flight controls to provide ability to maintain terrain and obstacle situational awareness during all DVEs both aircraft induced (brown-out & white-out) and environmentally induced (fog, rain, snow etc.). Flight testing on fleet aircraft is an integral component of the demonstration.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL6 / *Degraded Vis Environ Mitigation (DVE-M) Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will develop and demonstrate integrated cutting-edge sensors, advanced flight controls, and refined cueing schemes to provide the ability to maintain terrain and obstacle situational awareness during Degraded Visual Environments (DVEs) such as aircraft-induced (brown-out & white-out) and environmentally-induced (fog, rain, snow etc.). Will flight test a mission adaptive autonomy system adapted for use on a partial-authority helicopter. Efforts include flight trials in various climates and environments which also presents an opportunity for DoD, North Atlantic Treaty Organization (NATO) nations, industry, and academia to participate with their own assets to foster information exchange and collaboration. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort ends in FY20.			
Title: Sensors for DVE-M ***Description:*** This effort will mature and demonstrate combinations of sensors (radar and infrared) and sensor fusion technologies to assess their degree of effectiveness to improve safety of flight under degraded visual conditions. Effort includes development of 3 dimensional (3D) local area maps derived/refined by data from onboard sensors. 3D maps will be utilized to generate two dimensional (2D) views of the environment for presentation to pilots/crew and also support demonstration of autonomous behaviors including flight guidance and safe landing zone determination. Effort will result in an improved understanding of the complex sensor/fusion trade space to improve development of requirements and acquisition strategies for Future Vertical Lift (FVL) and the current fleet. ***FY 2020 Plans:*** Will complete initial flight testing and optimize DVE sensor subsystem; will integrate sensor subsystem with cueing and flight guidance/control subsystems onto single testbed aircraft. Will demonstrate combined DVE system in three DVEs. Will complete final technical report capturing lessons learned and recommendations. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort ends in FY20.	-	12.296	-
Accomplishments/Planned Programs Subtotals	-	29.151	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AL7 / *Full Spectrum Targeting Advanced Technology*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL7: *Full Spectrum Targeting Advanced Technology*	-	0.000	5.425	9.907	-	9.907	10.115	10.317	10.432	10.537	0.000	56.733

Note

In Fiscal Year 2020 (FY20) this Project was realigned from:
Program Element (PE) 0603710A Night Vision Advanced Technology
* Project K86 Night Vision, Abn Sys

A. Mission Description and Budget Item Justification

This Project demonstrates next generation targeting concepts for Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) platforms.

Work in this Project is fully coordinated with PE 0602148A (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.

All FY20 adjustments align program financial structure to Army Modernization Priorities in support of the National Defense Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Full Spectrum Targeting	-	5.425	9.907
Description: This effort will mature and demonstrate key targeting sensor system and automation (i.e. Artificial Intelligence / Machine Learning (AI/ML)) technologies essential to enable the Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) modernization priorities. Effort will leverage advancements in laser, infrared imaging focal plane arrays, and multi/ hyperspectral system technologies to develop a stabilized, turreted payload that can actively and/or passively image in multiple spectral bands simultaneously providing robust targeting and situational awareness capabilities for the prevailing battlefield conditions. Effort will demonstrate the ability of multi/hyperspectral sensing to autonomously identify tactical threats and reduce cognitive workloads through sensor fusion and automated spectral selection.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL7 / *Full Spectrum Targeting Advanced Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will mature laser imaging and automation components; will collect broadband and multi / hyperspectral data and optimize for increased automation; will complete initial payload design consistent with FVL size, weight, and power constraints. ***FY 2021 Plans:*** Will exploit broadband and multi/hyperspectral data from prior year collection to mature and demonstrate novel automated processing approaches for target detection, recognition, and identification. Will validate performance of broadband and multi/ hyperspectral automated processing algorithms. Will complete initial data processing architecture design and demonstrate functionality and performance. Will optimize and complete packaging of a high performance dual band megapixel infrared imaging sensor for the integrated targeting system demonstrator. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** The funding increase is required for demonstration of novel automated processing approaches for target detection, recognition and identification.			
Accomplishments/Planned Programs Subtotals	-	5.425	9.907

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AL9 / *Holistic Sit Awareness and Dec Making Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AL9: *Holistic Sit Awareness and Dec Making Adv Tech*	-	0.000	0.000	4.995	-	4.995	17.783	31.670	19.908	20.108	0.000	94.464

Note

This project transitions technologies from 0601248A AL8 Holistic Situational Awareness and Decision Making Technology project for further maturation and demonstration.

A. Mission Description and Budget Item Justification

This Project focuses on the development and demonstration of a pilotage and decision aiding system that allows for care free operations in complex and hostile environments through: demonstration of a comprehensive human machine interface for all SA domains (terrain & obstacles, threat, weather, & environment); and demonstration of decision aiding technologies to reduce cognitive loading of air crews during operations in complex and hostile environments.

Work in this Project is fully coordinated with Program Element (PE) PE 0602148A (Future Vertical Lift 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 (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Holistic Situational Awareness and Decision Making	-	-	4.995
Description: This program directly contributes to Future Vertical Lift (FVL) to ensure Future Aircraft pilots have the necessary situational awareness, accurate understanding of the tactical mission, and ability to decide faster than our adversaries.			
FY 2021 Plans: Will demonstrate the decision-aiding algorithms, next-generation crew stations, and architectures needed to operate in complex and high-threat environments. Will demonstrate how these systems effectively enable pilots to understand, process, and decide on the various information sources such as: threat awareness, manned-unmanned teaming with Unmanned Aircraft Systems (UAS), management of aviation survivability equipment, weapons targeting/handover, pilotage and navigation, operation in degraded visual environments, aircraft system management, GPS-denied operations, air-launched effects, blue force tracking, and communications.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AL9 / *Holistic Sit Awareness and Dec Making Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Planned technology transitions from 0601248A (Future Vertical Lift Technology) Project AL8 (Holistic Situational Awareness and Decision Making Technology).			
Accomplishments/Planned Programs Subtotals	-	-	4.995

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AM3 / *Aircraft and Aircrew Protection Advanced Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AM3: *Aircraft and Aircrew Protection Advanced Tech*	-	0.000	4.548	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	4.548

Note

In Fiscal Year 2020 (FY20) this Project is realigned from:
Program Element (PE) 0603003A Aviation Advanced Technology:
* Project 313 Adv Rotarywing Veh Tech

In Fiscal Year 2021 (FY21) this Project is realigned to:
PE 0603465A Future Vertical Lift Advanced Technology
* Project AJ5 Digital Vehicle Management & Control Advanced Tech)

A. Mission Description and Budget Item Justification

This Project demonstrates integrated, scalable, and structural platform solutions for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) platforms that improves crashworthiness, damage tolerance, sustainment, survivability and break-through weight efficiency while maintaining mission performance requirements.

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Aircraft and Aircrew Protection	-	4.548	-
Description: Demonstrate integrated, scalable, and structural platform solutions for Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) platforms that improves crashworthiness, damage tolerance, sustainment, survivability and break-through weight efficiency while maintaining mission performance requirements.			
FY 2020 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AM3 / *Aircraft and Aircrew Protection Advanced Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Will mature and demonstrate integrated, advanced structural assemblies that enable FVL and FUAS platform improved crashworthiness, damage tolerance, weight efficiency, sustainment, and survivability. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** This effort is realigned in FY21 to the PE 0603465A (Future Vertical Lift Advanced Technology) Project AJ5 (Digital Vehicle Management & Control Advanced Tech).			
Accomplishments/Planned Programs Subtotals	-	4.548	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) AM5 / *Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
AM5: *Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech*	-	0.000	0.000	1.998	-	1.998	3.537	5.348	5.391	5.391	0.000	21.665

Note

This project matures technologies transitioned from Program Element (PE) 0602148A
* Project AM4 Opt Energy Stg & Therm Mgmt for FVL Survivability.

A. Mission Description and Budget Item Justification

This Project develops and demonstrates at the system level, integrated power technologies (including power generation, distribution, and control along with advanced energy storage) and thermal management technologies to provide significantly higher electrical power capability to Future Vertical Lift (FVL) aircraft while addressing consequential size, weight, pulsed power, and thermal issues. Provides power capability for advanced electric aeromechanical effectors, advanced mission systems algorithms for route planning and teaming, and for advanced survivability and electronic warfare capability.

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

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 (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Optimized Energy for C5ISR Platforms Advanced Technology	-	-	1.998
Description: Enable advanced survivability systems on FVL platforms through component development improved high power and energy storage technologies, higher capacity lower Size, Weight, and Power (SWaP) cooling systems, and more efficient electrical architectures.			
FY 2021 Plans: Will improve management strategies for loads based on SWaP requirements and aircraft platform constraints which include architectures and intelligent control variants. Will mature the high resolution characterization of cyclical, step, and high power load profiles that are generated by lasers and other high power, short duration burst technology to demonstrate modular energy storage technology needed to support the loads. Will optimize thermal management technologies to mitigate waste heat			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** AM5 / *Opt Energy Stg & Therm Mgmt for FVL Surv Adv Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
generated from inefficiencies in power conversion. Will demonstrate hybrid energy storage technologies to support cyclic loads such as hybrid batteries or ultra-capacitor technology. Will mature intelligent controls for platform-integrated power systems. ***FY 2020 to FY 2021 Increase/Decrease Statement:*** Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	-	1.998

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) BP8 / *Future Vertical Lift Air Platform Adv Tech (CA)*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
BP8: *Future Vertical Lift Air Platform Adv Tech (CA)*	-	0.000	35.000	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	35.000

Note

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

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Future Vertical Lift Air Platform Advanced 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 2019	FY 2020
Congressional Add: Joint Tactical Aerial Resupply Vehicle	-	6.000
FY 2020 Plans: Joint Tactical Aerial Resupply Vehicle		
Congressional Add: Advanced Helicopter Seating System	-	5.000
FY 2020 Plans: Advanced Helicopter Seating System		
Congressional Add: Adhesive Technology	-	3.000
FY 2020 Plans: Adhesive Technology		
Congressional Add: Helicopter Emergency Oil Systems	-	2.000
FY 2020 Plans: Helicopter Emergency Oil Systems		
Congressional Add: UAV Fuel Systems Enhancements	-	2.000
FY 2020 Plans: UAV Fuel Systems Enhancements		
Congressional Add: Surface Tolerant Advanced Adhesives	-	5.000
FY 2020 Plans: Surface Tolerant Advanced Adhesives		
Congressional Add: Ferrium Steels for Improved Drive Systems	-	4.000
FY 2020 Plans: Ferrium Steels for Improved Drive Systems		
Congressional Add: Stretch Broken Composite Material Forms	-	8.000

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** BP8 / *Future Vertical Lift Air Platform Adv Tech (CA)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020
FY 2020 Plans: Stretch Broken Composite Material Forms		
Congressional Adds Subtotals	-	35.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) CA8 / *Adv Rotocraft Armaments Protection Sys*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CA8: *Adv Rotocraft Armaments Protection Sys*	-	0.000	0.000	0.999	-	0.999	1.249	2.797	9.298	12.296	0.000	26.639

Note

In Fiscal Year 2021 (FY21), this Project was realigned from:
Program Element (PE) 0603465A Future Vertical Lift Advanced Technology
* Project AK7 Adv Rotorcraft Armaments Protection Sys
* Project AK6 Adv Rotorcraft Armaments Protection Sys

A. Mission Description and Budget Item Justification

This Project investigates and demonstrates a holistic lethality solution for Future Vertical Lift (FVL) offensive and defensive applications, focused on but not limited to Future Long Range Assault Aircraft (FLRAA). Develop 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 0602148A (Future Vertical Lift 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 Army Futures Command (AFC).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Advanced Rotorcraft Armanents Protection System-Future Long Range Assault Aircraft	-	-	0.999
Description: This effort matures and demonstrates a holistic small caliber lethality solution for FVL offensive applications. Integrates and demonstrates components for use in multi-role armament solutions for fire control, software, and armament systems.			
FY 2021 Plans: Will mature a small caliber remote weapon system for integration on FVL. Will demonstrate the increased capability of a remotely operated, stabilized armament system versus current aviation armament solutions.			
FY 2020 to FY 2021 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** CA8 / *Adv Rotocraft Armaments Protection Sys*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Funding change reflects planned lifecycle of this effort.			
Accomplishments/Planned Programs Subtotals	-	-	0.999

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020
Appropriation/Budget Activity 2040 / 3	R-1 Program Element (Number/Name) PE 0603465A / *Future Vertical Lift Advanced Technology*	Project (Number/Name) CC4 / *FVL Radar Advanced Technologies*	

COST ($ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
CC4: *FVL Radar Advanced Technologies*	-	0.000	0.000	3.329	-	3.329	4.164	4.960	5.157	5.157	0.000	22.767

Note

In Fiscal Year 2021 (FY21) this Project was realigned from:
Program Element PE 0603772A / Advanced Tactical Computer Science and Sensor Technology
* Project 234 Sensors And Signals Processing

A. Mission Description and Budget Item Justification

This Project develops Next Generation Reconfigurable Radar Aperture for detection, tracking and precision targeting, navigation and fire control for both reconnaissance, surveillance, and target acquisition (RSTA) and intelligence, surveillance and reconnaissance (ISR).

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

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 effort is performed by the United States (US) Army Futures Command.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2019	FY 2020	FY 2021
Title: Multi-mission Airborne Radar	-	-	3.329
Description: Advanced Digital radio frequency (RF) processing integration with final demonstration subsystem and system level radar hardware and software designs.			
FY 2021 Plans: Will analyze radar modes and operations and conduct detailed system design review. Will perform full processing chain modeling and simulation to validate the models. Will optimize wide-band tuning applications for RF systems and exercise third party implementation through multi-function demonstrations.			
FY 2020 to FY 2021 Increase/Decrease Statement: In FY21, funding realigned from PE 0603772A / Advanced Tactical Computer Science and Sensor Technology, project 243 Sensors And Signals Processing.			
Accomplishments/Planned Programs Subtotals	-	-	3.329

Exhibit R-2A, RDT&E Project Justification: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 3	**R-1 Program Element (Number/Name)** PE 0603465A / *Future Vertical Lift Advanced Technology*	**Project (Number/Name)** CC4 / *FVL Radar Advanced Technologies*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A