Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
Total Program Element	-	0.000	0.000	93.601	-	93.601	88.903	88.170	89.971	91.056	0.000	451.701
AI5: *Next Gen Tactical UAS TD Technology*	-	0.000	0.000	9.242	-	9.242	7.577	7.668	8.233	8.340	0.000	41.060
AI7: *Alternative Concept Engine Technology*	-	0.000	0.000	3.657	-	3.657	3.730	3.805	3.881	3.925	0.000	18.998
AI9: *Future UAS Engine Technology*	-	0.000	0.000	2.888	-	2.888	3.054	3.227	3.372	3.487	0.000	16.028
AJ2: *Next Generation Rotorcraft Transmission Technology*	-	0.000	0.000	4.045	-	4.045	4.126	4.209	4.293	4.341	0.000	21.014
AJ4: *Digital Vehicle Management and Control Technology*	-	0.000	0.000	4.816	-	4.816	4.912	5.010	5.110	5.167	0.000	25.015
AJ6: *Advanced Rotors Technology*	-	0.000	0.000	2.362	-	2.362	2.422	2.480	2.532	2.535	0.000	12.331
AJ8: *Experimental and Computational Aeromechanics Techn*	-	0.000	0.000	5.185	-	5.185	5.274	6.217	6.456	6.631	0.000	29.763
AK1: *UAS Survivability Technology*	-	0.000	0.000	1.000	-	1.000	1.050	5.125	6.729	6.686	0.000	20.590
AK2: *Aviation Survivability Technology*	-	0.000	0.000	21.792	-	21.792	21.253	22.134	22.566	22.819	0.000	110.564
AK4: *Multi-Role Small Guided Missile Technology*	-	0.000	0.000	6.104	-	6.104	4.500	1.800	0.000	0.000	0.000	12.404
AK6: *Advanced Rotorcraft Armaments Protection System Te*	-	0.000	0.000	5.313	-	5.313	3.419	0.000	0.000	0.000	0.000	8.732
AK9: *Adv Teaming for Tactical Aviation Operations Tech*	-	0.000	0.000	13.583	-	13.583	13.777	12.427	12.450	12.615	0.000	64.852

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army													Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*								
AL2: *High Performance Computing for Rotorcraft App Tech*	-	0.000	0.000	1.169	-	1.169	1.192	1.216	1.240	1.254	0.000	6.071
AL4: *High Speed and Efficient VTOL Vehicle Technology*	-	0.000	0.000	1.500	-	1.500	1.500	1.500	1.530	1.547	0.000	7.577
AL5: *Air Vehicle Structures and Dynamics Technology*	-	0.000	0.000	2.766	-	2.766	2.827	2.890	2.948	2.981	0.000	14.412
AL8: *Holistic Situational Awareness and Dec Making Tech*	-	0.000	0.000	1.745	-	1.745	1.785	1.821	1.857	1.879	0.000	9.087
AM2: *Aircraft and Aircrew Protection Technology*	-	0.000	0.000	1.522	-	1.522	1.552	1.583	1.615	1.633	0.000	7.905
AM4: *Opt Energy Stg & Therm Mgmt for FVL Survivability*	-	0.000	0.000	4.912	-	4.912	4.953	5.058	5.159	5.216	0.000	25.298

Note

In Fiscal Year (FY) 2020, this Program Element (PE) is realigned with continuity of effort from the following PEs:
* PE 0602120A Sensors and Electronic Survivability
* PE 0602211A Aviation Technology
* PE 0602270A Electronic Warfare Technology
* PE 0602303A Missile Technology
* PE 0602624A Weapons and Munitions Technology
* PE 0602705A Electronics and Electronic Devices
* PE 0602709A Night Vision Technology

A. Mission Description and Budget Item Justification

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

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Army	Date: March 2019
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*

The cited work is consistent with the Under Secretary of Defense for Research and Engineering S&T focus areas and the Army Modernization Strategy. Work in this PE is performed by the United States Army Futures Command (AFC) and the Army Engineering Research and Development Center (ERDC).

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

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	0.000	0.000	0.000	-	0.000
Current President's Budget	0.000	0.000	93.601	-	93.601
Total Adjustments	0.000	0.000	93.601	-	93.601
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	93.601	-	93.601

Change Summary Explanation

The FY20 funding increase is related to the Science and Technology financial restructuring.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AI5 / *Next Gen Tactical UAS TD Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AI5: *Next Gen Tactical UAS TD Technology*	-	0.000	0.000	9.242	-	9.242	7.577	7.668	8.233	8.340	0.000	41.060

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

This Project utilizes improved computer modeling fidelity to investigate the effects that potential Future Unmanned Aircraft System (FUAS) capabilities could have on air vehicle design considerations and operational concepts. This project improves government capability to design and assess novel Unmanned Aircraft System (UAS) concepts.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Next Gen Tactical Unmanned Aircraft System Technology Demonstrator Technology	-	-	9.242
Description: Investigates and models operational concepts to understand the effects that potential FUAS capabilities will have on air vehicle properties			
FY 2020 Plans: Will continue to investigate the effects that potential FUAS capabilities might have on air vehicle design considerations such as size, system performance, survivability/vulnerability, reliability, maintainability, unit cost, and operations and sustainment (O&S) cost. Will assess potential designs to support the following operational concepts: resupply, reconnaissance, surveillance, electronic warfare, protection, medical evacuation and attack. Will explore integration of mission equipment and determine critical enabling technologies to support the potential FUAS conceptual designs.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AI5 / *Next Gen Tactical UAS TD Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	9.242

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AI7 / *Alternative Concept Engine Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AI7: *Alternative Concept Engine Technology*	-	0.000	0.000	3.657	-	3.657	3.730	3.805	3.881	3.925	0.000	18.998

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Alternative Concept Engine Technology	-	-	3.657
Description: Design and evaluate advanced turboshaft engine component technologies to support goals of reduced fuel consumption, engine size, weight, and cost, as well as improved reliability and maintainability. ***FY 2020 Plans:*** Alternative concept engine component development will be completed by validating compressor, combustor and turbine technology. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	3.657

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AI7 / *Alternative Concept Engine Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AI9 / *Future UAS Engine Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AI9: *Future UAS Engine Technology*	-	0.000	0.000	2.888	-	2.888	3.054	3.227	3.372	3.487	0.000	16.028

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47B Veh Prop & Struct Tech

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Multi-fuel Capable Hybrid Electric Propulsion	-	-	2.888
Description: Applied research to enable intelligent and robust propulsion performance and noise signature reduction via multi-fuel and optimized hybrid electric capability for small engines (20kW to 150kW) powering future Aircraft systems. The research focuses on the establishment of concepts to enable reduced fuel consumption, engine size, weight, and cost as well as improved group 3 and 4 FUAS reliability, survivability, and maintainability. ***FY 2020 Plans:*** Will establish research in assisted ignition technology and explore methodologies for robust combustion control. Will initiate research in hybrid-electric component optimization, thermal management analysis, advanced radial turbomachinery assessment, and additive-manufacturing for turbomachinery and high-temperature reaction chamber components. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47B (Veh Prop & Struct Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	2.888

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AI9 / *Future UAS Engine Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AJ2 / *Next Generation Rotorcraft Transmission Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AJ2: *Next Generation Rotorcraft Transmission Technology*	-	0.000	0.000	4.045	-	4.045	4.126	4.209	4.293	4.341	0.000	21.014

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Next Generation Rotorcraft Transmission Technology	-	-	4.045
Description: Design and evaluate advanced drive system component technologies to support Variable multi-speed (50-100%) and 60:1 ratio in two stage transmissions, lighter weight gearboxes, while doubling current transmission life cycles and improving platform reliability and maintainability.			
FY 2020 Plans: Will investigate innovative methods to achieve variable speed such as elliptical drive technologies. Variable speed component fabrication and testing will be completed. This effort will inform a full transmission demonstrator for FVL.			
FY 2019 to FY 2020 Increase/Decrease Statement: This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	4.045

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ2 / *Next Generation Rotorcraft Transmission Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AJ4 / *Digital Vehicle Management and Control Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AJ4: *Digital Vehicle Management and Control Technology*	-	0.000	0.000	4.816	-	4.816	4.912	5.010	5.110	5.167	0.000	25.015

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

This Project investigates potential manned Future Vertical Lift (FVL) and Future Unmanned Aircraft System (FUAS) fly-by-wire & fly-by-light rotor/flight control and autonomy for active rotor and compound concepts.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Digital Vehicle Management & Control Technology	-	-	4.816
Description: Investigate manned and unmanned advanced rotor/flight control concepts and vehicle management technologies focused on advanced aircraft configurations and complex missions. This effort will develop handling qualities requirements, mature simulation and optimization methods, and support goals of improved robustness, reduced weight, and collaborative teaming of FVL and 3rd generation FUAS platforms.			
FY 2020 Plans: Will complete fabrication of hardware components and will complete development of software for a new Research Flight Control Computer Assembly and associated Test Bench and Ground Test Unit. Will begin installation and testing of this new hardware into the Rotorcraft Aircrew Concept Airborne Laboratory (RASCAL) development facility and into the RASCAL test aircraft.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ4 / *Digital Vehicle Management and Control Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in Fy20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	4.816

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AJ6 / *Advanced Rotors Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AJ6: *Advanced Rotors Technology*	-	0.000	0.000	2.362	-	2.362	2.422	2.480	2.532	2.535	0.000	12.331

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Advanced Rotors Technology	-	-	2.362
Description: Investigate advanced rotor blade and hub technologies to support goals of increased speed and reduced drag by developing low weight rotors and hub configurations that increase hover and cruise efficiency. ***FY 2020 Plans:*** Will conduct design trades studies and technology bench tests to start technology down-selection for integrated high speed, highly efficient rotor system. Will commence conceptual design studies of the rotor system. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	2.362

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ6 / *Advanced Rotors Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AJ8 / *Experimental and Computational Aeromechanics Techn*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AJ8: *Experimental and Computational Aeromechanics Techn*	-	0.000	0.000	5.185	-	5.185	5.274	6.217	6.456	6.631	0.000	29.763

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Experimental Aeromechanics for FVL	-	-	3.037
Description: Develop and explore new methods to simulate aerodynamic effects for future FVL configurations. ***FY 2020 Plans:*** Will continue experimental investigation of interactional aerodynamic phenomena affecting the flow field and performance of winged-compound configurations; will conduct experimental efforts aimed at extending the state of the art for flow measurement & diagnostics techniques such as blade deformation measurement using digital image correlation, wake flow field measurements using particle image velocimetry, and laminar-to-turbulent transition measurement using pioneering infra-red thermography techniques. Will examine interactional aerodynamic effects on of multi-rotor configurations. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in Fy20 as part of the financial restructuring.			
Title: Computational Aeromechanics for FVL	-	-	2.148

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AJ8 / *Experimental and Computational Aeromechanics Techn*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: Investigate experimental aeromechanics technologies and test methods for FVL. ***FY 2020 Plans:*** Will automate the computational workflows and problem setup for high-fidelity computations that simulate the aerodynamics and structural dynamics of future vertical lift systems. Will adapt high-fidelity computational simulations to improve accuracy and optimize their computational efficiency on new and emerging high-performance computer architectures. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This work was previously performed in PE 0602211A Aviation Technology / Project 47A AERON & ACFT Wpns Tech.			
Accomplishments/Planned Programs Subtotals	-	-	5.185

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK1 / *UAS Survivability Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AK1: *UAS Survivability Technology*	-	0.000	0.000	1.000	-	1.000	1.050	5.125	6.729	6.686	0.000	20.590

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: UAS Survivability	-	-	1.000
Description: Investigate innovative methods to design FUAS with tailored signature management and enhanced survivability.			
FY 2020 Plans: Will perform trade studies for identification of FUAS specific susceptibility and vulnerability attributes. Will develop tailored signature management for FUAS applications missions; survivability-enhanced mission profiles; team-based survivability behaviors; and electronic warfare-resilient systems and architectures.			
FY 2019 to FY 2020 Increase/Decrease Statement: This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.000

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK1 / *UAS Survivability Technology*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK2 / *Aviation Survivability Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AK2: *Aviation Survivability Technology*	-	0.000	0.000	21.792	-	21.792	21.253	22.134	22.566	22.819	0.000	110.564

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE0 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech
PE 0602270A Electronic Warfare Technology
* Project 906 Tactical Electronic Warfare Applied Research
PE 0602624A Weapons and Munitions Technology
* Project H28 Warheads/Energetics Technology
PE 0602705A Electronics and Electronic Devices
* Project H94 Elec & Electronic Dev
PE 0602709A Night Vision Technology
* Project H95 Night Vision and Electro-Optic Technology

A. Mission Description and Budget Item Justification

This Project investigates advanced technologies to reduce Future Vertical Lift (FVL) platform susceptibility and vulnerability to damage from guided and unguided threats, as well as technologies to defeat small arms, rocket and missile threats.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Signature Reduction for Advanced Threat	-	-	4.085
Description: Investigate advanced technologies to reduce susceptibility and vulnerability of aircraft to damage from threats or accidents, as well as technologies to defeat small arms, rocket, and missile threats. ***FY 2020 Plans:*** Will complete an adaptive Infrared (IR) engine suppression system for FVL aircraft in an engine test cell to evaluate engine and IR suppression performance. Will develop signature management technologies. Will complete evaluation of holistic survivability			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
technology solutions through integrated survivability assessment trade studies for FVL concept aircraft. Will complete the development of modeling and simulation tools to support survivability analysis against advanced threat systems. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Title: Cognitive Countermeasures Technology Development ***Description:*** This effort investigates and matures novel materials, components, and techniques to counter legacy and emerging threats to FVL platforms. Emphasis will be placed on technologies and approaches to enable a robust, holistic countermeasure capability for target defeat, regardless of threat characteristics or guidance mode. ***FY 2020 Plans:*** Will investigate spectral and temporal radio frequency (RF) signatures associated with legacy and emerging threats, then will develop detection and identification algorithms based on the threat signatures; will investigate ultra-short pulse laser (USPL) detector photo bleaching phenomena and characterize fundamental temporal limits and necessary radiation requirements to produce saturation effects; will investigate novel rare earth-doped low-phonon laser materials; and will design and develop an in-band Midwave Infrared (MWIR) short-pulse laser source with surrogate-diode pumping to be used for direct defeat of unknown future threats. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602705A (Electronics and Electronic Devices) / Project H94 (Elec & Electronic Dev) in Fy20 as part of the financial restructuring.	-	-	2.000
Title: Reconfigurable Transformational Optics/Task based Display ***Description:*** This effort will deliver reconfigurable micro- and nano-scale filtering devices enabling frequency agile multi-task sensors. This will permit enhanced survivability of the FVL platforms with restored visual overmatch in any (day/night) environment. This will allow visual penetration of natural obscurants (e.g. brownout, white out) or custom man-made obscurants (e.g. engineered smokescreens) from a single sensor, as well as narrowband filtering for active imaging through obscurants. Improved detection and identification capability will result from filtering out scattered light and enabling 3-dimensional ranging through environmental obscurants. Wavelength agile imaging systems will be delivered that are capable of penetrating and imaging through a variety of obscurants and that are compatible with the FVL platforms. ***FY 2020 Plans:***	-	-	6.153

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Will investigate tunable filter designs in the midwave and longwave infrared for simultaneous on/off filter switching between broad and narrow bands, and tunability of the filter center wavelength; will validate selected filter designs maintain sufficient throughput. Will model and measure pulsed infrared laser illumination and ranging sources that will be incorporated into filter designs. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602709A (Night Vision Technology) / Project H95 (Night Vision and Electro-Optic Technology) in FY20 as part of the financial restructuring..			
Title: Multispectral Threat Warning and Countermeasures ***Description:*** This effort investigates and evaluates software and warning sensor/counter measure components to increase probability to detect and defeat current and evolving small arms and man-portable air defense system (MANPADS) type threats for FVL platforms using modeling and simulation (M&S) and hardware in the loop (HWIL) simulations. ***FY 2020 Plans:*** Will investigate tunable filter designs in the midwave and longwave infrared for simultaneous on/off filter switching between broad and narrow bands, and tunability of the filter center wavelength; will validate selected filter designs maintain sufficient throughput. Will model and measure pulsed infrared laser illumination and ranging sources that will be incorporated into filter designs. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602270A (Electronic Warfare Technology) / Project 906 (Tactical Electronic Warfare Applied Research) in FY20 as part of the financial restructuring.	-	-	7.054
Title: Tunable Pyrotechnics Technologies ***Description:*** Develop and investigate technologies for nano, reactive, and advanced/novel materials and energetic manufacturing processes to enable, customize and ?tune? a family of Countermeasure Decoys for FVL platforms. ***FY 2020 Plans:*** Will develop component technologies for the Dazzler Counter Measure to include new pyrotechnic formulations; will develop and modify Advanced Sensor Counter Measure (ASCM) formulations based on static and functional tests to assess viability of technology candidates; will investigate new counter measure designs in the electromagnetic (EM) spectrum to address emerging threats to the FVL platforms. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602624A (Weapons and Munitions Technology) / Project H28 (Warheads/Energetics Technology) in FY20 as part of the financial restructuring.	-	-	2.500
Accomplishments/Planned Programs Subtotals	-	-	21.792

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK2 / *Aviation Survivability Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK4 / *Multi-Role Small Guided Missile Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AK4: *Multi-Role Small Guided Missile Technology*	-	0.000	0.000	6.104	-	6.104	4.500	1.800	0.000	0.000	0.000	12.404

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602303A Missile Technology
* Project 214 Missile Technology.

A. Mission Description and Budget Item Justification

The Project investigates, designs and evaluates modular missile component technologies compatible with Future Vertical Lift (FVL) and Future Unmanned Aircraft Systems (FUAS) aviation platforms in a Multi-Domain Battle/Cross-domain Maneuver operational environment.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Modular Missile Technology	-	-	1.704
Description: Evaluate critical technology and designs components compatible with Manned and Unmanned Aviation environments to provide scalable and tailorable improved lethality. Provides open architecture external and internal interfaces. ***FY 2020 Plans:*** Will mature and validate modular missile technology subsystems and open system architecture and verify subsystem performance for the forward firing variant in bench-level and laboratory environments. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602303A (Missile Technology) / Project 214 (Missile Technology) in FY20 as part of the financial restructuring.			
Title: Multi-Role Guided Missile - Extended Range Technology	-	-	4.400
Description: Design and evaluate critical technologies that provide aviation and ground launched 35+km Non-Line of Sight man-in-the-loop situational awareness and targeting loiter capability; lethal effects against hard armor; and other high-value targets;			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK4 / *Multi-Role Small Guided Missile Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
and maneuverable precision strike missile systems that are effective in a Multi-Domain Battle/Cross-domain Maneuver operational environment. ***FY 2020 Plans:*** Will investigate missile system level and aviation platform interface requirements and conduct trade studies. Determine missile FVL and FUAS design architecture to include integration of Single Multi-Mission Attack Missile (SMAM) critical components matured under FY20 PE 0603464A (Long Range Precision Fires Advanced Technology / Project AH3 (Single Multi-mission Attack Missile Adv Tech). ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602303A (Missile Technology) / Project 214 (Missile Technology) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	6.104

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AK6 / *Advanced Rotorcraft Armaments Protection System Te*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AK6: *Advanced Rotorcraft Armaments Protection System Te*	-	0.000	0.000	5.313	-	5.313	3.419	0.000	0.000	0.000	0.000	8.732

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602624A Weapons and Munitions Technology
* Project H18 Weapons & Munitions Technologies.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Advanced Rotorcraft Armament & Protection System (ARAPS)	-	-	5.313
Description: The ARAPS effort designs and develops FVL technologies for lightweight armament systems and multi-role munitions with enhanced lethality at extended ranges. The effort investigates and determines the feasibility of a holistic fire control system that integrates all aspects of offensive and defensive capabilities for advanced protection and enhanced survivability.			
FY 2020 Plans: Will investigate integrated armament and advanced protection designs for FVL offensive and defensive applications; will design critical component technologies in order to develop advanced lethality and survivability capabilities in fire control, weapon systems, munitions and countermeasures; will investigate system architecture solutions for an integrated armament and advanced protection system.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK6 / *Advanced Rotorcraft Armaments Protection System Te*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602624A (Weapons and Munitions Technology) / Project H18 (Weapons & Munitions Technologies) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	5.313

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AK9 / *Adv Teaming for Tactical Aviation Operations Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AK9: *Adv Teaming for Tactical Aviation Operations Tech*	-	0.000	0.000	13.583	-	13.583	13.777	12.427	12.450	12.615	0.000	64.852

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A AERON & ACFT Wpns Tech
* Project 47B Veh Prop & Struct Tech

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Advanced Teaming Concepts	-	-	9.776
Description: Investigates and develops subsystem and component level technologies that enable advanced manned and unmanned teaming behaviors for mixed air and ground platform formations in combined arms operations. ***FY 2020 Plans:*** Will develop and refine subsystem and component level technologies that enable autonomous manned and unmanned teaming and decision making, including autonomous terrain and collision avoidance, and advanced human autonomy interface designs; adapt and tailor simulation models for technology integration and evaluation. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Title: Micro/Small Scale Unmanned Aerial Systems	-	-	3.807

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AK9 / *Adv Teaming for Tactical Aviation Operations Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: Enables micro/small Future Unmanned Aircraft System (FUAS) concepts for experimental prototypes to discover behaviors that can be scaled up to group 3 platforms to support advanced manned and unmanned air and ground teaming, and the maturation of basic research in the area of intelligent unmanned air systems. This includes controls that can adapt to damage or environmental conditions, models to perform aggressive maneuver in complex environments, reduction of noise signature, and adaptive structures. ***FY 2020 Plans:*** Will establish novel control schemes that will enable small unmanned aircraft systems to perform aggressive and energy aware maneuver through complex environments. Will incorporate higher fidelity methods into computationally efficient physics based modeling tools to enhance the design and maneuverability of novel FUAS concepts; this includes the establishment of an acoustics prediction module to enable the design of FUAS with reduced noise signature. Will perform applied research on novel platform concepts to enhance speed, endurance, payload capability, and adaptability. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47B (Veh Prop & Struct Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	13.583

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL2 / *High Performance Computing for Rotorcraft App Tech*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AL2: *High Performance Computing for Rotorcraft App Tech*	-	0.000	0.000	1.169	-	1.169	1.192	1.216	1.240	1.254	0.000	6.071

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A AERON & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: High Performance Computing for Rotorcraft App Tech	-	-	1.169
Description: Investigate new high performance and parallel computing efforts in support of FVL platforms. ***FY 2020 Plans:*** Will investigate accurate, efficient, easy-to-use, and validated aeromechanics modeling and simulation tools based on computational fluid and structural dynamics on high-performance parallel computers. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.169

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL2 / *High Performance Computing for Rotorcraft App Tech*

C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army											Date: March 2019	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*				Project (Number/Name) AL4 / *High Speed and Efficient VTOL Vehicle Technology*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
AL4: *High Speed and Efficient VTOL Vehicle Technology*	-	0.000	0.000	1.500	-	1.500	1.500	1.500	1.530	1.547	0.000	7.577

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47B Veh Prop & Struct Tech.

A. Mission Description and Budget Item Justification

This Project investigates and performs computer modeling of propulsion, aeromechanics, and platform technologies to meet performance capabilities required by Future Vertical Lift (FVL) platforms.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: High Speed & Efficient Vertical Take-off and Landing	-	-	1.500
Description: This research effort establishes concepts in vertical take-off and landing in the area of propulsion to enable improved, efficient hover and high-speed cruise at longer range without added weight. ***FY 2020 Plans:*** Will conduct research on technologies that will reduce peak transient loads in multi-speed rotorcraft transmission, and perform material modeling of dissimilar materials for hybrid gear technology. Will mature dynamic finite-element/contact analysis modeling for mechanical failure analysis for variable speed transmission and high-temperature material and design component optimization for higher power density. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47B (Veh Prop & Struct Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.500

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL4 / *High Speed and Efficient VTOL Vehicle Technology*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AL5 / *Air Vehicle Structures and Dynamics Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AL5: *Air Vehicle Structures and Dynamics Technology*	-	0.000	0.000	2.766	-	2.766	2.827	2.890	2.948	2.981	0.000	14.412

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47B Veh Prop & Struct Tech).

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Air Vehicle Structures and Dynamics Technology	-	-	1.766
Description: Establish improved experimentally validated modeling tools and methodologies that can be used to understand the physics of aeroelastic stability and design in next generation rotorcraft platform configurations for FVL platforms. This involves the development of an experimental capability, the Tiltrotor Aeroelastic Stability Test-bed (TRAST), which would be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort mitigates risk for the Joint Multi-Role Technology Demonstrator (JMR-TD) effort and informs FVL requirement definition and technology maturation. The experimentally validated models will also be used to investigate concepts to reduce the vibration and improve stability of future aircraft.			
FY 2020 Plans: Will evaluate the accuracy of current computational tools for the tilt-rotor configuration. Will complete the fabrication, acceptance tests, and initial wind tunnel test of TRAST, which will be used to generate novel wind tunnel experimental data to validate and refine the analytical modeling tools.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL5 / *Air Vehicle Structures and Dynamics Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47B (Veh Prop & Struct Tech) in FY20 as part of the financial restructuring.			
Title: Probabilistic and Damage Tolerance Methodologies ***Description:*** Advancement of probabilistic analytical algorithms and methods to enable air platform performance and availability. Probabilistic analytical methodologies resulting from this effort are expected to impact a broad range of air structure vehicle and dynamic technologies including enhanced damage tolerance. ***FY 2020 Plans:*** Will advance probabilistic analytics through exploitation of artificial intelligence and machine learning algorithms. Methods matured through this work will provide fundamental understanding for enhanced durability for next generation vertical lift manned and unmanned aircraft. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47B (Veh Prop & Struct Tech) in FY20 as part of the financial restructuring.	-	-	1.000
Accomplishments/Planned Programs Subtotals	-	-	2.766

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AL8 / *Holistic Situational Awareness and Dec Making Tech*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AL8: *Holistic Situational Awareness and Dec Making Tech*	-	0.000	0.000	1.745	-	1.745	1.785	1.821	1.857	1.879	0.000	9.087

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602120A Sensors and Electronic Survivability
* Project H16 S3I Technology
PE 0602705A Electronics and Electronic Devices
* Project H94 Elec & Electronic Dev

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Radar Sensing and Phenomenology	-	-	1.745
Description: This effort develops the technical underpinnings of radar and other active and passive radio frequency (RF) sensing modalities for several key Army requirements. Focus in on cost effective radar concepts to enhance the situational awareness and navigation capabilities of United States Army rotorcraft, allowing safe operation in Degraded Visual Environment (DVE). This research uses a combination of advanced computational electromagnetic models and algorithms, radar measurements, active and passive RF sensing technologies, and advanced signal processing.			
FY 2020 Plans: Will investigate novel forward looking synthetic aperture radar (FLSAR) concept for DVE using high fidelity electromagnetic radar signature models and verify with proof-of-concept laboratory measurements. Will explore techniques and algorithms to extend			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AL8 / *Holistic Situational Awareness and Dec Making Tech*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
the capability of rotorcraft collision avoidance radars to a hostile fire detection mode of operation and will investigate alternative architectures and modes of operation for FLSAR for imaging landing zones and targeting in DVE. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602120A (Sensors and Electronic Survivability) / Project H16 (S3I Technology) and PE 0602705A (Electronics and Electronic Devices) / Project H94 (Elec & Electronic Dev) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.745

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AM2 / *Aircraft and Aircrew Protection Technology*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AM2: *Aircraft and Aircrew Protection Technology*	-	0.000	0.000	1.522	-	1.522	1.552	1.583	1.615	1.633	0.000	7.905

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602211A Aviation Technology
* Project 47A Aeron & ACFT Wpns Tech.

A. Mission Description and Budget Item Justification

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

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Aircraft & Aircrew Protection	-	-	1.522
Description: Enables survivable, sustainable rotorcraft configurations by conceiving of and evaluating critical aviation technologies using design and analysis methods with greater modeling fidelity with an ultimate goal of reducing the timelines associated with overall design of FVL and FUAS platforms. Introduces high fidelity methodology for improved performance and design predictions earlier in the development and acquisition process. Use physics of failure modeling and coupled discipline analysis to drastically improve component and system reliability.			
FY 2020 Plans: Will develop more accurate analytical prediction of rotorcraft internal structural loads resulting from external air loads, and light-weight biology-inspired structural concepts enabling on-the-fly configuration adaptation for near-optimal performance and protection across various flight conditions.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AM2 / *Aircraft and Aircrew Protection Technology*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
This research effort was realigned from PE 0602211A (Aviation Technology) / Project 47A (AERON & ACFT Wpns Tech) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	1.522

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army			Date: March 2019
Appropriation/Budget Activity 2040 / 2	R-1 Program Element (Number/Name) PE 0602148A / *Future Verticle Lift Technology*	Project (Number/Name) AM4 / *Opt Energy Stg & Therm Mgmt for FVL Survivability*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
AM4: *Opt Energy Stg & Therm Mgmt for FVL Survivability*	-	0.000	0.000	4.912	-	4.912	4.953	5.058	5.159	5.216	0.000	25.298

Note

In Fiscal Year (FY) 2020 this Project was realigned from:
Program Element (PE) 0602705A Electronics and Electronic Devices
* Project H11 Tactical and Component Power Technology.

A. Mission Description and Budget Item Justification

This Project investigates emerging power generation, energy storage, and thermal management technologies needed for future Command, Control, Communications, computers, Intelligence, Surveillance and Reconnaissance (C4ISR) and survivability equipment that could be incorporated onto Future Vertical Lift (FVL) and other Army platforms.

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

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Optimized Energy for C4ISR Platforms	-	-	4.912
Description: This effort investigates power and thermal management associated with high power C4ISR capabilities on ground and air platforms enabling enhanced mobility and mission flexibility. This effort funds research to improve FVL aircraft and other Army platforms power efficiency through the use of on-demand hybrid power architectures, while also researching ways to eliminate platform thermal constraints. This effort will also investigate very high density power sources and energy storage for high rate pulsed power, power management, and thermal management for dynamic high rate pulsed power.			
FY 2020 Plans: Will investigate power requirements for emerging C4ISR capabilities to include directed energy, lasers, high power sensors, and electromagnetic weapons. Will develop models based on size, weight, and power requirements and aircraft platform constraints which include architectures and intelligent control variants to manage these loads. Will analyze the high resolution characterization of cyclical, step and high power load profiles likely to result from use of lasers or other high power, short duration burst technology to inform the modularization of the storage technology needed to support the loads. Will examine thermal implications of waste heat generated from inefficiencies in power conversation and its impact on the aircraft. Will conduct experiments on hybrid energy			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Army		Date: March 2019
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602148A / *Future Verticle Lift Technology*	**Project (Number/Name)** AM4 / *Opt Energy Stg & Therm Mgmt for FVL Survivability*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
storage technologies to support cyclical loads such as hybrid batteries or ultra-capacitor technology. Will define models for the use of intelligent control strategies for platform integrated power systems. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** This research effort was realigned from PE 0602705A (Electronics and Electronic Devices) / Project H11 (Tactical and Component Power Technology) in FY20 as part of the financial restructuring.			
Accomplishments/Planned Programs Subtotals	-	-	4.912

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A