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

<b>Appropriation/Budget Activity</b> 2040: Research, Development, Test & Evaluation, Army / BA 2: Applied Research	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
Total Program Element	-	6.356	41.588	48.163	-	48.163	42.393	46.675	45.428	45.899	0.000	276.502
CL5: Air Platform Enabling University Applied Research	-	0.673	0.905	0.526	-	0.526	0.957	1.291	1.293	1.307	0.000	6.952
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	3.801	4.168	4.249	-	4.249	4.378	4.383	4.386	4.435	0.000	29.800
CN1: Disruptive Countermeasure Concepts for Aviation	-	1.882	7.387	7.546	-	7.546	7.653	7.231	7.235	7.314	0.000	46.248
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	4.485	4.796	-	4.796	5.411	6.633	5.539	5.589	0.000	32.453
CU8: Structures Tech for Enduring Efficient Resilience	-	-	1.648	1.682	-	1.682	1.046	1.048	1.048	1.059	0.000	7.531
CU9: Systems Design Technology	-	-	3.109	3.135	-	3.135	3.026	5.227	5.335	5.394	0.000	25.226
CW3: Advanced Rotors Applied Technology	-	-	2.589	2.614	-	2.614	2.011	2.013	2.645	2.673	0.000	14.545
CW4: Air Vehicle Structures and Dynamics Tech	-	-	2.985	3.042	-	3.042	3.072	3.077	3.079	3.113	0.000	18.368
CW5: Experimental and Computational Aeromechanics Tech	-	-	6.600	6.835	-	6.835	6.904	6.913	6.917	6.993	0.000	41.162
CW6: Future UAS Propulsion Technology	-	-	3.414	3.560	-	3.560	3.595	3.598	3.601	3.640	0.000	21.408
CW7: High Speed and Efficient VTOL Vehicle Tech	-	-	1.549	1.580	-	1.580	1.580	1.582	1.584	1.601	0.000	9.476
CW8: Next Generation Aviation Transmission Apl Tech	-	-	1.482	1.511	-	1.511	1.454	2.371	1.457	1.458	0.000	9.733

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<b>Exhibit R-2, RDT&amp;E Budget Item Justification:</b> PB 2024 Army	<b>Date:</b> March 2023
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<b>Appropriation/Budget Activity</b>	<b>R-1 Program Element (Number/Name)</b>											
2040: <i>Research, Development, Test &amp; Evaluation, Army / BA 2: Applied Research</i>	PE 0602183A / Air Platform Applied Research											
DC2: <i>High Performance Computing for Rotorcraft Apl Tech</i>	-	-	1.267	1.293	-	1.293	1.306	1.308	1.309	1.323	0.000	7.806
DE2: <i>Airborne Threat Defeat</i>	-	-	-	5.794	-	5.794	-	-	-	-	0.000	5.794

**A. Mission Description and Budget Item Justification**

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

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

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

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

**B. Program Change Summary (\$ in Millions)**

	<b><u>FY 2022</u></b>	<b><u>FY 2023</u></b>	<b><u>FY 2024 Base</u></b>	<b><u>FY 2024 OCO</u></b>	<b><u>FY 2024 Total</u></b>
Previous President's Budget	6.597	41.588	41.582	-	41.582
Current President's Budget	6.356	41.588	48.163	-	48.163
Total Adjustments	-0.241	0.000	6.581	-	6.581
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.241	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	6.581	-	6.581

**Change Summary Explanation**

Increase funding to support new start effort in project DE2 (Airborne Threat Defeat) which will address the need to engage and disorient guided threats.

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CL5 / Air Platform Enabling University Applied Research			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CL5: Air Platform Enabling University Applied Research	-	0.673	0.905	0.526	-	0.526	0.957	1.291	1.293	1.307	0.000	6.952

**A. Mission Description and Budget Item Justification**

This Project focuses on applied research originating from extramural applied research in academia pertaining to navigation/routing, autonomous robotic vehicles, artificial intelligence and machine learning as applied to aerial mobility and maneuver, holistic survivability, teaming, integrated mission systems, air-launched effects, and other innovative air enabling applied research technologies that will accelerate the Army modernization in next generation aerial vehicles. This Project will perform discovery research efforts to focus more on mid to far-term Army modernization priorities while also maintaining delivery of near-term technologies fundamental to the modernization priorities. This Project conducts applied research and development leading to all the potential emerging technologies in areas of strategic importance to Army Aviation in artificial intelligence / machine learning (AI/ML), autonomous teaming systems, survivability, aeromechanics, advanced vertical take-off and landing (VTOL) design & concepts, flight dynamics, vibration & noise control, propulsion, human factor engineering and structures & materials, etc., by bringing competitively selected Universities with research and development teams into Technical Alliances. The Project will also continuously experiment with methods to identify, demonstrate and transition novel technology from entities that might not otherwise collaborate with the Department of Defense (DoD), with the end goal of accelerating the adoption of cutting-edge applied research technology for the warfighter in the Army aviation portfolio.

Work in this Project complements Program Element (PE) 0602148A (Future Vertical Lift Technology), PE 0603465A (Future Vertical Lift Advanced Technology Development), PE 0603043A (Air Platform Advanced Technology) and PE 0602144A (Ground Technology).

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> Advanced Teaming <b>Description:</b> Develop capabilities to self-organize and coordinate large teams of unmanned vehicles participating in long-term reconnaissance operation using distributed command/control architectures despite communication delays and/or failures and showcasing resilience to wide-area jamming.	0.321	-	-
<b>Title:</b> Coordinated Air-Ground Vehicle Maneuvering <b>Description:</b> Develop the technology for a fleet of ground and air vehicles to have the capabilities required to perform an autonomous reconnaissance mission in a relevant environment.	0.352	-	-
<b>Title:</b> Vertical Lift Applied Research	-	0.872	0.526

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CL5 / Air Platform Enabling University Applied Research

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p><b>Description:</b> Conduct applied research in academia to elevate Vertical Lift research and continue to investigate promising and emerging technologies</p> <p><b>FY 2023 Plans:</b> Will conduct applied research in emerging technologies in areas of autonomous teaming systems, survivability, aeromechanics, advanced VTOL design &amp; concepts, flight dynamics, vibration &amp; noise control, propulsion, human factor engineering and structures &amp; materials.</p> <p><b>FY 2024 Plans:</b> Will continue to conduct applied research in rotorcraft emerging technologies through autonomous teaming systems, aeromechanics, advanced VTOL design &amp; concepts, flight dynamics models to extend reach, and agility.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>			
<p><b>Title:</b> SBIR/STTR</p> <p><b>Description:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638</p>	-	0.033	-
<b>Accomplishments/Planned Programs Subtotals</b>	0.673	0.905	0.526

<p><b>C. Other Program Funding Summary (\$ in Millions)</b> N/A</p> <p><b>Remarks</b></p> <p><b>D. Acquisition Strategy</b> N/A</p>
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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CL8 / Aviation Teaming Autonomy Concepts & Technologies			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CL8: Aviation Teaming Autonomy Concepts & Technologies	-	3.801	4.168	4.249	-	4.249	4.378	4.383	4.386	4.435	0.000	29.800

**A. Mission Description and Budget Item Justification**

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

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

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> Intelligent Unmanned Aerial System Teaming Technologies	3.801	4.093	4.249
<p><b>Description:</b> Enables the establishment of component technologies to support resilient, multi-modal, survivable Unmanned Aircraft System (UAS) teams that can plan and act on time-scales beyond human capability and have a robust shared understanding of contested and dynamic environments to support effective tactical engagement. Specific topics include 1) novel artificial-intelligence algorithms and methods for adaptive team composition and control, 2) increased team knowledge base and understanding of local and global world models, 3) hierarchical, composable, and adaptive learning methods for increased mission resilience, and 4) understanding interaction and scalability between, amongst, and across heterogeneous team members and the environment.</p> <p><b>FY 2023 Plans:</b> Develop methods and technologies to enable teams of unmanned air vehicles to autonomously detect, identify, locate, and report radio frequency (RF) signals of opportunity; develop physics based models for Air-Launched Effects (ALE) simulation and advanced ALE/ Future Attack Reconnaissance Aircraft (FARA) teaming simulation; simulate ALE multi-agent tactics for RF homing and will assess multi-operator, multi-agent simulation with real human operators replacing simulated operators; investigate</p>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CL8 / Aviation Teaming Autonomy Concepts & Technologies

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p>algorithms for detection, localization, and navigation on a s-UAS; create control algorithms for high speed obstacle avoidance, GPS-denied localization, and cooperative tactical teaming behaviors; examine efficacy of wireless power transfer hardware and battery management electronics for s-UAS; determine power requirements for s-UAS and examine effects of platform design variables, control methodologies, and autonomous functions on performance; investigate s-UAS endurance with optimized mission planning logistics under fixed energy constraints.</p> <p><b>FY 2024 Plans:</b> Will develop multi-agent tactics for autonomous teams of unmanned air vehicles to autonomously detect, identify, locate, and report radio frequency (RF) signals of opportunity. Will develop multi-agent tactics, path planning, and controls for tethered UAS teams. Will develop multi-agent behaviors for executing cooperative localized tasks. Will implement machine learning on the battery management system to achieve improved performance over multiple charging/discharging cycles. Will investigate novel UAS vertical take-off and landing (VTOL) design for increased endurance and effects on optimization algorithms for mission planning under fixed energy constraints.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>			
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>Description:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638</p>	-	0.075	-
<b>Accomplishments/Planned Programs Subtotals</b>	3.801	4.168	4.249

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CN1 / Disruptive Countermeasure Concepts for Aviation			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CN1: <i>Disruptive Countermeasure Concepts for Aviation</i>	-	1.882	7.387	7.546	-	7.546	7.653	7.231	7.235	7.314	0.000	46.248

**A. Mission Description and Budget Item Justification**

This Project investigates advanced technologies to reduce Future Vertical Lift (FVL) platform susceptibility and vulnerability to damage from guided and unguided threats, as well as technologies to defeat small arms, rocket, and missile threats. This Project performs research and develops innovative detect and defeat technologies against next-generation threats to the FVL. Areas of research include new laser materials and designs for in-band, low size, weight, power, and cost (SWaP-C) precision laser soft-kill countermeasures operating in the mid- and long-wave infrared, lethality effects of ultrashort pulsed lasers, and sensitive radio frequency (SeRF) detection modality for use as aircraft survivability equipment (ASE). In addition, this Project will also perform research and development on the use of remotely-deployed, passive multi-modal sensors to localize threat ground vehicles and discriminate decoys.

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

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> Cognitive Countermeasures Technology Development	1.882	2.064	2.095
<b>Description:</b> 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.			
<b>FY 2023 Plans:</b>			
Investigate a range of rare earth-doped laser materials based on low-phonon hosts; conduct comprehensive spectroscopic research aiming at directly diode-pumped, in-band MWIR laser source; conduct laser material selection among the studied materials aimed at avoidance of two-photon pump absorption by hosts - thus ensuring laser device longevity for military use; investigate temperature dependence of device laser parameters aiming at drastic efficiency improvements; investigate USPL optical effects against realistic surrogate target system and validate sensor Disrupt/Damage/Defeat using non-optical USPL			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CN1 / Disruptive Countermeasure Concepts for Aviation

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p>effects; develop and validate sensor hardware with algorithms for detection of specific targets and perform breadboard validation and assessments against select targets.</p> <p><b>FY 2024 Plans:</b> Will investigate optimal approaches to multi-band sensitive radio frequency (SeRF) novel detection modalities and integrate multi-band components for system assessments. Will investigate the feasibility of realizing state-of-the-art Microelectromechanical (MEMS) Radio Frequency (RF) power and phase detection for augmented range and signals intelligence capabilities of related SeRF systems. Will design and develop optimized pulsed laser sources based on selected best Midwave Infrared (MWIR) approach. Will mature Q-switching and cooling design components. Will conduct experiments to identify best pathways toward pulsed Longwave Infrared (LWIR) sources. Will improve experimental techniques in LWIR region using Ultra-Short Pulse Lasers (USPL) to further study optical and non-optical RF effects.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>			
<p><b>Title:</b> Deep Autonomous Sensing</p> <p><b>Description:</b> This effort investigates the ability to localize and recognize the formation of threat ground vehicles deep in the battlefield in support of the FVL platform. Emphasis will be placed on developing novel, passive multi-modal sensors on aerial, ground, and re-locatable platforms to enable high fidelity, low false alarm target recognition and counter concealment and camouflage with decoy discrimination.</p> <p><b>FY 2023 Plans:</b> Generate processing and algorithms for layered hybrid networks of multi-modal, multi-component aerial and ground sensors that can autonomously deploy, localize, and track near-peer ground threat vehicles and explore techniques for discriminating decoys; develop low size, weight, and power (SWaP) electric- and magnetic-field, acoustic, seismic, and infrasonic sensing capabilities to capture target signatures insensitive to obscurant, camouflage, and jamming; explore sensor performance characteristics with metrics, fusing distributed data to enable efficient processing at the edge and information dissemination over low SWaP optical communication systems with the ability to operate in several data conditions including high rate burst; investigate technologies and capabilities for emplacement and retrieval of ground sensors in challenging operational environments such as rugged terrain or mega-cities. Advance approaches to remotely emplace sensors in optimal locations to maximize coverage and increase the likelihood of detection of threats and decoy discrimination.</p> <p><b>FY 2024 Plans:</b> Will conduct experiments to validate approaches to teaming between multi-modal ground-based sensor constellations with FVL airborne platforms (manned and/or unmanned) by integrating prototype sensor constellations with Army aviation prototype and surrogate platforms. Will investigate and conduct experiments with air-deployed sensor concepts and methodologies to</p>	-	5.278	5.451

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<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CN1 / Disruptive Countermeasure Concepts for Aviation		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
ensure low-cost mechanical designs. Will investigate and experiment with implementations of cost effective Position, Navigation, and Timing (PNT) techniques in the ground constellation of fixed and relocatable sensors in support of position and attitude determination for cost effective geolocation of threats. Will enhance methods of multi-modal sensor fusion, classification, and tracking of threat vehicles insensitive to obscurant, camouflage, and jamming.				
<b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.				
<b>Title:</b> SBIR/STTR Transfer				
<b>Description:</b> Funding transferred in accordance with Title 15 USC §638				
<b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638				
<b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638				
<b>Accomplishments/Planned Programs Subtotals</b>		-	0.045	-
		1.882	7.387	7.546
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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

<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CU7 / Control & Autonomy for Tactical Superiority Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU7: Control & Autonomy for Tactical Superiority Tech	-	-	4.485	4.796	-	4.796	5.411	6.633	5.539	5.589	0.000	32.453

**A. Mission Description and Budget Item Justification**

This Project will develop and flight-validate new approaches and tools applicable to advanced high-speed configurations being considered for Future Vertical Lift (FVL) and transition to industry to ensure that FVL aircraft meet Army requirements. Work in this Project may also address and be applied to the needs of other Army and specific Department of Defense (DoD) aviation systems.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2022	FY 2023	FY 2024
<p><b>Title:</b> Adaptive Tactical Autonomy and Control (ATAC) Tech</p> <p><b>Description:</b> Develop advanced vehicle management, flight control, and autonomy technologies that enable FVL aircraft to achieve superior maneuverability and agility at all speeds, effectively exploit extreme/degraded environmental conditions as a force multiplier, fight and win in presence of failure or damage, and operate on a cognitive-loading-spectrum from piloted to fully autonomous.</p> <p><b>FY 2023 Plans:</b> Collaborate with Original Equipment Manufacturers (OEMs) to use available flight data to compare, validate, and improve Future Attack Reconnaissance Aircraft (FARA) and Future Long-Range Assault Aircraft (FLRAA) models. Mature and evaluate, in piloted simulation, algorithms for automatic reallocation of redundant controls to compensate for failure or battle damage. Start enhancing Army-developed autonomy algorithms through the application of Machine Learning and Artificial Intelligence concepts.</p> <p><b>FY 2024 Plans:</b> Will develop flight control concepts that intelligently adjust aircraft response characteristics based on configuration, mission, and pilot input. Will mature concepts for transition of control between pilot and autonomous system and back to normalize pilots' utilization of autonomous functions. Will develop an architecture for the interface between autonomy algorithms and flight controls</p>	-	4.321	4.796

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CU7 / Control & Autonomy for Tactical Superiority Tech		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
for over-actuated FVL-relevant configurations that enable control re-allocation schemes developed to enhance survivability and damage tolerance to be extended to autonomous flight.  <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding increase in FY24 supports the development of metrics and performance requirements that guide the design and testing of autonomy algorithms.				
<b>Title:</b> SBIR/STTR Transfer  <b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638  <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638		-	0.164	-
<b>Accomplishments/Planned Programs Subtotals</b>		-	4.485	4.796
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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

<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CU8 / Structures Tech for Enduring Efficient Resilience
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU8: Structures Tech for Enduring Efficient Resilience	-	-	1.648	1.682	-	1.682	1.046	1.048	1.048	1.059	0.000	7.531

**A. Mission Description and Budget Item Justification**

This Project will ensure critical structures technologies providing improved weight efficiency, fatigue tolerance, parasitic weight avoidance, and integration / synergy opportunities will transition to Advanced Technology Development tasks to later provide Future Vertical Lift (FVL) Project Management Offices and Original Equipment Manufacturers mission performance benefit in terms of range/payload, survivability, sustainment, and operational availability. Research in this Project may also address and be applied to the needs of other Army and specific DoD aviation systems.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2022	FY 2023	FY 2024
<p><b>Title:</b> Multifunctional Advanced Structural Concepts (MASC)</p> <p><b>Description:</b> Develop innovative, critical, highly weight-optimized, durable, fatigue-resistant, damage-tolerant structural concepts exploiting multifunctionality for weight savings and broad multi-scale FVL benefit impact.</p> <p><b>FY 2023 Plans:</b> Develop innovative concepts enhancing structural weight efficiency applicable to FVL across size classes. Develop structural concepts using multifunctionality for parasitic weight avoidance. Apply integration methodology in guiding development of technologies to optimize benefits of reduced weight, increased resilience, and reduced maintenance.</p> <p><b>FY 2024 Plans:</b> Will apply advanced composite material forms and titanium additive manufacturing to develop innovative concepts enhancing structural weight efficiency applicable to FVL across size classes. Will develop enhanced analysis of structural composites. Will continue to apply integration methodology in guiding development of technologies to optimize benefits of reduced weight, increased resilience, and reduced maintenance.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	1.588	1.682
<p><b>Title:</b> SBIR/STTR Transfer</p>	-	0.060	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CU8 / Structures Tech for Enduring Efficient Resilience

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b><i>FY 2023 Plans:</i></b> Funding transferred in accordance with Title 15 USC §638			
<b><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i></b> Funding transferred in accordance with Title 15 USC §638			
<b>Accomplishments/Planned Programs Subtotals</b>	-	1.648	1.682

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**UNCLASSIFIED**

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

<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CU9 / Systems Design Technology
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CU9: <i>Systems Design Technology</i>	-	-	3.109	3.135	-	3.135	3.026	5.227	5.335	5.394	0.000	25.226

**A. Mission Description and Budget Item Justification**

This Project will leverage large datasets and advances in multi-disciplinary optimization techniques, incorporate higher fidelity analysis, and machine learning techniques to improve predictions of emerging aviation requirements and system complexity.

Research in this Project is fully coordinated with Program Element (PE) 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2022	FY 2023	FY 2024
<p><b>Title:</b> Concept Design and Optimization Methods</p> <p><b>Description:</b> Expand scope of design and assessment support across Future Vertical Lift (FVL) lines of effort (LOEs) and the science and technology portfolio. Incorporate method enhancements to improve timeliness, accuracy, and detail of conceptual design (performance, weight, and cost).</p> <p><b>FY 2023 Plans:</b> Develop tools and methods to improve rotorcraft design and optimization with advanced component models. Apply tools to design and analyze Future Vertical Lift and other manned/unmanned air vehicle concepts.</p> <p><b>FY 2024 Plans:</b> Will further develop tools and methods to improve rotorcraft design and optimization with advanced component models and improved modeling framework. Will apply tools to trade studies to explore aircraft concepts for Future Vertical Lift (FVL) as well as electric and hybrid rotorcraft concepts.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	2.996	3.135
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>FY 2023 Plans:</b></p>	-	0.113	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / <i>Air Platform Applied Research</i>	<b>Project (Number/Name)</b> CU9 / <i>Systems Design Technology</i>		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
Funding transferred in accordance with Title 15 USC §638				
<b><i>FY 2023 to FY 2024 Increase/Decrease Statement:</i></b>				
Funding transferred in accordance with Title 15 USC §638				
<b>Accomplishments/Planned Programs Subtotals</b>		-	3.109	3.135
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW3 / Advanced Rotors Applied Technology			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CW3: Advanced Rotors Applied Technology	-	-	2.589	2.614	-	2.614	2.011	2.013	2.645	2.673	0.000	14.545

**A. Mission Description and Budget Item Justification**

This Project investigates Future Vertical Lift (FVL) and other Army and Department of Defense (DoD) aviation systems technologies that mature high speed and highly efficient rotor and hub system designs.

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p><b>Title:</b> Advanced Hubs Tech</p> <p><b>Description:</b> Investigate advanced rotor system and hub technologies to support goals of increased speed and lift by developing configurations and technologies that reduce drag and enable more efficient rotor system performance.</p> <p><b>FY 2023 Plans:</b> Complete advanced rotor hub conceptual design studies. Commence hub component testing.</p> <p><b>FY 2024 Plans:</b> Will refine advanced rotor hub conceptual designs. Will conduct detailed analysis on hub to determine performance benefits.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	2.495	2.614
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638</p>	-	0.094	-
<b>Accomplishments/Planned Programs Subtotals</b>	-	2.589	2.614

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / <i>Air Platform Applied Research</i>	<b>Project (Number/Name)</b> CW3 / <i>Advanced Rotors Applied Technology</i>

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW4 / Air Vehicle Structures and Dynamics Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CW4: Air Vehicle Structures and Dynamics Tech	-	-	2.985	3.042	-	3.042	3.072	3.077	3.079	3.113	0.000	18.368

**A. Mission Description and Budget Item Justification**

This Project develops modeling tools and methodologies needed to research low noise and aeroelastically stable rotor technologies. Research in this Project enables high speed flight, longer flight envelopes, and lower noise signatures in Future Vertical Lift (FVL) platforms and is also applicable to the family of FVL manned and unmanned platforms.

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

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> Air Vehicle Structures and Dynamics Technologies	-	2.876	3.042
<b>Description:</b> 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 (TRAST), which will be used to generate novel experimental data. This data will be used to increase fundamental understanding of the whirl flutter instability, which currently limits the high speed performance of tiltrotor rotorcraft. This effort will inform FVL requirement definition and technology maturation. This effort also establishes low noise rotor concepts and investigates the intersection of artificial intelligence and classical mechanics to enable novel mechanics and new approaches in structural dynamics for FVL applications to enable higher Operating Tempo (OPTEMPO) operations.			
<b>FY 2023 Plans:</b> Experimentally and analytically explore active control technologies for tiltrotor aeroelastic stability augmentation and performance improvement to enable lighter, higher speed, and higher range tiltrotor aircraft. Investigate aerodynamic interactions between closely spaced airfoil elements and their potential to reduce boundary layer height and separation, thus reducing broadband noise. Validate a rotor using this effect to achieve a reduced noise signature through high fidelity simulations and experiments. Develop			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CW4 / Air Vehicle Structures and Dynamics Tech

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
analysis tools to design internal structures capable of exhibiting adaptive reconfiguration. Identify an algorithmic code to prescribe a topological optimization of the structure of an adaptive Unmanned Aerial System (UAS) platform.  <b>FY 2024 Plans:</b> Will conduct Tiltrotor Aeroelastic Stability Test (TRAST) in NASA's Langley Transonic Dynamics Tunnel (TDT) to explore effects of the rotor and control system parameters on tiltrotor aircraft whirl flutter boundaries. Will explore experimentally and analytically, the active control technology-Generalized Predictive Control (GPC) on tiltrotor stability augmentation. Will explore analytically, winglet and wing extension for tiltrotor aircraft performance and stability improvement. Will investigate aeroelastic stability and vibratory loads of lift-offset coaxial rotor at high flight speed. Will develop a tool chain to analyze the boundary layer noise from rotor airfoils, including multi element airfoils and use the tools to find low noise rotor blade designs; assess the low noise designs experimentally. Will develop crashworthy navigation and flight controls algorithms to adapt to congested environments.  <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.			
<b>Title:</b> SBIR/STTR Transfer  <b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638  <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638	-	0.109	-
<b>Accomplishments/Planned Programs Subtotals</b>	-	2.985	3.042

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW5 / Experimental and Computational Aeromechanics Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CW5: <i>Experimental and Computational Aeromechanics Tech</i>	-	-	6.600	6.835	-	6.835	6.904	6.913	6.917	6.993	0.000	41.162

**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 and other Army and Department of Defense (DoD) aviation systems.

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p><b>Title:</b> Experimental Aeromechanics</p> <p><b>Description:</b> Develop and explore new methods to simulate aerodynamic effects for aircraft and other future FVL configurations.</p> <p><b>FY 2023 Plans:</b> Conduct test of winged compound rotorcraft configurations through expanded high speed flight envelope with rotor revolutions per minute (RPM) variation and auxiliary propulsion to provide fundamental understanding and validation data for computational tools; Investigate state of the art of measurement &amp; diagnostics techniques for rotorcraft; Test rotor blade structural deformation and boundary layer transition using embedded sensor networks; Investigate methods for rotorcraft hub drag reduction.</p> <p><b>FY 2024 Plans:</b> Will develop a powered tail rotor test stand for more accurate physical modeling of winged compound rotorcraft interactional aeromechanics to provide fundamental understanding and validation data for computational tools. Will investigate advanced high speed compound rotorcraft wing designs to provide improved hover and forward flight performance. Will investigate state of the art measurement &amp; data analysis techniques for rotorcraft to provide new or improved data sets for computational tool validation. Will conduct tests to investigate methods of rotorcraft hub drag reduction on FVL relevant configurations.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	4.044	4.366
<p><b>Title:</b> Computational Aeromechanics</p> <p><b>Description:</b> Verify, validate and apply high-fidelity modeling and simulation software tools for rotorcraft aeromechanics.</p>	-	2.315	2.469

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CW5 / Experimental and Computational Aeromechanics Tech		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p><b>FY 2023 Plans:</b> Test and validate computational models for interactional aerodynamics applications including fast-running reduced-order computational fluid dynamics (CFD) models. Test and validate computational models for rotorcraft air launched effects (ALE) deployment simulations.</p> <p><b>FY 2024 Plans:</b> Will verify and validate reduced-order and surrogate computational aeromechanics models for Future Vertical Lift (FVL) aircraft that provide high accuracy while running fast enough for use in rotorcraft design applications. Will demonstrate and test these new design-oriented computational models by addressing engineering problems for relevant FVL aircraft configurations.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>				
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638</p>		-	0.241	-
<b>Accomplishments/Planned Programs Subtotals</b>		-	6.600	6.835
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW6 / Future UAS Propulsion Technology			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CW6: Future UAS Propulsion Technology	-	-	3.414	3.560	-	3.560	3.595	3.598	3.601	3.640	0.000	21.408

**A. Mission Description and Budget Item Justification**

This Project designs and assesses advanced engine and power system component technologies to support the goals of multi-fuel capability, reduced fuel consumption, and reduced engine size, weight, and cost in current and Future Unmanned Aircraft Systems (FUAS).

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

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> Multi-Fuel Capable Hybrid Electric Propulsion	-	3.289	3.560
<b>Description:</b> 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 three and four FUAS reliability, survivability, and maintainability.			
<b>FY 2023 Plans:</b> Assess robust ignition for low quality fuels utilizing advanced ignition assistants and ignition sensing and control; complete models for oil-free bearings relevant to aviation turbochargers; validate bearingless motor design and optimization tool with experimental data; enhance hybrid-electric optimization tool to include design optimization and uncertainty analysis.			
<b>FY 2024 Plans:</b> Will integrate combustion and fuel property sensing, explore control strategy for varied ignition quality fuels to enable multi-fuel capability, and assess novel ignition assistant in relevant engine environment. Will validate oil-free bearing analysis tool and turbocharger aeroelasticity tool. Will extend validation of motor design tools to higher rotational speeds. Will validate and verify system level hybrid-electric architectures. Will continue augmenting hybrid-electric optimization and integration tool capabilities by introducing new higher fidelity models.			
<b>FY 2023 to FY 2024 Increase/Decrease Statement:</b>			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CW6 / Future UAS Propulsion Technology		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
Funding change reflects planned lifecycle of this effort.				
<b>Title:</b> SBIR/STTR Transfer		-	0.125	-
<b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638				
<b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638				
<b>Accomplishments/Planned Programs Subtotals</b>		-	3.414	3.560
<b>C. Other Program Funding Summary (\$ in Millions)</b>				
N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b>				
N/A				

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW7 / High Speed and Efficient VTOL Vehicle Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
CW7: High Speed and Efficient VTOL Vehicle Tech	-	-	1.549	1.580	-	1.580	1.580	1.582	1.584	1.601	0.000	9.476

**A. Mission Description and Budget Item Justification**

This Project designs and develops material component technologies and dynamic models to enable future generation capabilities for Future Vertical Lift (FVL) platforms. This Project is focused on improving range, payload, and endurance performance as well as reliability and maintainability metrics. The outcomes from the efforts within this Project will be applicable to the Family of Future Vertical Lift manned and unmanned platforms.

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

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<b>Title:</b> High Speed Efficient Vertical Take-Off and Landing (VTOL) Vehicle Technologies	-	1.492	1.580
<b>Description:</b> This effort establishes propulsion concepts for vertical take-off and landing to enable improved, efficient hover and high-speed cruise at longer range without added weight.			
<b>FY 2023 Plans:</b> Validate dynamic models for hybrid composite gears with integrated shafts in the VIPER facility; determine hybrid gear's capability to deliver continuous power at 525 HorsePower (HP); develop experimental techniques to access hybrid gear failure modes and develop a dynamic model of a non-conventional transmission topology; perform oil-out experiments of hybrid composite gear components; quantify effectiveness of data-driven condition indicators for gears, bearings, and lubrication; investigate using simulated dynamic responses to train data-drive condition indicators.			
<b>FY 2024 Plans:</b> Will continue to develop experimental techniques to assess hybrid gear failure modes. Will continue to develop a dynamic model of a transmission topology that is non-conventional for rotorcraft. Will prepare the Vehicle Innovative Powertrain Experimental Research (VIPER) facility to perform hybrid-electric propulsion transmission experiments. Will assess tribological performance			

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CW7 / High Speed and Efficient VTOL Vehicle Tech		
<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
of functionally-graded ceramic/metal materials at the coupon level. Will expand the machine learning (ML) toolbox for investigating failure modes of electric rotating machinery. <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.				
<b>Title:</b> SBIR/STTR Transfer <b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638 <b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding transferred in accordance with Title 15 USC §638		-	0.057	-
<b>Accomplishments/Planned Programs Subtotals</b>		-	1.549	1.580
<b>C. Other Program Funding Summary (\$ in Millions)</b> N/A				
<b>Remarks</b>				
<b>D. Acquisition Strategy</b> N/A				

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

<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> CW8 / Next Generation Aviation Transmission Apl Tech			
COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
CW8: Next Generation Aviation Transmission Apl Tech	-	-	1.482	1.511	-	1.511	1.454	2.371	1.457	1.458	0.000	9.733

**A. Mission Description and Budget Item Justification**

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

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	FY 2022	FY 2023	FY 2024
<p><b>Title:</b> High Reduction Ratio Transmission (HRT) Components</p> <p><b>Description:</b> Effort investigates advanced materials and component designs that allow a 60:1 reduction ratio two-stage gearbox design that provides significant weight and volume reduction for extended range and component life for manned and unmanned applications.</p> <p><b>FY 2023 Plans:</b> Test new corrosion resistant steel components for physical material properties such as tensile strength, surface hardness, bending strength, and surface fatigue. Develop improved manufacturing techniques based on the physical material properties data as well as develop and test new seal materials and seal configurations.</p> <p><b>FY 2024 Plans:</b> Will perform tribology testing and analysis of advanced gear/bearing materials using in-house testing facilities.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	1.428	1.511
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b></p>	-	0.054	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> CW8 / Next Generation Aviation Transmission Apl Tech

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
Funding transferred in accordance with Title 15 USC §638			
<b>Accomplishments/Planned Programs Subtotals</b>	-	1.482	1.511

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

**UNCLASSIFIED**

<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army										<b>Date:</b> March 2023		
<b>Appropriation/Budget Activity</b> 2040 / 2					<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research				<b>Project (Number/Name)</b> DC2 / High Performance Computing for Rotorcraft Appl Tech			
<b>COST (\$ in Millions)</b>	<b>Prior Years</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024 Base</b>	<b>FY 2024 OCO</b>	<b>FY 2024 Total</b>	<b>FY 2025</b>	<b>FY 2026</b>	<b>FY 2027</b>	<b>FY 2028</b>	<b>Cost To Complete</b>	<b>Total Cost</b>
DC2: High Performance Computing for Rotorcraft Appl Tech	-	-	1.267	1.293	-	1.293	1.306	1.308	1.309	1.323	0.000	7.806

**A. Mission Description and Budget Item Justification**

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

Research in this Project is fully coordinated with PE 0603043A (Air Platform Advanced Technology).

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

Research in this Project is performed by the United States Army Futures Command.

**B. Accomplishments/Planned Programs (\$ in Millions)**

	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
<p><b>Title:</b> High Performance Computing for Aviation Applications</p> <p><b>Description:</b> Develop automated, high-fidelity computational tools for rotorcraft analysis and design.</p> <p><b>FY 2023 Plans:</b> Develop new high-order accurate computational fluid dynamics models for rotorcraft aerodynamic analysis. Develop accurate and fast-running surrogate models suitable for use in rotorcraft design.</p> <p><b>FY 2024 Plans:</b> Will develop and demonstrate new high-fidelity aeromechanics modeling and simulation tools to address relevant rotorcraft design problems for FVL-relevant aircraft. Will ensure that these new aeromechanics modeling and simulation tools run efficiently and effectively on state-of-the-art new heterogeneous high-performance computing systems.</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> Funding change reflects planned lifecycle of this effort.</p>	-	1.221	1.293
<p><b>Title:</b> SBIR/STTR Transfer</p> <p><b>FY 2023 Plans:</b> Funding transferred in accordance with Title 15 USC §638</p> <p><b>FY 2023 to FY 2024 Increase/Decrease Statement:</b></p>	-	0.046	-

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<b>Exhibit R-2A, RDT&amp;E Project Justification:</b> PB 2024 Army		<b>Date:</b> March 2023
<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> DC2 / High Performance Computing for Rotorcraft Appl Tech

<b>B. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2022</b>	<b>FY 2023</b>	<b>FY 2024</b>
Funding transferred in accordance with Title 15 USC §638			
<b>Accomplishments/Planned Programs Subtotals</b>	-	1.267	1.293

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A

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

<b>Appropriation/Budget Activity</b> 2040 / 2	<b>R-1 Program Element (Number/Name)</b> PE 0602183A / Air Platform Applied Research	<b>Project (Number/Name)</b> DE2 / Airborne Threat Defeat
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COST (\$ in Millions)	Prior Years	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
DE2: Airborne Threat Defeat	-	-	-	5.794	-	5.794	-	-	-	-	0.000	5.794

**Note**  
Airborne Threat Defeat is a new start within the Air Platform Applied Research program in FY 2024.

**A. Mission Description and Budget Item Justification**

Airborne Threat Defeat is a new start effort in FY2024 to address the need to engage and disorient guided threats.

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

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

**B. Accomplishments/Planned Programs (\$ in Millions)**

<b>Title:</b> Airborne Threat Defeat Tech	FY 2022	FY 2023	FY 2024
<b>Description:</b> This effort develops novel weapon, munition and fire control system technology required to increase standoff distance and engagement time to decoy or defeat guided threats.	-	-	5.794
<b>FY 2024 Plans:</b> Will investigate concepts to decoy and defeat advanced, agile, and guided aerial threats with novel weapon, munition, and fire control system technologies. Will develop modeling and simulation tools to evaluate potential decoy and defeat techniques. Will investigate miniaturized electro-chemical-mechanical payloads for advanced threat decoy or threat.			
<b>FY 2023 to FY 2024 Increase/Decrease Statement:</b> This is a New Start in FY2024			
<b>Accomplishments/Planned Programs Subtotals</b>	-	-	5.794

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

N/A

**Remarks**

**D. Acquisition Strategy**

N/A