Exhibit R-2, RDT&E Budget Item Justification: PB 2012 Army										DATE: February 2011	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 2: *Applied Research*				R-1 ITEM NOMENCLATURE PE 0602211A: *AVIATION TECHNOLOGY*							
COST ($ in Millions)	**FY 2010**	**FY 2011**	**FY 2012 Base**	**FY 2012 OCO**	**FY 2012 Total**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**Cost To Complete**	**Total Cost**
Total Program Element	44.810	43.476	44.610	-	44.610	45.123	47.672	47.913	49.525	Continuing	Continuing
47A: *AERON & ACFT WPNS TECH*	36.413	38.028	39.034	-	39.034	39.442	41.460	41.358	42.587	Continuing	Continuing
47B: *VEH PROP & STRUCT TECH*	4.221	5.448	5.576	-	5.576	5.681	6.212	6.555	6.938	Continuing	Continuing
47C: *ROTORCRAFT COMPONENT TECHNOLOGIES (CA)*	4.176	-	-	-	-	-	-	-	-	Continuing	Continuing

A. Mission Description and Budget Item Justification

This aviation technology program element (PE) conducts applied research applicable to rotary wing vehicle (RWV) technologies to move towards air vehicle objectives. Emphasis is on developing rotary wing platform technologies to enhance manned and unmanned RWV combat and combat support operations for attack, reconnaissance, air assault, survivability, logistics and command and control missions. The PE supports the research and development of components and subsystems for air vehicles in the areas of aviation and aircraft weapons technology (project 47A) and vehicle propulsion and structures technology (project 47B). This PE also supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia. Project 47C funds congressional special interest items. Efforts under this PE transition to projects supported by PE 0603003A (Aviation-Advanced Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this PE is performed by the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), located at Redstone Arsenal, AL; Fort Eustis, VA; Moffett Field, CA; and Hampton, VA, and at the Army Research Laboratory (ARL), located at Adelphi, MD; Hampton, VA; and Cleveland, OH.

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B. Program Change Summary ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total
Previous President's Budget	49.273	43.476	42.598	-	42.598
Current President's Budget	44.810	43.476	44.610	-	44.610
Total Adjustments	-4.463	-	2.012	-	2.012
• Congressional General Reductions		-			
• Congressional Directed Reductions		-			
• Congressional Rescissions	-	-			
• Congressional Adds		-			
• Congressional Directed Transfers		-			
• Reprogrammings	-3.979	-			
• SBIR/STTR Transfer	-0.484	-			
• Adjustments to Budget Years	-	-	2.012	-	2.012

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
47A: *AERON & ACFT WPNS TECH*	36.413	38.028	39.034	-	39.034	39.442	41.460	41.358	42.587	Continuing	Continuing

A. Mission Description and Budget Item Justification

The objective of this project is to develop Rotary Wing Vehicle (RWV) technologies for manned and unmanned Army/ Department of Defense (DoD) rotorcraft to increase strategic and tactical mobility/deployability; improve combat effectiveness; increase aircraft and crew survivability; and improve combat sustainability. Areas of research address desired characteristics applicable to all aviation platforms, such as enhanced rotor efficiencies, improved survivability, increased structure and airframe capability, improved engine performance, improved sustainability, improved mission avionics performance, and reduced cost. This project supports the National Rotorcraft Technology Center (NRTC), a partnership of government, industry, and academia. This project leverages work accomplished in collaboration with the National Aeronautics and Space Administration (NASA). Technologies within this project transition to advanced technology development programs with application to future, as well as current, Army/DoD rotorcraft systems.

Work in this project is fully coordinated with PE 0603003A (Aviation Advanced Technology) and work in this project related to aircraft weapons integration is also fully coordinated with PE 0602624A (Weapons and Munitions Technology) and PE 0602303A (Missile Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Aero-Flight Dynamics Directorate of the Aviation and Missile Research, Development, and Engineering Center (AMRDEC), (located at the NASA Ames Research Center, Moffett Field, CA; and the NASA Langley Research Center, Hampton, VA); and the Aviation Applied Technology Directorate, Fort Eustis, VA.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: National Rotorcraft Technology Center (NRTC)	7.741	8.091	8.060
Description: The goal of the NRTC is to focus government, US rotorcraft industry and academia resources on pre-competitive, high priority, military focused technology development to maintain U.S. preeminence in rotorcraft capabilities.			
FY 2010 Accomplishments: Correlated nonlinear aeroelasticity analysis results with wind tunnel and flight test data to improve understanding of predictive capability for rotor stall flutter; completed design and fabrication of 2-D oscillating rotor icing model; conducted icing evaluation			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
in the NASA Icing Research Tunnel (IRT); and developed crashworthiness models of single-rotor, tandem and tilt-rotor configurations. ***FY 2011 Plans:*** Evaluate metal matrix composite structural elements as replacements for titanium elements; incorporate new dynamic stall model, based on a hybrid computational approach, into a comprehensive code and validate the new model by comparison with test data; and validate physics-based analysis methodology predictions for hub drag reductions with available test data. ***FY 2012 Plans:*** Will conduct an icing evaluation of a spinning rotor in the NASA Icing Research Tunnel (IRT) to validate prediction tools; will conduct hover stand evaluation of rotor with Miniature Trailing-edge Effector (MiTE) actuation system; will perform validation testing of an in-flight acoustic detection footprint prediction system and in-cockpit display; and will validate analytic predictions with UH-60 wind tunnel and flight test data.			
Title: Rotor Technology ***Description:*** Evaluate performance enhancements gained from advanced rotor technologies, including on-blade controls. ***FY 2010 Accomplishments:*** Evaluated rotor aeromechanics issues for high speed configurations using high fidelity analysis; validated methods for UH-60 and active rotor evaluations; and fabricated Active Elevon Rotor (AER) and modified test stand to avoid dynamic instabilities. ***FY 2011 Plans:*** Acquire high quality interactional aerodynamics measurements for a high speed active flow control rotor configuration; execute active on-blade control evaluation; and utilize high quality UH-60 rotor measurements to assess rotorcraft modeling and simulation tools for rotor structural loads, deflections and flowfield measurements. ***FY 2012 Plans:*** Will apply advanced, high performance computing tools, simulating UH-60 rotor measurements, to assess accuracy of computed rotor structural loads, deflections and flowfield measurements; will perform pre-test computations and participate in international evaluation of an active twist rotor; and will apply aeromechanics analysis tools to rotorcraft configurations for improved performance in support of PE 0603003A, Project 313.	3.332	3.185	3.400
Title: Survivability Technologies ***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.	7.409	8.993	7.114

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
FY 2010 Accomplishments: Completed conventional ballistic protection and advanced crew protection efforts; transitioned knowledge gained to ballistic protection and advanced crew protection technology maturation in PE 0603003A, Project 313; and developed remote Optical Parametric Oscillators (OPOs) to tune laser countermeasure wavelengths to desired threat bands for effective Infra-Red (IR) jamming of man-portable missiles. ***FY 2011 Plans:*** Fabricate crashworthy systems/subsystems, conduct evaluation, and correlate test results with models previously developed; and integrate optic laser fiber and OPO component technologies into a complete multi-function IR and visual laser countermeasure system, and transition to PE 0603003A, Project 313 effort for flight evaluation on a threat range. ***FY 2012 Plans:*** Will begin design of advanced IR/EO signature control materials; and will develop improved materials and airframe structural configurations that provide threat protection against non-conventional weapons, to include directed energy, blast/overpressure, and high velocity low mass fragments.			
Title: Advanced Engines ***Description:*** Design and develop advanced turboshaft engine component technologies to support goals of reduced fuel consumption, engine size, weight, cost, as well as improved reliability, maintainability and survivability. ***FY 2010 Accomplishments:*** For utility/attack sized aircraft, completed the design of an advanced compressor and conducted laboratory rig evaluation; and for cargo sized aircraft, completed fabrication of a gas generator turbine. ***FY 2011 Plans:*** For a cargo sized aircraft, complete advanced combustor design for improved engine performance and structural life; complete fabrication of advanced compressor for improved engine performance and reduced weight; and complete evaluation of gas generator turbine to validate improved engine performance and durability. ***FY 2012 Plans:*** For a cargo sized aircraft, will complete advanced mechanical systems fabrication for improved engine performance and structural life; will complete evaluation of advanced compressor for improved engine performance and reduced weight; and transition technologies to engine advanced development efforts under PE 0603003A, Project 447.	1.971	2.551	3.550
Title: System Concepts Studies	2.348	2.315	3.130

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Description: Enables new rotorcraft configurations by evaluating critical advanced technology using design and analysis methods with greater modeling fidelity. Introduces high fidelity methodology for improved performance and design predictions earlier in the development and acquisition process. ***FY 2010 Accomplishments:*** Extended the computational fluid dynamics (CFD) flight conditions for transition and maneuver flight; and continued the validation of modeling capabilities and the ability to pass/generate data within the integrated analysis environment, such as automating the methodology for transforming a 3-D Computer Aided Design (CAD) drawing into a grid which can be analyzed with CFD tools. ***FY 2011 Plans:*** Enhance/extend the fidelity of the integrated analysis and design environment to increase prediction accuracy as well as investigate techniques for rigorous optimization of the rotorcraft design in full flight envelope simulation. ***FY 2012 Plans:*** Will complete small scale wind tunnel test to validate performance predictions and will document requirements for multi-role configuration technology.			
Title: Network Operations and System Integration ***Description:*** Perform feasibility, operations, and concept studies to identify promising candidate technologies for improved and new platform capabilities. ***FY 2010 Accomplishments:*** Investigated Unmanned Aircraft Systems (UAS) supervisory techniques in flight to permit efficient assignment of distributed tasks; investigated geo-location improvements and lightweight sensors utilizing advanced image stabilization techniques incorporated to provide hemispherical situational awareness for improved pilotage; and pursued UAS/weaponization investigation initiatives with other Services. ***FY 2011 Plans:*** Investigate use of UAS supervisory techniques in Manned-Unmanned Teaming flight evaluations; develop/evaluate interface technologies for rapid immersion of UAS operators into remote environments; integrate a lightweight, distributed sensor array into a UAS test-bed platform to evaluate autonomous pilotage and collision avoidance techniques; develop/evaluate virtual interface technologies for rapid virtual immersion of UAS operators into UAS operating environment; extend supervisory control techniques to airborne control station applications; continue assessment of low space, weight and power wide field of view sensor systems for local situational awareness; and complete ground based evaluation of autonomous sniper system with fire control upgrades. ***FY 2012 Plans:***	5.051	5.444	5.136

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Will investigate UAS supervisory control techniques applied in relevant tactical operations through flight evaluation; will investigate integration of advanced lethality concepts for application to manned and unmanned aviation assets, addressing energy storage, system pointing accuracy, stabilization, and incapacitation effects.			
Title: Flight Controls ***Description:*** Develop advanced rotor and aircraft flight control architectures as well as control laws to permit enhanced vehicle performance over expanded and more challenging flight envelopes. ***FY 2010 Accomplishments:*** Developed handling quality criteria for legacy upgrades and future rotorcraft; developed the Rotorcraft Air Crew Systems Concepts Airborne Laboratory (RASCAL, a JUH-60A Black Hawk helicopter) into a variable-stability in-flight simulator; flight evaluated increased agility, obstacle field navigation and landing algorithms for unmanned platforms; and investigated geo-location improvements and lightweight sensors incorporating advanced image stabilization techniques to provide hemispherical situational awareness for improved pilotage. ***FY 2011 Plans:*** Define control system architectures for emerging rotorcraft configurations based on initial dynamic simulation models and in-flight simulation experiments. ***FY 2012 Plans:*** Will investigate integrated control of large rotorcraft using feedback of rotor state, external loads, and structural measurements.	3.483	2.603	4.169
Title: Durability and Sustainment Technologies ***Description:*** Develop prognostic and system health assessment technologies to enable transition to a Condition Based Maintenance supportability structure. ***FY 2010 Accomplishments:*** Investigated the accuracy and robustness of developed prognostic and diagnostic technologies; investigated the physics of failure models for electronics, as well as validated a prognostic reasoner to predict failures; and integrated a corrosion monitoring system into the Health and Usage Monitoring System and validated on an airframe structural component. ***FY 2011 Plans:***	5.078	4.846	4.475

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Develop prognostic capabilities for more chaotic, nonlinear dynamic failure modes of mechanical systems; develop improved probabilistic methods for prediction of failure initiation and progression; evaluate nano-sensing technology for real-time integrity monitoring; and implement improved design and analysis criteria. ***FY 2012 Plans:*** Will develop prognostic algorithms for predicting remaining life of engine controls, sensors and lubrication systems; will perform evaluation of data fusion of structural integrity algorithms for extending component time on wing and damage tolerance; and will develop algorithms to assess rotor component health and vehicle control systems.			
Accomplishments/Planned Programs Subtotals	36.413	38.028	39.034

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
47B: *VEH PROP & STRUCT TECH*	4.221	5.448	5.576	-	5.576	5.681	6.212	6.555	6.938	Continuing	Continuing

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

The objective of this project is to investigate engine, drive train, and airframe enabling technologies such as multifunctional materials, fluid mechanics and high temperature, high strength, low cost shaft materials.

Work in this project complements and is fully coordinated with PE 0603003A (Aviation Advanced Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) at the NASA Glenn Research Center, Cleveland, OH, the NASA Langley Research Center, Hampton, VA, and the Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Rotor and Structure Technology	0.898	2.010	2.060
Description: Devise improved tools and methodologies to more accurately design for improved component reliability and durability, resulting in platforms that are lighter in weight and less costly to acquire and maintain. ***FY 2010 Accomplishments:*** Conducted structural and dynamic evaluations of a conceptual active rotor system to improve performance. ***FY 2011 Plans:*** Perform a series of analytical and validation studies, including in-flight evaluations conducted jointly with the Federal Aviation Administration and other Research, Development and Engineering Center field elements, to enhance analytical tools and methodologies for structural damage detection and condition-based maintenance of key structural components. Complete fabrication of six 1/4-scale high-performance active-twist rotor blades based on Apache baseline performance characteristics. Conduct parametric wind-tunnel evaluations of two sets of advanced active-twist rotor configurations, one of which has been			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
optimized for rotor performance improvements. Complete analytical comparison study with data validation to document benefits of high-performance active designs. ***FY 2012 Plans:*** Will complete wind-tunnel evaluation of high performance ATR blades and will validate prognostics and diagnostics technologies and framework for computation of remaining useful life of vehicle structures.			
Title: Propulsion and Drive Train Technology ***Description:*** Investigate high temperature materials, advanced models for flow physics and improved methods for predicting propulsion system mechanical behavior to increase fuel efficiency and reduce propulsion system weight. ***FY 2010 Accomplishments:*** Assessed the feasibility of fabricating sub-elements of hollow and solid turbine blades from monolithic ceramic/composite hybrid materials to reduce engine weight; and designed sand injection facility to enable the development of improved inlet particle separators. ***FY 2011 Plans:*** Develop joining technologies to enable the fabrication and integration of ceramic fuel injectors for improved combustion process design, and develop a coupled engine and drive train dynamic model that will enhance the accuracy of mechanical behavior predictions. ***FY 2012 Plans:*** Will demonstrate the feasibility of fabricating hybrid ceramic/metal turbine engine components.	3.323	3.438	3.516
Accomplishments/Planned Programs Subtotals	4.221	5.448	5.576

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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COST ($ in Millions)	FY 2010	FY 2011	FY 2012 Base	FY 2012 OCO	FY 2012 Total	FY 2013	FY 2014	FY 2015	FY 2016	Cost To Complete	Total Cost
47C: *ROTORCRAFT COMPONENT TECHNOLOGIES (CA)*	4.176	-	-	-	-	-	-	-	-	Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Rotorcraft Component Technologies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2010	FY 2011	FY 2012
Title: Composite Small Main Rotor Blades ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** In FY10, this Congressional Interest Item investigated innovative rotor design and fabrication processes that reduced the time and cost of a typical metal blade to composite blade conversion program; completed rapid prototype fabrication, structural testing, and whirl test.	2.983	-	-
Title: Intensive Quenching (IQ) for Advanced Weapons Systems ***Description:*** This is a Congressional Interest Item. ***FY 2010 Accomplishments:*** In FY10, this Congressional Interest Item investigated an advanced heat treating process to improve performance and cost of high strength steel components such as helicopter gears and gun barrels; processed full scale gears and gun barrels using IQ technique and subjected same to fatigue testing to validate benefits.	1.193	-	-
Accomplishments/Planned Programs Subtotals	4.176	-	-

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.