PE NUMBER: 0602201F
PE TITLE: Aerospace Vehicle Technologies

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies

	Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	64.700	76.401	96.679	104.229	96.987	102.672	104.208	105.648	Continuing	TBD
2401	Structures	26.541	32.542	41.005	44.258	37.002	41.284	41.885	42.446	Continuing	TBD
2403	Flight Controls and Pilot-Vehicle Interface	15.079	17.785	28.805	31.694	26.933	28.734	29.175	29.588	Continuing	TBD
2404	Aeromechanics and Integration	23.080	26.074	26.869	28.277	33.052	32.654	33.148	33.614	Continuing	TBD

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace vehicle technologies in the three primary areas of structures, controls, and aeromechanics. Advanced structures concepts are explored and developed to exploit new materials, fabrication processes, and design techniques. Flight control technologies are developed and simulated for aerospace vehicles. Advanced aerodynamic vehicle configurations are developed and analyzed through simulations, experiments, and multi-disciplinary analysis. Resulting technologies reduce life cycle costs and improve the performance of existing and future manned and unmanned aerospace vehicles. Note: In FY 2005, Congress added $1.3 million for the Intelligent Flight Control Simulation Research Laboratory and $1.1 million for the Unique Stealth Unmanned Air Vehicle Houck Aircraft Design program. This program is in Budget Activity 2, Applied Research, since it develops and determines the technical feasibility and military utility of evolutionary and revolutionary aerospace vehicle technologies.

(U) B. Program Change Summary ($ in Millions)

		FY 2004	FY 2005	FY 2006	FY 2007
(U)	Previous President's Budget	64.311	74.679	103.895	111.893
(U)	Current PBR/President's Budget	64.700	76.401	96.679	104.229
(U)	Total Adjustments	0.389	1.722		
(U)	Congressional Program Reductions				
	Congressional Rescissions		-0.678		
	Congressional Increases		2.400		
	Reprogrammings	0.400			
	SBIR/STTR Transfer	-0.011			
(U)	Significant Program Changes:				

Not Applicable.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies

PROJECT NUMBER AND TITLE: 2401 Structures

Cost ($ in Millions)	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2401 Structures	26.541	32.542	41.005	44.258	37.002	41.284	41.885	42.446	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops advanced structures concepts to exploit new materials and fabrication processes and investigates new structural concepts and design techniques. New structural concepts include incorporating subsystem hardware items (e.g., antennas, sensors, directed energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Resulting technologies strengthen and extend the life of current and future manned and unmanned aerospace vehicle structures, while providing increased capabilities. Payoffs to the warfighter include reduced weight and cost, as well as improved operability and maintainability of aerospace vehicles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes. Note: Decrease in FY 2006 and out is due to reduction of related sustainment efforts in PE 0603211F.	5.122	6.281	2.344	1.880

(U) In FY 2004: Developed economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Developed unitized structural concepts and multi-disciplinary methodologies that enhance affordability and decrease vulnerability for current and future aerospace vehicles. Completed reliability-based design tools for advanced aircraft components and concepts.

(U) In FY 2005: Develop alternative methodologies and concepts for structural repair. Develop structural health monitoring schemes for structures susceptible to damage. Pursue additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools for life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts. Complete the development of unitized structural concepts and multi-disciplinary methodologies that enhance affordability and decrease vulnerability for current and future aerospace vehicles.

(U) In FY 2006: Continue to pursue additional aspects of the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools into life prediction and failure analysis. Continue to refine failure criteria tools for advanced high temperature aircraft components and concepts.

(U) In FY 2007: Continue development of structural health management schemes for structures susceptible

	to damage. Continue the development of economic service life analysis and structural design tools for current and future aircraft, enhancing capabilities, component replacement, and technology direction. Incorporate newly developed analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.				
(U)					
(U)	MAJOR THRUST: Develop methodologies to allow for analytical airworthiness certification that will reduce the cost and time involved in actual full-scale testing of components and aircraft prior to obtaining airworthiness certification.	5.308	6.508	7.236	6.959
(U)	In FY 2004: Developed analytical certification methodologies for the incorporation of advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Improved the airworthiness certification process for aircraft subject to dynamics loads and with high fidelity.				
(U)	In FY 2005: Continue to develop analytical certification methodologies for the incorporation of advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Improve airworthiness certification process for aircraft subject to dynamic loads and with high fidelity.				
(U)	In FY 2006: Continue development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.				
(U)	In FY 2007: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Complete development of medium- and high-fidelity, and real-time analytical certification methodologies that improve airworthiness certification process and reduce development and testing for aircraft and components subject to dynamics loads.				
(U)					
(U)	MAJOR THRUST: Develop design methods to capitalize on new materials and integration of various subsystem hardware items (e.g., antennas, sensors, direct energy weapon components, and integrated energy storage) and adaptive mechanisms into the actual aircraft structures and/or skin of the aircraft. Note: In FY 2006 and out, funding increased due to initiation of full-scale feasibility determination of air vehicle monitoring in advanced structures. Efforts in this thrust are integrated with efforts in Project 2403 for advanced flight controls, components, and integrated vehicle health monitoring.	4.379	5.369	14.025	18.864
(U)	In FY 2004: Developed concepts, design, and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability of future systems. Continued the development of concepts that include adaptive structures,				

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
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subsystem hardware, and antenna integration into a load-bearing structure to create multi-function or ultra-lightweight concepts.

(U) In FY 2005: Refine concepts, design and analysis methods, and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability of future systems. Continue the development of concepts that include adaptive structures, subsystem hardware, and antenna integration into a load-bearing structure to create multi-function or ultra-lightweight concepts.

(U) In FY 2006: Continue development and initiate evaluation and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Initiate the development and analysis of critical subsystem hardware integration methods to enable directed energy weapons to be carried out on future air vehicles. Complete analysis and continue feasibility determination of energy storage concepts that are integrated into load-bearing structures. Continue the development and initiate evaluation, assessment, and ground evaluation of adaptive structures and antenna integration concepts into load-bearing structures to create multi-function or ultra-lightweight concepts.

(U) In FY 2007: Continue the development, evaluation, and assessment of design and analysis methods and components that enable the integration of structures with other air vehicle functions to reduce cost and weight, as well as increase the survivability and performance of future systems. Continue the development, evaluation, assessment, and ground testing of adaptive structures, subsystem hardware, and antenna integration into load-bearing structures to create multi-function or ultra-lightweight concepts. Complete feasibility determination efforts of energy storage concepts that are integrated into load-bearing structures. Complete the development and analysis, and initiate evaluation and testing of critical subsystem hardware integration methods that enable directed energy weapons to be carried out on future air vehicles. Initiate development, analysis, and evaluation of innovative technologies that integrate active aeroelastic design concepts, adaptive structures, and aerodynamic flow control technologies to enable viable long-range and long endurance air vehicle concepts.

(U)

(U)	MAJOR THRUST: Develop technologies that will permit the structural development of aircraft that can operate at an extreme altitude while at sustained speeds greater than Mach 2. Note: In FY 2005 and out, funding increased due to increased emphasis placed on air vehicle structures for high-speed vehicles.	11.732	14.384	17.400	16.555

(U) In FY 2004: Developed technologies that incorporate advanced materials, as well as passive and active cooling to withstand extreme flight environments. Completed the development of assessment methodologies for air vehicle assessment.

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(U) In FY 2005: Continue to develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Continue the development of concepts germane to advanced, all-weather, durable, thermal protection systems; attachment techniques; vehicle health monitoring; joining concepts; and tanks.

(U) In FY 2006: Refine the development of technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Continue the development of concepts germane to advanced, all weather, durable, thermal protection systems; attachment techniques; vehicle health management; joining concepts; and tanks.

(U) In FY 2007: Further develop technologies that incorporate advanced materials and design concepts for the creation of an integrated air vehicle structure that can withstand extreme flight environments. Technologies will improve durability of existing and future aerospace vehicle structures resulting in reduced cost and increased life. Complete development of concepts germane to advanced, all weather, durable, thermal protections systems; attachment techniques; vehicle health management; hot primary structures; hybrid structures; joining concepts; and tanks.

(U)

(U) Total Cost	26.541	32.542	41.005	44.258

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
PE 0602500F - (U) Multi-Disciplinary Space Technology.										
PE 0603112F, Advanced (U) Materials for Weapon Systems.										
(U) PE 0603211F, Aerospace Technology Dev/Demo.										
(U) PE 0604015F, Next Generation Bomber.										

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(U) C. Other Program Funding Summary ($ in Millions)

This project has been coordinated through the
(U) Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification

DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies

PROJECT NUMBER AND TITLE: 2403 Flight Controls and Pilot-Vehicle Interface

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2403	Flight Controls and Pilot-Vehicle Interface	15.079	17.785	28.805	31.694	26.933	28.734	29.175	29.588	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into flight control.

(U) A. Mission Description and Budget Item Justification

This project develops technologies that enable maximum affordable capability from manned and unmanned aerospace vehicles. Advanced flight control technologies are developed for maximum vehicle performance throughout the flight envelope and simulated in virtual environments. Resulting technologies contribute significantly towards the development of reliable autonomous unmanned air vehicles, space access systems with aircraft-like operations, and extended-life legacy aircraft. Payoffs to the warfighter include enhanced mission effectiveness, optimized flight safety, increased survivability, improved maintenance, and decreased size, weight, and cost. Leverages a network of synthetic environments for evaluation of advanced concepts.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop advanced flight control systems, components, and integrated vehicle health monitoring systems for both manned and unmanned aircraft. In addition to increased reliability, efforts will also focus on reducing the size, weight, and cost of control and prognostic systems. Note: Increased funding in FY 2006 and out, is due to increased emphasis being placed on incorporating data from air vehicle monitoring components into the flight control systems.	5.483	7.108	13.730	15.912

(U) In FY 2004: Developed and assessed advanced control mechanization to provide highly reliable operations for manned and unmanned systems at reduced size, weight, and cost. Developed demonstrations of validation and verification techniques for complex, adaptive, and autonomous control software. Defined sensing requirements for unmanned systems situational awareness in airspace operations.

(U) In FY 2005: Continue to develop and assess advanced control mechanization to provide highly reliable operations for manned and unmanned systems at reduced size, weight, and cost. Develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Develop design analyses and technologies that enable analytical safety of flight certification of advanced complex control systems for applications in legacy and future air vehicles. Continue evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continue to enhance real-time fault compensation for aerospace vehicles using an integrated prognostic health management system. Initiate the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.

(U) In FY 2006: Further the development and assessment of advanced control mechanization technologies to

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provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Develop technologies and analysis tools to extend design-time verification and validation of intelligent, autonomous, and reconfigurable control systems for enhanced assurance. Continue the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continue to enhance real-time fault compensation for aerospace vehicles using integrated health management. Continue the development and evaluation of novel flight control effectors for distributed actuation and morphing aerospace vehicles.

(U) In FY 2007: Further the development and assessment of advanced control mechanization technologies to provide highly reliable operations for manned and unmanned systems under adverse environments at significantly reduced size, weight, and cost. Develop high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Design systems for safety-critical control using high-density optical components. Continue to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Refine technologies and analysis tools for reconfigurable control systems. Complete the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in aerospace operations. Refine technologies that permit integrated vehicle health management.

(U)

(U)	MAJOR THRUST: Develop flight control systems that will permit safe interoperability between manned aircraft and unmanned aircraft. Concepts will also provide mission responsiveness and adaptability for improved operational effectiveness of manned and unmanned systems. Note: In FY 2006 and out, increased funding is due to increased emphasis being placed on developing flight controls for small air platforms operating in an urban environment.	3.990	3.646	6.530	9.422

(U) In FY 2004: Developed and assessed novel control automation techniques and algorithms to enable safe and interoperable application of unmanned vehicle systems. Investigated feasibility of biology inspired control techniques to simplify unmanned systems autonomy implementations. Continued to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle packages. Developed intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems.

(U) In FY 2005: Continue efforts to develop and assess novel control automation techniques and algorithms

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	to enable safe and interoperable applications of unmanned vehicle systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Continue development of intelligent situational awareness algorithms to implement autonomous airspace operations control for unmanned vehicle systems.				
(U)	In FY 2006: Assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations.				
(U)	In FY 2007: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continue to enhance reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Initiate development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations.				
(U)					
(U)	MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft. Note: In FY 2006 and out, funding increased to expand simulation efforts.	4.427	5.743	8.545	6.360
(U)	In FY 2004: Assessed the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Conducted simulation assessments of advanced unmanned aerospace vehicles concepts. Enhanced simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Refined the development capability to virtually simulate future strike aircraft. Formulated and simulated concepts for future intelligence, surveillance, and reconnaissance platforms, future high-speed vehicles, advanced transports, and future tankers.				
(U)	In FY 2005: Refine efforts to assess the value of air vehicle technologies to future aerospace systems through the development and utilization of in-house tools, systems, and processes for simulation-based research and development. Conduct simulation assessments of advanced manned and unmanned aerospace vehicles concepts. Complete the enhancement of simulation and analysis capabilities through incorporation of cost models to determine the affordability of new technologies. Complete the development of the virtual simulation environment for future strike aircraft. Continue to formulate and simulate concepts for future intelligence, surveillance, and reconnaissance platforms, future high-speed vehicles, advanced transports, and future tankers.				

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(U) In FY 2006: Conduct assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Conduct analysis of future strike concepts in a 2020+ virtual environment. Continue analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Continue to support simulation activities for advanced transports and future tankers. Support the analysis of new concepts in hostile urban environments and missions requiring aircraft-like access to space.

(U) In FY 2007: Complete assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Complete analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Conduct technology trade studies for next generation theater transports. Conduct the analysis of new concepts in access to space missions. Conduct analyses of new concepts in hostile urban environments.

(U)

(U) CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research.	1.179	1.288	0.000	0.000

(U) In FY 2004: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.

(U) In FY 2005: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	15.079	17.785	28.805	31.694

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities: PE 0602202F, Human Effectiveness Applied Research.										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0602500F - Multi-Disciplinary Space Technology.										
(U) PE 0603211F, Aerospace										

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(U) C. Other Program Funding Summary ($ in Millions)

(U) Technology Dev/Demo. PE 0604015F, Next Generation Bomber.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

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DATE: February 2005

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies

PROJECT NUMBER AND TITLE: 2404 Aeromechanics and Integration

Cost ($ in Millions)		FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total
2404	Aeromechanics and Integration	23.080	26.074	26.869	28.277	33.052	32.654	33.148	33.614	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) A. Mission Description and Budget Item Justification

This project develops aerodynamic configurations of a broad range of revolutionary, affordable air vehicles. It matures and applies modeling and numerical simulation methods for fast and affordable aerodynamics prediction, and integrates and demonstrates multi-disciplinary advances in airframe, propulsion, weapon, and air vehicle control integration. Technologies developed will greatly enhance warfighter capability in aircraft, missiles, and high-speed aerospace vehicles. The payoffs from these technology programs include lower vehicle costs (both production, and operations and support costs), increased payload and range capability, and improved supportability, safety, and survivability of aerospace vehicles.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2004	FY 2005	FY 2006	FY 2007
(U) MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles. Note: In FY 2006, efforts for both manned and unmanned air vehicles were combined in this Major Thrust.	4.028	2.571	3.532	3.275

(U) In FY 2004: Developed and assessed aeronautical technologies that enable broad use of unmanned air vehicles in future missions to reduce life cycle costs and decrease human risk. Developed signature compatible, high lift wings for long-duration surveillance missions. Developed technology to improve engine nozzle design for increased survivability. Performed mission assessment and developed low-cost unmanned air vehicle concept to perform tactical surveillance. Applied flow control techniques to complex air vehicle designs to achieve reduced drag and improve propulsion performance.

(U) In FY 2005: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Continue to apply flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Initiate research into rapid prototyping and analysis techniques to support virtual and physical models. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.

(U) In FY 2006: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Evaluate the application of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.

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(U)	In FY 2007: Continue efforts to develop and assess aeronautical technologies that enable broad use of unmanned air vehicles in future missions, including offensive missions, to reduce life cycle costs and decrease human risk. Continue to perform mission assessment and develop low-cost unmanned air vehicle concept to perform tactical surveillance and weapon delivery. Initiate development and evaluation of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance on low speed vehicles. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.				
(U)					
(U)	MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned air vehicles. Note: This effort was completed in FY 2004.	3.916	0.000	0.000	0.000
(U)	In FY 2004: Developed design tools that permit quicker and more affordable certification of aerodynamic enhancements to extend the operational life of the current fleet. Enhancement of computer design and analysis code that reduced the need for expensive flight-testing, including completion of a robust unstructured mesh generation and adoption framework.				
(U)	In FY 2005: Not Applicable.				
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Not Applicable.				
(U)					
(U)	MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for sustained high-speed flight and re-useable high altitude aerospace vehicle efforts. Note: In FY 2004, the funding for this effort was zeroed to support increased emphasis that was placed on DDR&E's National Aerospace Initiative. In FY 2005, reuseable, high altitude aircraft efforts were broken out for increased visibility between high-speed and reuseable, high altitude aircraft efforts. In FY 2006 and out, increased emphasis has been placed on assessing the next generation long-range, high-speed air vehicle concepts.	0.000	8.815	13.460	15.901
(U)	In FY 2004: Not Applicable.				
(U)	In FY 2005: Develop and assess aerospace technologies that enable sustained high-speed (greater than Mach 2) flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Develop analytic methods for modeling the plasma flow field over high-speed vehicles to reduce drag. Complete development of techniques to carry and deploy weapons from aerospace vehicles operating at high speeds (greater than Mach 2) and high temperatures.				
(U)	In FY 2006: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conduct computational aerodynamic analysis and sub-scale				

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aerodynamic testing of advanced inlet boundary layer flow control techniques, secondary flow devices, and high-speed inlet apertures. Conduct computational aerodynamic analysis of high performance vectoring exhaust nozzles. Continue development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag. Conduct computational aerodynamic analysis of high efficiency wing-body aero configurations including advanced flight control techniques.

(U) In FY 2007: Continue development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continue development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conduct sub-scale aerodynamic testing of integrated inlet concepts on high efficiency aero configurations for system level performance validation. Develop and analyze thermally integrated structures for lightweight integrated exhaust systems and airframes. Conduct high fidelity aerodynamic testing of advance control techniques for low speed and high-speed operation. Develop analytical stability and control simulations to verify system level operability. Complete development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag

(U)

(U)	MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude aircraft . Note: In FY 2004, the funding for this effort was zeroed to support increased emphasis that was placed on DDR&E's National Aerospace Initiative. In FY 2005, the reuseable, high altitude aircraft efforts previously described in the above related Major Thrust area were broken out to allow for increased visibility between high-speed and reuseable, high altitude aircraft efforts. The FY 2006 and FY 2007 efforts will be leveraging the results of the high-speed Major Thrust area previously listed above.	0.000	7.245	3.738	1.501

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Develop and assess aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft operations. Continue development of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Develop techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.

(U) In FY 2006: Continue development and assessment of aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft. Continue development and initiate evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments. Continue and evaluate development of techniques to evaluate transatmospheric vehicle aerodynamic

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BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2404 Aeromechanics and Integration	

	configurations to validate aero thermodynamic predictions and analysis techniques.				
(U)	In FY 2007: Develop and assess aerospace technologies that enable reuseable, high altitude aircraft. Complete development and evaluation of computational, multi-disciplinary, experimental, and analytical tools to simulate and control the flow fields around advanced concepts for ultra-high-speed aerospace vehicles in extreme flight environments, including staging. Complete development of techniques to evaluate transatmospheric vehicle aerodynamic configurations to validate aero thermodynamic predictions and analysis techniques.				
(U)					
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into current and future air vehicle platforms. Note: In FY 2006 and out, investment is decreasing pending further development of directed energy applications.	9.566	4.093	2.544	1.716
(U)	In FY 2004: Developed and evaluated critical aeronautical technologies to enable directed energy weapons to be carried on future air vehicles to improve combat effectiveness. Developed aircraft techniques to enhance energy beam transmission through the complex, turbulent aerodynamic environment surrounding aircraft enabling the use of directed energy weapons from high-speed, maneuvering aircraft. Performed flight test measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft. Perform evaluation and demonstration of scalable technologies leading toward a high energy laser weapon.				
(U)	In FY 2005: Develop and evaluate critical aeronautical technologies to enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Complete analysis of the tactical utility a high energy laser on fighter aircraft. Continue measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.				
(U)	In FY 2006: Continue development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Complete analysis of tactical utility of high energy laser on fighter aircraft. Continue measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.				
(U)	In FY 2007: Complete development and evaluation of critical aeronautical technologies that enable directed energy weapons to be carried on future air vehicles, including maneuvering fighter aircraft, to improve combat effectiveness. Complete measurements of the actual aero-optics effects encountered when employing a laser weapon on a fighter aircraft.				
(U)					
(U)	MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft.	5.570	2.259	3.595	5.884

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2404 Aeromechanics and Integration**

(U) In FY 2004: Developed and assessed aeronautical technologies to enable revolutionary re-fueling and transport aircraft designs for rapid global mobility. Developed technologies to enable multiple roles and missions for support aircraft. Completed innovative designs for re-fueling and transport aircraft to improve range and payload capacity. Completed investigation of an aerodynamic flow field behind re-fueling aircraft to improve modeling and simulation.

(U) In FY 2005: Continue efforts to develop and assess aeronautical technologies to enable revolutionary tanker and transport aircraft designs for rapid global mobility, including multi-role designs. Continue to develop technologies to enable multiple roles and missions for delivery and support aircraft.

(U) In FY 2006: Continue to develop and assess aeronautical technologies including high lift systems, transonic, and structural designs that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft.

(U) In FY 2007: Further development and assessment of aeronautical technologies including high lift systems, transonic, and structural that enable revolutionary tanker and transport aircraft designs for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft.

(U) CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck Aircraft Design Program.	0.000	1.091	0.000	0.000

(U) In FY 2004: Not Applicable.

(U) In FY 2005: Initiated Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.

(U) In FY 2006: Not Applicable.

(U) In FY 2007: Not Applicable.

(U) Total Cost	23.080	26.074	26.869	28.277

(U) C. Other Program Funding Summary ($ in Millions)

	FY 2004 Actual	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	Cost to Complete	Total Cost
(U) Related Activities: PE 0602500F - (U) Multi-Disciplinary Space Technology. (U) PE 0603211F, Aerospace Technology Dev/Demo. (U) PE 0603500F -										

Exhibit R-2a, RDT&E Project Justification		DATE February 2005
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2404 Aeromechanics and Integration

(U) C. Other Program Funding Summary ($ in Millions)

Multi-Disciplinary Advanced Development Space Technology.

(U) PE 0604015F, Next Generation Bomber.

This project has been coordinated through the

(U) Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.