PE NUMBER: 0602201F
PE TITLE: Aerospace Vehicle Technologies

Exhibit R-2, RDT&E Budget Item Justification

DATE: February 2007

BUDGET ACTIVITY: 02 Applied Research

PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies

	Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
	Total Program Element (PE) Cost	102.792	118.901	131.948	119.637	144.898	146.714	142.567	146.421	Continuing	TBD
22SP	Applied Space Access Vehicle Tech	0.000	3.797	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
2401	Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	Continuing	TBD
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	Continuing	TBD
2404	Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	Continuing	TBD

Note: In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidisciplinary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts.

(U) A. Mission Description and Budget Item Justification

This program investigates, develops, and analyzes aerospace and access to space 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 2007, Congress added $2.4 million for Neurobiologically Autonomous Vehicle Operations, $1.0 million for the Unmanned Air Vehicle Research, $1.0 million for Sentient Adaptive Systems for Rapid Vehicle Condition-Based Maintenance, and $2.2 million for Wight Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers. 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 2006	FY 2007	FY 2008	FY 2009
(U)	Previous President's Budget	104.469	112.751	106.517	111.837
(U)	Current PBR/President's Budget	102.792	118.901	131.948	119.637
(U)	Total Adjustments	-1.677			
(U)	Congressional Program Reductions				
	Congressional Rescissions	-0.003	-0.450		
	Congressional Increases		13.100		
	Reprogrammings	-0.298	-6.500		
	SBIR/STTR Transfer	-1.376			
(U)	Significant Program Changes:				

Exhibit R-2, RDT&E Budget Item Justification	DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies

Not Applicable.

(U) C. Performance Metrics

Under Development

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 22SP Applied Space Access Vehicle Tech

Cost ($ in Millions)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
22SP	Applied Space Access Vehicle Tech	0.000	3.797	0.000	0.000	0.000	0.000	0.000	0.000	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

Note: In FY 2007, Project 6266SP, Applied Space Access Vehicle Technology, efforts were transferred from PE 0602500F, Multidiscipliary Space Technology, Project 625030, Applied Space Access Vehicle Technology, in order to effectively manage and provide oversight of the efforts. In FY 2008, efforts were terminated due to higher Air Force priorities.

(U) A. Mission Description and Budget Item Justification

This project develops technologies in areas of advanced structures, flight controls, and aerodynamics to enable affordable on-demand military access to space. Resulting technologies contribute significantly towards the development of reliable, responsive space access systems with aircraft-like operations. Payoffs to the warfighter include enhanced mission effectiveness, improved flight safety, improved maintenance, and decreased size, weight, and cost.

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop advanced structure, flight control, and aerodynamic technologies to enable horizontal launch for affordable on-demand military access to space.	0.000	3.797	0.000	0.000
(U) In FY 2006: Not Applicable.				
(U) In FY 2007: Further define and develop integrated guidance and control laws to expand the launch vehicle performance envelope.				
(U) In FY 2008: Not Applicable.				
(U) In FY 2009: Not Applicable.				
(U)				
(U) Total Cost	0.000	3.797	0.000	0.000

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activies:										
(U) PE 0603211F, Aerospace Technology Dev/Demo.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2401 Structures	

Cost ($ in Millions)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2401 Structures	37.077	46.136	38.132	37.681	51.802	50.629	44.892	61.039	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop an economic service life analysis capability comprised of analysis tools, methodologies, and structural health monitoring schemes.	2.060	2.120	3.705	3.593

(U) In FY 2006: Continued 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. Incorporated newly developed analysis tools into life prediction and failure analysis. Continued 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) In FY 2008: Based upon results of demonstration efforts in PE 0603211F - Aerospace Technology Dev/Demo, refine 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. Continue the development analysis tools into life prediction and failure analysis. Continue to develop failure criteria tools for advanced high temperature aircraft components and concepts.

(U) In FY 2009: 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.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2401 Structures**

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	Continue the development 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.	6.886	7.293	3.716	3.314
(U)	In FY 2006: Continued 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)	In FY 2008: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Incorporate newly developed analysis in 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 2009: Continue development of analytical certification methodologies that incorporate advanced methods, concepts, diagnostic techniques, and manufacturing technologies into legacy aircraft components and airframe design. Initiate development of high-fidelity and continue 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.	12.726	19.442	17.582	17.296

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY **02 Applied Research**	PE NUMBER AND TITLE **0602201F Aerospace Vehicle Technologies**	PROJECT NUMBER AND TITLE **2401 Structures**

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009

(U) In FY 2006: Continued development and initiated 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. Initiated the development and analysis of critical subsystem hardware integration methods to enable directed energy weapons to be carried out on future air vehicles. Completed analysis and continued feasibility determination of energy storage concepts that are integrated into load-bearing structures. Continued the development and initiated 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) In FY 2008: 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. Continue development, analysis, evaluation and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners and active denial concepts. Initiate characterization of high energy laser concepts. Initiate development, evaluation, and assessment of multi-functional structures to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2401 Structures

(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2009: 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. Initiate analysis for capabilities for conformal load bearing antenna structure. 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. Continue development, analysis, evaluation and simulation of innovative technologies to advance active aero elastic design concepts, adaptive structures, aerodynamic flow control technologies, system health reasoners and active denial concepts. Continue characterization of high energy laser concepts. Continue development, evaluation, and assessment of multi-functional structural to include ground demonstration of energy storage concepts, integrated distributed electronics, and homogeneous sensor integration systems.				
(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.	15.405	17.281	13.129	13.478
(U) In FY 2006: Refined 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. Continued 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) In FY 2008: 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. Incorporate newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2401 Structures

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) In FY 2009: 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. Incorporate newly developed structural concepts and analysis methods for design and evaluation of hot primary structure.				
(U)				
(U) Total Cost	37.077	46.136	38.132	37.681

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602102F, Materials.										
(U) PE 0603112F, Advanced Materials for Weapon Systems.										
(U) PE 0603211F, Aerospace Technology Dev/Demo.										
(U) PE 0604015F, Next Generation Bomber.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2403	Flight Controls and Pilot-Vehicle Interface	26.753	37.269	37.501	33.765	37.196	39.375	38.475	37.574	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 controls.

(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 2006	FY 2007	FY 2008	FY 2009
(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.	9.507	16.145	20.752	18.380

(U) In FY 2006: Furthered 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. Developed high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost, while considering maintainability. Designed systems for safety-critical control using high-density optical components. Continued to develop and assess tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Developed technologies and analysis tools to extend design-time verification and validation of intelligent, autonomous, and reconfigurable control systems for enhanced assurance. Continued the evaluation of sensing and associated interpretation techniques for unmanned system situational awareness in airspace operations. Continued to enhance real-time fault compensation for aerospace vehicles using integrated health management. Continued 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

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: 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. Complete development of high-density optical component technologies for adverse environments that reduce subsystem size, weight, and cost while considering maintainability. Complete systems design for safety-critical electromagnetic tolerant systems. Complete the assessment of enhanced tools and processes for the affordable validation and verification of complex, adaptive, and autonomous control software. Complete refinement of actuation fault compensation technologies for integrated vehicle health management.				
(U)	In FY 2009: 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. Initiate development of control architecture enhancements to enable design for certification to ease validation and verification for complex and adaptive unmanned systems. Initiate development of low-maintenance/fault tolerant control-effector technology for aerospace applications.				
(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.	4.506	9.783	9.817	8.665
(U)	In FY 2006: Assessed novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Continued to enhance reliability				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	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)	In FY 2008: 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. Continue development and assessment of cooperative control techniques for close-in surveillance of urban environments. Complete control and situational awareness requirements development for interoperability of unmanned vehicles in terminal area and ground operations. Develop and assess adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations.				
(U)	In FY 2009: Continue to develop and assess novel control automation techniques and adaptive algorithms to enable safe and interoperable application of manned and unmanned aerospace systems. Complete reliability and performance analysis of self-organizing, distributed control of multi-unmanned vehicle flight formations. Complete development and assessment of cooperative control techniques for close-in surveillance of urban environments. Initiate technology development for interoperability of unmanned vehicles in terminal area and ground operations. Continue to develop and assess adaptive guidance and control technologies for fault/damage tolerant aerospace vehicle operations.				
(U)					
(U)	MAJOR THRUST: Develop tools and methods for capitalizing on simulation-based research and development of future aircraft.	5.997	6.958	6.932	6.720
(U)	In FY 2006: Conducted assessments of advanced manned and unmanned aerospace concepts in simulated future environments. Conducted analysis of future strike concepts in a 2020+ virtual environment. Continued analysis of long endurance intelligence, surveillance, and reconnaissance platforms in a network centric environment. Continued to support simulation activities for advanced				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	transports and future tankers. Supported 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)	In FY 2008: Refine network-centric environment to broaden advanced technology assessment capability. Expand breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continue technology trade studies for next generation theater transports. Conduct simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.				
(U)	In FY 2009: Refine network-centric environment to broaden advanced technology assessment capability. Expand breadth of simulation analyses in refined net-centric environment to address multi-directorate technology trade studies for refined long-range strike and reconnaissance concepts. Continue technology trade studies for next generation theater transports. Conduct simulations to analyze advanced launch and reentry technologies for access-to-space concepts. Continue technology trade studies of small and medium sized unmanned air vehicles in hostile urban environments.				
(U)					
(U)	CONGRESSIONAL ADD: Intelligent Flight Control Simulation Research.	0.973	0.000	0.000	0.000
(U)	In FY 2006: Continued Congressionally-directed effort for intelligent flight control simulation research laboratory.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Sentient Adaptive Systems Technology for Vehicle Condition-Based Maintenance.	1.653	0.996	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.				

Exhibit R-2a, RDT&E Project Justification		DATE: February 2007
BUDGET ACTIVITY: 02 Applied Research	PE NUMBER AND TITLE: 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE: 2403 Flight Controls and Pilot-Vehicle Interface

	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	In FY 2007: Continue Congressionally-directed effort for sentient adaptive systems technology for vehicle condition-based maintenance.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Modeling and Simulation for Rapid Integration and Technology Evaluation.	1.653	0.000	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for rapid integration and technology evaluation.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmanned Systems Initiative for Army Missile Research, Development, Engineering Center (AMRDEC).	2.464	0.000	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for unmanned systems initiative for AMRDEC.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Neurobiologically Autonomus Vehicle Operations	0.000	2.391	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Initiate Congressionally-directed effort for neurobiologically autonomus vehicle operations.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Unmanned Air Vehicle Research	0.000	0.996	0.000	0.000
(U)	In FY 2006: Not Applicable.				
(U)	In FY 2007: Initiate Congressionally-directed effort for unmanned air vehicle research.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				

Exhibit R-2a, RDT&E Project Justification		DATE February 2007
BUDGET ACTIVITY 02 Applied Research	PE NUMBER AND TITLE 0602201F Aerospace Vehicle Technologies	PROJECT NUMBER AND TITLE 2403 Flight Controls and Pilot-Vehicle Interface

(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009
(U) Total Cost	26.753	37.269	37.501	33.765

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost
(U) Related Activities:										
(U) PE 0602202F, Human Effectiveness Applied Research.										
(U) PE 0602204F, Aerospace Sensors.										
(U) PE 0603211F, Aerospace Technology Dev/Demo.										
(U) PE 0604015F, Next Generation Bomber.										
(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.										

(U) D. Acquisition Strategy

Not Applicable.

Exhibit R-2a, RDT&E Project Justification			DATE: February 2007
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 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total
2404 Aeromechanics and Integration	38.962	31.699	56.315	48.191	55.900	56.710	59.200	47.808	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 2006	FY 2007	FY 2008	FY 2009
(U) MAJOR THRUST: Develop aerodynamic prediction efforts centered on expanding the design capabilities of manned and unmanned air vehicles.	4.839	3.402	4.061	3.226

(U) In FY 2006: Continued 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. Evaluated the application of flow control techniques to complex air vehicle designs to achieve reduced drag and improved propulsion system performance. Continued to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.

(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) In FY 2008: 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 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. Initiate development of fluid-based

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
thrust vectoring concept for unmanned air vehicle. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.				
(U) In FY 2009: 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 of innovative aerodynamic control methods for small unmanned air vehicles. Refine development of fluid-based thrust vectoring concept for unmanned air vehicle. Continue to develop technologies for improved weapon delivery and propulsion system performance in unmanned air vehicles.				
(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 2006 and out, increased emphasis has been placed on assessing the next generation long-range, high-speed air vehicle concepts. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.	18.143	16.373	26.931	19.758
(U) In FY 2006: Continued development and assessment of aerospace technologies that enable sustained high-speed flight to permit global reach. Continued development of integrated airframe propulsion design concepts for high-speed aerospace vehicles. Conducted computational aerodynamic analysis and sub-scale aerodynamic testing of advanced inlet boundary layer flow control techniques, secondary flow devices, and high-speed inlet apertures. Conducted computational aerodynamic analysis of high performance vectoring exhaust nozzles. Continued development of analytic methods for modeling the plasma flow field over high-speed vehicles to significantly reduce drag. Conducted 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.				

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(U) B. Accomplishments/Planned Program ($ in Millions)

	FY 2006	FY 2007	FY 2008	FY 2009

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) In FY 2008: 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. Initiate study of energy-based analysis and optimization techniques for vehicle design. Evaluate supersonic tailless aerodynamic concepts. Initiate efforts to characterize hypersonic phenomena and develop and validate fundamental hypersonic component technologies through experimental flight techniques in a relevant high-speed environment. Initiate efforts to integrate self-defense systems to counter multi-spectrum system threats. Evaluate sub-scale aerodynamic integrated inlet concepts on high efficiency aero configurations for system level performance. Evaluate thermally integrated structures for lightweight integrated exhaust systems and airframes. Continue high fidelity aerodynamic testing of advance control techniques for low-speed and high-speed operation. Validate analytical stability and control simulations for system level operability. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.

(U) In FY 2009: 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. Continue efforts to integrate self-defense systems to counter multi-spectrum system threats. Initiate advanced high-speed aero/flight control development. Initiate study of interaction of high-load, high-temperature flexible structural materials and fluid mechanics of inlet. Initiate component development enabling shock/boundary layer interaction control. Initiate study of exhaust systems for advanced hypersonic vehicles, and initiate cold-flow testing of sub scale components. Continue efforts to characterize high-speed phenomena and develop and validate fundamental high-speed component technologies through experimental flight techniques in a relevant environment. Note: Provide support to SECAF directed effort (Energy Conservation - Assured Fuels Initiative) to identify and develop technologies that provide revolutionary aircraft configurations that enable the use of domestic fuel sources for military energy needs.

(U)

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
(U)	MAJOR THRUST: Develop new and improved concepts, designs, and analysis of technologies to enable revolutionary capabilities for re-useable, high altitude aircraft. Note: The FY 2006 and FY 2007 efforts will be leveraging the results of the high-speed Major Thrust area previously listed above.	5.119	1.842	6.717	7.324
(U)	In FY 2006: Continued development and assessment of aerospace technologies that enable high-speed flight to permit reuseable, high altitude aircraft. Continued 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. Continued and evaluated development of techniques to evaluate transatmospheric vehicle aerodynamic 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)	In FY 2008: Continue development and assessment of aerospace technologies that enable reusable, space-access aircraft. Develop robust design methodology and integration approaches for high-speed aeropropulsion. Develop extensive application and 3D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Develop unique high temperature structures and materials in support of re-usable space-access aircraft. Pursue multi-disciplinary optimization of complex high speed, high temperature, reusable air vehicles.				
(U)	In FY 2009: Continue development and assessment of aerospace technologies that enable reusable, space-access aircraft. Enhance robust design methodology and integration approaches for high-speed aeropropulsion. Continue extensive application and 3D validation experience in applying aerothermal computational tools to conceptual, ground-tested and flight-tested vehicles traveling at high-speeds. Refine unique high temperature structures and materials in support of high speed re-usable space-access aircraft. Continue multi-disciplinary optimization of complex high-speed, high temperature, reusable air vehicles. Initiate design and test of components of integrated high-speed space-access air vehicle system.				
(U)					
(U)	MAJOR THRUST: Develop enabling technologies to allow integration of directed energy weapons into	3.556	1.789	2.278	1.108

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(U) B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
current and future air vehicle platforms.				
(U) In FY 2006: Continued 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. Completed analysis of tactical utility of high energy laser on fighter aircraft. Continued 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) In FY 2008: Initiate development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low speed aircraft. Initiate development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems.				
(U) In FY 2009: Continue development of combined flow control and adaptive optics systems to optimize directed energy system performance on large low-speed aircraft. Continue development of analysis tools for predicting the performance of advanced flow control and adaptive optics systems. Initiate preliminary design of beam control systems for large scale demonstration.				
(U)				
(U) MAJOR THRUST: Develop and assess technologies for the next generation of multi-role large aircraft. Note: In FY 2008 and out, investment is increasing due to higher Air Force priority for next generation large aircraft.	4.971	6.101	16.328	16.775
(U) In FY 2006: Continued 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. Continued 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) In FY 2008: Continue development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts that enable revolutionary tanker and transport aircraft designs				

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	B. Accomplishments/Planned Program ($ in Millions)	FY 2006	FY 2007	FY 2008	FY 2009
	for rapid global mobility. Continue to develop technologies that enable multiple roles and missions for delivery and support aircraft. Initiate trade studies between short take-off and landing performance, and high-speed cruise. Initiate development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities.				
(U)	In FY 2009: Continued development and assessment of aeronautical technologies including high-lift systems, transonic, and structural concepts 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. Optimize configuration for trade-off between short take-off and landing performance, and high speed cruise. Continue development of inlet and integration technologies for an advanced mobility platform designed to operate efficiently at transonic speeds and provide short take-off capabilities.				
(U)					
(U)	CONGRESSIONAL ADD: Unique Stealth Unmanned Air Vehicle Houck Aircraft Design Program.	1.361	0.000	0.000	0.000
(U)	In FY 2006: Continued Congressionally-directed effort for unique stealth unmanned air vehicle Houck aircraft design program.				
(U)	In FY 2007: Not Applicable.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	CONGRESSIONAL ADD: Wright Brothers Institute (WBI) - Characterization of Airborne Environment for Tactical Lasers.	0.973	2.192	0.000	0.000
(U)	In FY 2006: Initiated Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers.				
(U)	In FY 2007: Continue Congressionally-directed effort for WBI - characterization of airborne environment for tactical lasers.				
(U)	In FY 2008: Not Applicable.				
(U)	In FY 2009: Not Applicable.				
(U)					
(U)	Total Cost	38.962	31.699	56.315	48.191

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

	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	Cost to Complete	Total Cost

(U) Related Activities:

(U) PE 0603211F, Aerospace Technology Dev/Demo.

(U) PE 0604015F, Next Generation Bomber.

(U) This project has been coordinated through the Reliance 21 process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.