RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)							DATE February 2007	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Advanced Aerospace Systems PE 0603286E					
COST (In Millions)	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
Total Program Element (PE) Cost	50.272	80.474	86.385	95.703	98.923	100.923	128.923	142.021
Advanced Aerospace Systems AIR-01	50.272	80.474	86.385	95.703	98.923	100.923	128.923	142.021

(U) Mission Description:

(U) The Advanced Aerospace Systems program element is budgeted in the Advanced Technology Budget Activity because it addresses high payoff opportunities to dramatically reduce costs associated with advanced aeronautical systems and provide revolutionary new system capabilities for satisfying current and projected military mission requirements. Research and development of integrated system concepts, as well as enabling vehicle subsystems will be conducted. Studies conducted under this project include examination and evaluation of emerging aerospace threats, technologies, concepts, and applications for missiles, munitions, and vehicle systems.

(U) Program Accomplishments/Planned Programs:

	FY 2006	FY 2007	FY 2008	FY 2009
Heliplane (formerly Advanced Aeronautics Demonstration)	10.600	14.800	17.400	13.000

(U) The Heliplane program will design, develop and flight test an air vehicle that combines the vertical take-off and landing (VTOL) and low disk loading characteristics of a helicopter with the speed and efficiency characteristics of a fixed wing aircraft. The Heliplane demonstrator aircraft will be tailored to a Combat Search and Rescue (CSAR) mission with a 400 mph cruise speed, a 1,000 lb payload, and an unrefueled range of 1,000 miles. The Heliplane program will conduct a combination of analysis and experiments to develop and demonstrate key enabling technologies. Once key enabling technologies have been demonstrated, a preliminary and detailed design of the Heliplane system will be completed, a full scale test of the rotor system will be conducted, and a Heliplane demonstrator will be fabricated and flight tested. Potential customers include the Army, Special Operations Command (SOCOM), Marines, and AFSOC.

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(U) Program Plans:
- Perform Heliplane system trade studies and develop conceptual design.
- Develop and conduct risk-reduction demonstrations of key Heliplane technologies and components.
- Demonstrate capability for stable operation of the full-scale Heliplane rotor system at high speed in a wind tunnel.
- Complete preliminary and detailed design of Heliplane demonstrator.
- Fabricate Heliplane demonstrator aircraft.
- Conduct flight tests to validate Heliplane performance.

	FY 2006	FY 2007	FY 2008	FY 2009
Oblique Flying Wing (OFW)	7.028	16.500	27.150	40.850

(U) The Oblique Wing aircraft is a flying wing, which flies with variable sweep to improve high speed characteristics. The variable sweep is achieved asymmetrically on the oblique wing, with one wing swept forward and the other swept aft. A supersonic, variable sweep oblique flying wing would be efficient in both high speed cruise and low speed loiter, would be compatible with survivability requirements, and would have a structurally efficient airframe. Possible missions that would take advantage of the combination of high and low speed performance could include: penetrating intelligence, surveillance, reconnaissance, long range strike, hunter/killer, and multimission aircraft. A supersonic aircraft capable of extremely long loiter times would have a revolutionary impact on the battlefield, necessitating fewer combat aircraft and fewer tankers to accomplish mission objectives. The goal of the Oblique Flying Wing (OFW) program is to expand the design space for future aircraft concepts, particularly for those missions that demand both supersonic speed and long endurance. The potential for a unique combination of excellent high speed and low speed performance would enable rapid deployment and long loiter time, for example, in surveillance or combat air patrol (CAP) roles. The OFW program will integrate technologies such as advanced controls to develop and fly a small-scale technology demonstrator vehicle. The program will also identify key design requirements for the objective system, allowing the services to evaluate the technology for implementation in future operational systems. The anticipated transition partner is the Air Force.

(U) Program Plans:
- Develop oblique wing concept design.

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- Define, develop, and demonstrate key oblique wing component technologies.
- Begin system design for an objective oblique wing system and a flight demonstrator.
- Develop preliminary design and detailed design of oblique wing flight demonstrator aircraft.

	FY 2006	FY 2007	FY 2008	FY 2009
Heavy Fuel Engine	6.612	6.729	5.535	3.153

(U) The Heavy Fuel Engine program will develop and demonstrate a heavy-fuel, lightweight, and efficient engine for air vehicles. In the future, heavy fuel (diesel or JP-8) may be the only logistic fuel for the battlefield. Conventional heavy fuel engines are too heavy for air vehicles and, at the desired size, not efficient enough. Innovative and advanced diesel engine designs are being developed to achieve both efficiency and a significant reduction in weight. Such engines will enable air vehicles increased maximum range and endurance while operating on diesel fuel. Novel approaches to achieving challenging performance goals include an opposed piston, opposed cylinder (OPOC) concept and a very low friction in-line opposed piston configuration. The OPOC engine is designed to achieve sustained high power at high altitude and to minimize the impact of lapse rate. The Low Friction Engine (LFE) is designed to operate without conventional piston rings which are a principal cause of internal combustion engine friction and diminish the amount of useful work that is available from an engine. Detailed design, fabrication, and testing is being conducted to assess engine performance and reliability. Initial engine technology transition planning identified the A160 air vehicle as a promising platform for a heavy fuel engine. Integration of a heavy fuel engine could potentially double endurance for a given weight of fuel. Potential customers include the Army, Special Operations Command (SOCOM), and Marines.

(U) Program Plans:

- Completed single OPOC prototype engine performance and endurance testing.
- Complete final OPOC design and assembly.
- Conduct full OPOC twin-module engine tests.
- Demonstrate performance and reliability of optimized engines at 38% efficiency, a power to weight ratio of 0.9hp/lb, and producing 450 hp at 15,000 ft.
- Conduct LFE comparative demonstration of ringless piston operation for low friction and viable operation.

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- Complete Low Friction Engine (LFE) performance, structural and thermodynamic analysis, assessment, and conceptual design.
- Demonstrate a single cylinder engine for incremental performance capability.
- Demonstrate four-cylinder engine for full performance.
- Integrate prototype engines with the A160 air vehicle.

	FY 2006	FY 2007	FY 2008	FY 2009
Advanced Aerospace System Concepts	3.254	4.345	3.500	2.500

(U) Studies conducted under this program examine and evaluate emerging aerospace technologies and system concepts for applicability to military use. This includes the degree and scope of potential impact/improvements to military operations, mission utility, and warfighter capability. Studies are also conducted to analyze emerging aerospace threats along with possible methods and technologies to counter them. The feasibility of achieving potential improvements, in terms of resources, schedule, and technological risk, is also evaluated. The results from these studies are used, in part, to formulate future programs or refocus ongoing work. Topics of consideration include: methods of defeating enemy anti-aircraft attacks; methods to intercept and defeat enemy unmanned air vehicles (UAVs); autonomous refueling for air vehicles; munition technologies to increase precision, range, endurance, and lethality of weapons for a variety of mission sets; novel launch systems; and air vehicle control, power, propulsion, materials, and architectures.

(U) Program Plans:
- Perform studies of candidate technologies and develop system concepts.
- Conduct modeling and simulation of system architectures and scenarios.
- Conduct enabling technology and sub-system feasibility experiments.

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	FY 2006	FY 2007	FY 2008	FY 2009
A160	7.000	7.000	5.000	0.000

(U) The A160 program will exploit a hingeless, rigid rotor concept operating at the optimum rotational speed to produce a vertical take-off and landing (VTOL) unmanned air vehicle (UAV) with low disk loading and rotor tip speeds resulting in an efficient low power loiter and high endurance system. This unique concept offers the potential for significant increases in VTOL UAV range (>2,000 nm) and/or endurance (>20 hours). The focus of the remaining program is on the final development and demonstration of the A160 turbo-shaft variant. Proof of concept flight test will demonstrate platform performance goals, most notably, endurance, a 15,000 feet high altitude hover-out-of-ground effect capability, payload carrying and speed. This program will also demonstrate airworthiness, reliability, and autonomous capabilities of the vehicle. The A160 concept has the potential to meet a range of surveillance and targeting, communications and data relay, crew recovery, resupply of forces in the field, and special operations missions in support of Army, Navy, Marine Corps, and other agency needs. The program also provides a platform for integration and testing of highly efficient heavy fuel engine technologies. These technologies can further advance current range and endurance. The A160 program will transition after completion of this Phase.

(U) Program Plans:
- Complete development of the turbo-shaft A160 including the major components of engine, flight control system and transmission system.
- Demonstrate performance goals through flight tests.

	FY 2006	FY 2007	FY 2008	FY 2009
Cormorant Unmanned Air Vehicle (UAV)	9.600	5.100	0.000	0.000

(U) The Cormorant Unmanned Air Vehicle (UAV) program examined the feasibility of a UAV that may be deployed from the sea without carrier support. The program explored concepts that launch from both the sea surface and submarines. Technical challenges included underwater recovery and docking of the aircraft with a submerged submarine, aircraft structural integrity and water tightness at submarine launch depths and

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on the surface, aircraft dynamics at the air/sea interface, engine technology to survive periodic immersion in salt water, and advanced composite materials development to withstand sea-surface operations.

(U) Program Plans:
- Conducted feasibility studies; conducted modeling and simulation of vehicle behaviors in the air/sea interface.
- Performed concept design studies.
- Performed engine quick start demonstration and engine concept development.
- Conducted initial technology demonstrations for underwater in-haul and docking of an air vehicle in a series of full scale tests.

	FY 2006	FY 2007	FY 2008	FY 2009
Critical Munition Capability	6.178	6.000	0.000	0.000

(U) The Critical Munition Capability program consisted of four efforts: Hypersonic Joint Attack Munition (HyperJAM), Multi-target Autonomous Loitering Littoral Munition (MAULLM), Battlefield Electronically Disruptive Loitering Attack Missile (BEDLAM), and Deep Interdiction with Multiple Engagements (DIME). The goal of each of these efforts was to provide the warfighter with a range of weapons that enable effective, precise, responsive, and decisive disruption to enemy forces.

(U) HyperJAM explored the ability to deliver GPS precision guided weapons to high value, well defended, and relocatable targets with range capability in excess of 400 nm. HyperJAM investigated the use of conventional rocket technology (black brandt rocket) integrated with a modified aerodynamically enhanced Joint Direct Attack Munition (JDAM) high speed nosecone to deliver MK84 munitions to precise locations. MAULLM developed concepts and technologies for a containerized, platform-independent multi-mission weapon concept that could provide rapid response and lethality in packages with significantly lower missile unit cost, decreased logistical support and lower life-cycle costs, while increasing flexibility compared to current Naval gun and missile systems. BEDLAM developed concepts and technologies for detection, exploitation, and disruption of a wide variety of enemy electronic emissions which could be integrated into a mission module suitable for use on small loitering missiles to establish patterns or meetings with other emitters to aid in intelligence and targeting. DIME investigated the trade-space

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between missiles and aircraft, with the objective of improving the operational utility of aircraft and UAVs with the support requirements, acquisition characteristics, and attritability of munitions.

(U) Program Plans:
- Completed HyperJAM simulation studies to determine range capability and control requirements for potential Army, Navy, and Air Force customers.
- Developed system level requirements and CONOPS for air and gun delivered munitions.
- Conducted preliminary concept studies for MAULLM and BEDLAM.
- Developed DIME mission concepts and technical requirements studies.

	FY 2006	FY 2007	FY 2008	FY 2009
Dual Mode Small Gunship	0.000	6.000	7.600	8.400

(U) The objective of the Dual Mode Small Gunship program is to build, test and fly a low-cost small aircraft, configured with sensors, weapons and special equipment that are controlled either remotely or by a crew onboard. The vehicle will demonstrate persistent, sustained gunship and strike mission capabilities with troops on the ground directly commanding the aircraft's weapons and sensors. The gunship will give the ground warfighter particular advantage in urban environments where it will operate with high availability, fast response, precision strike and low collateral damage. The ability to have a pilot on-board will allow for easy deployment to theater and safe operation over populated areas by allowing the pilot to interface with the air traffic control infrastructure rather than the current, cumbersome method of deploying large UAVs. The plan to "unman" an existing aircraft also minimizes development costs. The Dual Mode Small Gunship is expected to have low development and procurement costs, high endurance and range, a large payload, and high dash speeds with a day/night adverse weather capability. Potential customers include the Army, SOCOM, Marines, and AFSOC.

(U) Program Plans:
- Complete a preliminary feasibility study for modification of an existing low cost aircraft.
- Modify an existing low cost aircraft for use as an "optionally piloted" aircraft, with weapons systems and sensors.

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– Demonstrate ability to control the aircraft, its weapons and sensors from the ground.

	FY 2006	FY 2007	FY 2008	FY 2009
Close Air Support Technology for Loitering Engagement (CASTLE)	0.000	2.500	5.000	7.100

(U) The Close Air Support Technology for Loitering Engagement (CASTLE) program will develop alternatives to current, manned systems and explore approaches to provide persistent on-demand overhead fire support with gun-ship like precision, tailored lethal effectiveness and unit directed responsive command and control. Key technologies to be analyzed, developed and integrated under CASTLE include 1) affordable, survivable, and persistent unmanned aircraft, 2) weapons consistent with man-in-the loop close air support application, such as auto-loading Electro Magnetic (EM) guns, directed energy weapons, vertical launch missiles, or deep magazine traditional guns and precision bombs, 3) sensors for targeting and designation, and 4) an adaptive command and control system to permit small unit request, coordination, and direction of supporting fires. Potential customers include the Army, SOCOM, Marines, and AFSOC.

(U) Program Plans:
- Evaluate candidate technologies for CASTLE.
- Conduct initial concept trade-off for preliminary CASTLE system designs.
- Perform modeling and simulation of alternative candidate air system architectures to assess effectiveness of alternative CASTLE approaches.
- Complete preliminary design of air vehicle design concept and development.
- Perform CASTLE technology risk reduction experiments and demonstrations.

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	FY 2006	FY 2007	FY 2008	FY 2009
Aircraft Self Protection (ASP)	0.000	6.000	7.000	9.000

(U) The Aircraft Self Protection (ASP) program will explore the active protection of slow moving, high altitude aircraft systems with guided missiles or high energy laser weapons as an alternative/complement to passive defense by signature control. Today such aircraft rely on stealth technology to avoid detection and engagement by long range surface to air missile threats. In the future, the unique advantage enjoyed by the United States may be eroded by technological advances, and stealthy aircraft often give up their advantage in detectibility when they utilize active radar and laser sensors in the conduct of their mission. An active aircraft self-defense system could relax the design constraints imposed by signature control, allowing a greater range of platform capabilities. Because lasers provide "speed-of-light" response and a deep magazine, we will examine their suitability relative to the more conventional missile based solutions. The ASP program will evaluate both pod-mounted and fully integrated system concepts and will develop and demonstrate missile detection, threat tracking, engagement, and defeat at a safe range. Potential customers include the Army, SOCOM, Marines, and AFSOC.

(U) Program Plans:

- Perform ASP system trade-off analysis, resulting in system size, weight, power and effectiveness criteria.
- Evaluate alternative high energy laser designs and missile or projectile technologies for ASP applications.
- Demonstrate integration of missile warning and tracking capabilities with lightweight beam director technology against incoming missile threats.
- Select initial ASP design concept and perform development to preliminary design review.

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	FY 2006	FY 2007	FY 2008	FY 2009
Rapid Eye	0.000	0.000	4.500	7.500

(U) The goal of the Rapid Eye program is to develop a high altitude, long endurance unmanned aircraft that can be rocket-deployed from the continental United States world-wide within 1-2 hours to perform intelligence, surveillance, reconnaissance (ISR), and communication missions. The enabling technologies are inflatable/folding structures, stable and dense energy storage, and low-oxygen propulsion. Rapid Eye will provide decision makers rapid-reaction ISR and persistent communication capability for emerging situations.

(U) Program Plans:
- Develop Rapid Eye preliminary design, risk management plan, and technology and system maturation plan.
- Begin conceptual design study of system trades, effectiveness, and affordability through modeling and simulation.
- Develop sufficient system concept fidelity to validate program goals and objectives.
- Perform multi-team study of aerodynamic decelerators, inflatable wings, and propulsion concepts.

	FY 2006	FY 2007	FY 2008	FY 2009
VULTURE	0.000	0.000	3.700	4.200

(U) The goal of the Very-high altitude, Ultra-endurance, Loitering Theater Unmanned Reconnaissance Element (VULTURE) program is to develop a high altitude, long endurance (multi-month) unmanned aircraft to perform intelligence, surveillance, reconnaissance (ISR), and communication missions over an area of interest. The enabling technologies are solar collection, dense and efficient energy storage, and improved reliability for components, and lightweight structures. VULTURE, in effect, will be a retaskable, persistent satellite capability, in an aircraft package.

(U) Program Plans:
- Perform multi-team conceptual design study of system trades, effectiveness, and affordability through modeling and simulation.

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- Develop sufficient system concept fidelity to validate program goals and objectives.
- Begin technology development in the areas of solar collection and energy storage.
- Begin sub-scale demonstration of components.

	FY 2006	FY 2007	FY 2008	FY 2009
Heavy Lift	0.000	4.500	0.000	0.000

(U) The Heavy Lift program explored technologies that would lead to novel STOL/VTOL air vehicle concepts and designs. The objective VTOL aircraft would have been optionally-manned and able to lift a 20-ton payload and carry it forward at speeds of 200+ knots with a tactical radius of 400 miles. The program examined technology advances in advanced rotors, propellers, hybrid-mode engines, controls, and advanced composite airframes.

(U) Program Plans:
- Performed trade studies.

	FY 2006	FY 2007	FY 2008	FY 2009
Heavy Fuel Engine Development	0.000	1.000	0.000	0.000

(U) The Heavy Fuel Engine program will develop and demonstrate a heavy-fuel (e.g. diesel), lightweight, and efficient engine for air vehicles. Innovative and advanced diesel engine designs are being developed to achieve both efficiency and a significant reduction in overall weight. Such engines will enable air vehicles increased maximum range and endurance while operating on a logistic fuel.

(U) Program Plans:
- Assess initial concepts.
- Complete preliminary design.

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(U) Program Change Summary: *(In Millions)*

	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget	54.594	115.829	202.587	250.823
Current Budget	50.272	80.474	86.385	95.703
Total Adjustments	-4.322	-35.355	-116.202	-155.120
Congressional program reductions	-3.000	-36.355		
Congressional increases	0.000	1.000		
Reprogrammings	0.000			
SBIR/STTR transfer	-1.322			

(U) Change Summary Explanation:

FY 2006	The decrease reflects SBIR/STTR transfer and the Section 8040 rescission.
FY 2007	The decrease reflects congressional cuts to Heavy Fuel Engine, Cormorant, Global Range Transatmospheric Vehicle, A160, Advanced Aeronautics Demonstration, Critical Munition Technology, Seaplane UAV, Heavy Lift, CASTLE, and a reduction for Section 8106 Economic Assumptions. The decreases are offset by a congressional add for Heavy Fuel Engine Development.
FY 2008/09	The decreases reflect overall funding reductions due to the cancellation of several major programs such as the Cormorant.

(U) Other Program Funding Summary Cost:

A160	FY 2006	FY 2007	FY 2008	FY 2009
Army S&T, Phase I	10.000	15.000	0.000	0.000
Army S&T, Phase II	9.190	18.740	0.000	0.000