

**UNCLASSIFIED**

PE NUMBER: 0603790F  
 PE TITLE: NATO Cooperative R&D

<b>Exhibit R-2, RDT&amp;E Budget Item Justification</b>	DATE <b>February 2007</b>
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<b>BUDGET ACTIVITY</b> <b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	<b>PE NUMBER AND TITLE</b> <b>0603790F NATO Cooperative R&amp;D</b>
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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	3.842	4.080	4.280	4.370	4.479	4.547	4.636	4.731	Continuing	TBD
NATO Nato Coop R&D	3.842	4.080	4.280	4.370	4.479	4.547	4.636	4.731	Continuing	TBD

**(U) A. Mission Description and Budget Item Justification**

These funds will be used to help implement international cooperative research, development, and acquisition (ICRD&A) agreements with North Atlantic Treaty Organization (NATO) member states, major non-NATO allies (Argentina, Australia, Egypt, Bahrain, Israel, Japan, Jordan, and Rep. of Korea (South Korea), Kuwait, Morocco, New Zealand, Pakistan, Taiwan, Thailand, and Phillipines) and friendly foreign countries (Austria, Brazil, Bulgaria, Finland, India, Singapore, South Africa, Sweden, Switzerland, and Ukraine). The program implements the provisions of Title 10 U.S. Code, Section 2350a on NATO Cooperative Research and Development (R&D). The program was established to improve cooperation among NATO nations, and later major non-NATO allies, in research, development, and acquisition. The legislation authorized funds to significantly improve United States (US) and allied conventional defense capabilities by leveraging the best defense technologies, eliminating costly duplication of R&D efforts, accelerating the availability of defense systems, and promoting US and allied interoperability or commonality. The program will be reported as required by Title 10 U.S. Code, Section 2350a(f). This program element funds the implementation of Air Force ICRD&A agreements in (1) Basic Research (2) Applied Research (3) Advanced Technology Development (4) Advanced Component Development and Prototypes (5) System Development and Demonstration and (6) RDT&E Management Support. This PE is designated in Budget Activity 4 because most of the ICRD&A projects support specific systems, include all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology, and help expedite technology transition from the laboratory to operational use.

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Previous President's Budget	3.916	3.972		
(U) Current PBR/President's Budget	3.824	4.080	4.280	4.370
(U) Total Adjustments	-0.092			
(U) Congressional Program Reductions				
Congressional Rescissions	-0.015			
Congressional Increases				
Reprogrammings				
SBIR/STTR Transfer	-0.077			
(U) <u>Significant Program Changes:</u>				
Change Summary Explanation: N/A				

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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
NATO Nato Coop R&D	3.842	4.080	4.280	4.370	4.479	4.547	4.636	4.731	Continuing	TBD
Quantity of RDT&E Articles	0	0	0	0	0	0	0	0		

(U) **A. Mission Description and Budget Item Justification**

These funds will be used to help implement international cooperative research, development, and acquisition (ICRD&A) agreements with North Atlantic Treaty Organization (NATO) member states, major non-NATO allies (Argentina, Australia, Egypt, Bahrain, Israel, Japan, Jordan, and Rep. of Korea (South Korea), Kuwait, Morocco, New Zealand, Pakistan, Taiwan, Thailand, and Phillipines) and friendly foreign countries (Austria, Brazil, Bulgaria, Finland, India, Singapore, South Africa, Sweden, Switzerland, and Ukraine). The program implements the provisions of Title 10 U.S. Code, Section 2350a on NATO Cooperative Research and Development (R&D). The program was established to improve cooperation among NATO nations, and later major non-NATO allies, in research, development, and acquisition. The legislation authorized funds to significantly improve United States (US) and allied conventional defense capabilities by leveraging the best defense technologies, eliminating costly duplication of R&D efforts, accelerating the availability of defense systems, and promoting US and allied interoperability or commonality. The program will be reported as required by Title 10 U.S. Code, Section 2350a(f). This program element funds the implementation of Air Force ICRD&A agreements in (1) Basic Research (2) Applied Research (3) Advanced Technology Development (4) Advanced Component Development and Prototypes (5) System Development and Demonstration and (6) RDT&E Management Support. This PE is designated in Budget Activity 4 because most of the ICRD&A projects support specific systems, include all efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology, and help expedite technology transition from the laboratory to operational use.

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

	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) Visual Process Fit & Accommodation Consulting Tools (AFRL / The Netherlands) - Planned cooperative project to develop web based, comprehensive, international data system on 3-D body size, shape, fit and performance. The new data visualization tools will be used to make information more usable, and additional data on pilot performance will be more dynamic.	0.140			
(U) Coalition Mission Training (AFRL / Canada/UK) - Planned cooperative project is being conducted to enable warfighters to train for coalition air operations while remaining at their home stations. Partner nations will develop distributed simulation technologies, implement a multi-national distributed training network, and conduct a series of coalition force training exercises. Warfighters will use real-time virtual simulators to conduct readiness training for combined air operations within a common synthetic environment. The program will support incorporation of USAF simulators located outside the Continental US into Distributed Mission Training exercises and will provide the foundation for integrating coalition partners' simulation assets into future multi-national training readiness exercises.	0.600			
(U) Distributed Mission Training (DMT) Technologies (AFRL / Canada) - Planned cooperative project to develop DMT technologies that will enhance allied simulator based training of fighter aircrews and demonstrate proof of concept. Project will complete research and development of next generation visual	0.100			

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(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
systems for DMT to include ultra-high resolution laser projector, image generator, and collimating display screen materials.					
(U) C2 Warrior (AFRL / Australia) - Planned cooperative project will develop advanced work-centered interface technologies to enhance ISR Collection Management and Air Space Control operations within an Air Operations Center (AOC). The work-centered interface systems will integrate stereoscopic visualization, speech control, head-eye based control, gesture recognition, intelligent interface agents, and face recognition. By combining technical components within a work-centered organizing framework, an interface client system can be developed that will improve information integration, decision making, and operational execution.	0.500				
(U) High-Power Microwave Narrowband Effects Investigations (AFRL / UK) - Planned cooperative project will conduct High-Power Microwave (HPM) electronics effects experiments in the UK. There is a need for HPM effects information on electronic systems in a statistically significant format with high confidence values in order to investigate the impact of future HPM systems on the battlefield. There is a need to perform test series in order to build up a library of electronic asset response distributions. This cooperative project will perform these needed experiments and tests.	0.129	0.071			
(U) Refractive Turbulence and Transient Electronic Disconnectivity (AFRL/VS / Australia) - This cooperative project falls with the AFRL/VS thrust areas of Surveillance and Force Projection, under which is the Optical Turbulence Program, a technical area driven by the operational requirements of the Airborne Laser (ABL) Program and the High Energy Laser-Joint Technology Office (HEL-JTO) AFRL/CC Memorandum for HQ AFMC/DR, stated requirement for stratospheric turbulence research and improved forecasting capability to support of U-2 and UAV operations. The projected use of directed energy weapons, high band-width laser communication (air-to-air, air-to-ground and air-to-space) and high resolution imagery from manned and unmanned aircraft requires knowledge of and the ability to forecast the location, severity, and duration of refractive turbulence structure that limit system performance.	0.075	0.075			
(U) Optical Sensor Protection Development and Evaluation (AFRL / UK) - Planned cooperative project to develop and assess promising electro-optic protection materials, devices, and configurations for laser hazard and threat protection for eyes and sensors. In FY03, development, testing, and analyses will begin.	0.698				
(U) Aero-Engine Component Life Extension, Phase II (AFRL / Australia) - Ongoing cooperative project to develop life extension techniques and strategies that can be applied to advanced military engines. The engines involved include the US Air Force F100, -220, -229 and F101 and Australia's TF30, F404 and	0.500	0.400			

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	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b> T700. Much of the technology will be generic and flow from one engine to another. In FY03, development of NDE techniques for characterization of residual stress profiles will conclude; activities to address the shortfalls in life prediction capabilities will conclude, and; the final report will be written.					
(U) Network-Centric Strike Controller (AFRL/HECP) - Planned cooperative project to design and develop interface technologies to extend the effectiveness and capabilities of Air Battle Managers (ABMs) working within a network-centric framework. Using simulated AWACS and MC2A work environments, it will make use of networked data, advance data visualization tools, knowledge and content management systems, decision-aiding and automation algorithms, and advance collaboration interface technologies. This approach will enable greater shared battlespace awareness, more efficient and effective individual and team decision-making, increased speed of command, and adaptability. Cognitive engineering and user-centered design methodologies will be employed to identify the appropriate information and interface requirement for operators working within the domain.	0.125	0.150	0.150		
(U) Operator and State Assessment and Aiding Implementation (AFRL / Sweden) - Planned project provides enhanced mission effectiveness by matching the cognitive demands placed on the operator with the current, momentary, capabilities of the human operator. Existing and future systems can easily overload the cognitive capabilities of the human operator. However, these systems are also capable of controlling the amount and rates of information presented to the operator. Accurate assessment of the operator's cognitive state coupled with intelligent agents will permit the real-time tailoring of system demands placed upon the operator to produce enhanced overall system performance and increase mission effectiveness. The proposed project is a follow-on to the very successful Annex E, "Pilot Performance and Mental Workload", to that MOA. This proposed project will permit continuation of our excellent relationship with the Swedish FMV and FOI organizations. AFRL/HEC and FOI have common goals and complementary personnel and facilities. While the AFRL/HEC interests are primarily with unmanned aircraft operators FOI has excellent cockpit and dynamic simulators. Sweden can adapt and test the operator assessment and adaptive aiding technology in these cockpits while AFRL/HEC will focus on the unmanned operator environment. These parallel efforts will permit lessons learned from these two environments to jointly benefit one another.	0.050	0.150	0.200		
(U) Resilient Structural and Blast Suppression Systems for Blast Protection Research Program (AFRL / UK) - Planned cooperative project to conduct technical research to increase the level of protection to national and coalition force troops in military facilities worldwide in the event of a terrorist bombing. These research activities and full-scale experiments will involve US Air Force (USAF) and UK Home Office personnel developing and testing blast mitigating resilient structural systems for implementation into	0.100	0.400	0.400		

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	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	
(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>					
new construction and for retrofit of existing conventional facilities.					
(U) Hard Target Defeat (AFRL / Germany) - PA signed April 15th 1998, established the Hard Target Defeat Technology Project as a Project in accordance with the Memorandum of Understanding between the Secretary of Defense on behalf of the Department of Defense of the United States of America and the Federal Minister of Defense of the Federal Republic of Germany for Research and Technology Projects. The objectives of the Hard Target Defeat (HTD) Technology Project are to investigate the lethality of conventional warheads against targets representative of hardened facilities. This new effort will be the next phase of that research and will improve the predictive accuracy of models that measure the functional degradation resulting from destruction of and/or damage to mission critical components and protective structural components due to internal and external detonations of conventional warheads. In addition, this new effort investigates methods for predicting the effect of engaging a facility containing chemical or biological materials, related research, or production equipment. The results of this proposed investigation are critical for the development, improvement and validation of computer-based methodologies used to predict the weapon effects against hard to defeat targets. Accurate predictions are necessary to provide operational command with targeting options against high value targets.	0.050	0.200	0.200		
(U) Coalition-Interoperable SATCOM Data Broadcast Protocols (GBS-JPO/HQ ESC/NATO / Australia) - Planned groundwork for a US and coalition interoperable satellite data delivery system that ensure the right data is received by warfighters who need them in real-time to save lives and gain tactical advantage and information dominance. The objective of the proposal is to test, analyze and coordinate technical solutions for interoperable data broadcast protocols among three principle international partners and to set the stage for documenting an interoperable coalition agreement in an Annex to the current Draft NATO STANAG 4622, Interoperability Standard for Satellite Broadcast Services (SBS). These three partners are among the world's leaders in technical maturity of data broadcast capability, USAF GBS JPO, NATO Command, Control and Communications Agency (NC3A) and Australian Theatre Broadcast System (TBS). This assists these players in aggressively pursuing military coalition interoperability based on direct broadcast and very small aperture terminal (VSAT) internet capability in the rapidly advancing worldwide satellite broadcast industry.	0.100	0.215	0.300		
(U) Multi-modal Situational Awareness Displays for Maneuvering Aircraft (AFRL / The Netherlands) - Planned project develops audio, visual, and tactile display symbology to increase situational awareness, decrease pilot workload, and reduce the risk of spatial disorientation in fast jet aircraft. Pilot-vehicle interface development is currently underway for the JSF, which will be the first USAF aircraft with a 3-D audio display capable of directionalizing the warning sounds presented to the pilot. AFRL/HE is	0.100	0.250	0.250		

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(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b> currently researching how 3-D audio should be used, in conjunction with visual and tactile displays, to maximize pilot performance and minimize the likelihood of spatial disorientation in USAF aircraft. However, AFRL/HE is unable to evaluate its prototype display designs under the dynamic acceleration conditions that occur in maneuvering fast jet aircraft. This is a critical deficiency, because visual-vestibular and audio-vestibular interactions are known to cause sensory illusions that might enhance or compromise a pilot's ability to make use of audio and visual information presented in a cockpit display.					
(U) International Mission Training Research (AFRL / Sweden) - The objective of this project is to collaboratively conduct research and development activities that will enhance the technologies, processes, and strategies for training based on Distributed Simulation. To achieve these objectives, the participants will cooperatively conduct research efforts to enhance the capabilities of national Distributed Mission Operations (DMO) systems and accelerate collection of research data. Participants will also develop a secure data link between the US and Sweden to support DMO exercises and to develop and evaluate application of DMO for training coalition operations in Peacekeeping Support Operations	0.100	0.325	0.325		
(U) 3-Dimensional Laser Radar Technology and Phenomenology (AFRL / Sweden) - Planned development of FLASH (that is, a sensor that captures the entire image with a single laser pulse) 3-Dimensional laser radar receiver technology. This technology has tremendous potential for improving capabilities to quickly locate and to identify difficult targets (e.g. vehicles hidden behind camouflage or under foliage). However, the data produced by these sensors have many unique properties that do not lend themselves readily to processing and analysis using traditional algorithms and procedures. AFRL/SNJM has a program to characterize these sensors, develop metrics and procedures for quantifying the quality of these data and for extracting target identification information from these data. The results of these activities will be used to determine the utility of these sensors to address mission requirements as well as to identify technical issues that require additional development. Sweden (FOI) has had an extensive effort to develop software to model imaging laser radar performance. They have also developed tools for extracting useful information from these types of data (e.g. segmenting regions of interest from background and clutter, using filters developed from CAD data to identify targets). They have also been investigating atmospheric effects on laser propagation and data quality.	0.050	0.150	0.200		
(U) Policy Enabled Coalition Communication Environment (PECC) (AFRL/IDCP) and Australia, Canada, United Kingdom - Planned cooperative project that will allow overarching "on Paper" mission objectives to be translated into a set of rules/policies (and machine executable code) which dictate the	0.125	0.134	0.175		

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(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
control level of resources at any level. Initially, policies capable of altering the network posture will be implemented for each INFOCON level (Normal, Alpha, Bravo, Charlie, Delta). Other policies could address operational requirements (e.g. higher network precedence given to a specific application for a short-term mission). In all cases, the cyber commander has an understandable interface for making real-time decisions. The Command and Control Enterprise Management System (C2EMS) will also be integrated to provide: real-time readiness; and understanding of how network degradation/failure impacts mission accomplishment.				
(U) Material and Technologies for Laser Protection (AFRL/MLPJ) and Sweden - Planned cooperative agreement to conduct research, develop, and test passive and active laser protection materials. This will be accomplished by exchanging research expertise and novel nonlinear and electro-optic materials. Each country has specialized expertise in different aspects of passive and active laser protection materials. This exchange of materials, models and data obtained from characterization and testing experiments will facilitate the development of realistic laser protection devices. The US will provide expertise in the areas of nonlinear optical, electro-optical, and matrix materials, US developed materials, experimental facilities, data, and analysis. The Swedish Defence Research Agency) will provide expertise in the area of nonlinear optical, electro-optical, and matrix materials, experimental facilities, data, and analysis. Data gathered on provided samples will be shared. The results of this ICR&D project will be used by the participants, independently, in their own development of actual laser protection devices in future work.	0.100	0.050	0.100	
(U) Strike Information Displays (AFRL / UK) - Follow on project to The Strike Warrior Project Arrangement PA. Planned program was approved on 26 April 2000 and is valid through 26 April 2005. This PA has successfully enabled both nations to mutually develop and demonstrate several emerging display technologies. For example, off-boresight symbology improvements and the benefits of panoramic wide-field-of-view Night Vision Goggles (NVGs) over standard NVGs have both been demonstrated. As a result of this PA, there have been several "lessons learned" that serve as the justification for this follow-on proposal. This continuation effort will focus on 1) the exploitation of emerging display technologies that will enhance collaborative information sharing, and 2) the evaluation and implementation of common display symbologies that will foster increased warfighter effectiveness and achieve greater interoperability within the coalition. When considering display technologies, these areas have been identified as the greatest impediments in improving warfighter capabilities. Different phases of warfighter activity will be considered. The assessments will begin in the AWACS platform (AFRL MOLTKE lab) then migrate to Air Operations Centers and Strike Assets. Candidate	0.100	0.050	0.210	

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<b>(U) <u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
collaborative display technologies will include on and off head, in and out of the cockpit, and wireless and tethered technologies.					
(U) Theater Battle Management Core Systems (TBMCS) and NATO Air Command and Control System Interoperability Analysis and Demonstration (HQ/ESC/AC / NATO) - This planned project is to proactively design interoperability into the operational and technical architectures of the US Air Operations Center (AOC) and NATO's parallel Combined Air Operations Center (CAOC) construct, and to then develop, test and field middleware software that will support the successful prosecution of a combined/joint air operation. This 3-year co-operative effort will begin with a comprehensive study to examine the Command and Control Systems which are the operational backbone of the US AOC (Theater Battle Management Core Systems) and NATO (Air Command and Control System). The product of FY 06 activities will be a detailed analysis of each program's design, the identification of USMTF 2006 and AdatP-3 Baseline 14 message sets that will be implemented, message standards and rules application, data fields and elements structures, as well as data base designs. FY 07 efforts will concentrate on developing prototype middleware that will tested in US and NATO lab environments for potential fielding to provide a seamless exchange of NATO and US operational data used to plan and execute the air war. FY 08 funding will be to support remaining middleware development and to address network security issues and potential resolutions. In the end, the warfighters operating in coalition environments will be able to vastly reduce the time and duplicative effort currently required to manipulate multiple command and control and message standards to plan and execute the air war.	0.000	0.050	0.150		
(U) Coalition/Joint Force Air Component Commander (C/JFACC) Battle Board (AFRL / Australia) - Planned collaborative project is to provide the capability for the Coalition/Joint Force Air Component Commander (C/JFACC) and senior staff to develop and continuously assess the progress and contribution of air operations to the coalition's air campaign in order to attain agile and stable control of distributed coalition military operations conducted in an uncertain and rapidly changing environment. The guiding vision of this research is a "Commanders' Virtual Collaboration Portal (CVCP)" or Battle Board (BB). The BB is a distributed, collaborative decision-making environment for commanders and senior staff to share a common knowledge base, collaborate during planning and execution, share assessments of current operations, visualize the operation across spatial and temporal domains, optimize effects-action-resource, and model and project the operational environment for predictive planning and assessment. This project will facilitate the shared research and development of technologies that provide:· Faster recognition and better understanding of changing situations (Agents And Multi-Agent Systems In Dynamic Adversarial Environments)· Faster and more complete exploration of available	0.000	0.100	0.100	0.100	

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<p>(U) courses of action (e.g., Causal Modeling And Analysis) Faster and more accurate decision-making (e.g. Expert Team Collaboration) Concepts such as Effects Based Operations (EBO) and Predictive Battlespace Awareness (PBA) are two key enablers of this research. The grand challenge of this project is the initial research and development of technologies as the foundation for a "Battle Board" to be used by the C/JFACC and staff providing team-based strategic planning, operational anticipation, and effects-based assessment. The end result will be for both the US and Australian participants to have the technologies necessary to integrate into their separate national tools than from conducting basic and applied research alone. It is in the best interest of both parties to utilize these synergies.</p>					
<p>(U) Development of Electro-Optic and Infrared Countermeasures and Protection Measures (AFRL / UK) - The planned objective of this PA is to increase US and UK capabilities in the area of Electro-Optic and Infrared (EO/IR) countermeasures and protection measures for enhancing survivability and force protection. As such, this PA will provide for collaborative research and development on materials, technologies, devices, and systems for electro-optic and infrared countermeasures and protection measures. It should be noted that the PA for this activity is to span a 10-year period of research and development beginning in January 2006. ICR&amp;D start-up funding support is being requested under this PA to establish testing to evaluate the current state-of-the-art in EO/IR countermeasures and protection measures. The ICR&amp;D funding will allow immediate field trials that are not currently scheduled until FY08. This acceleration of testing will better focus the materials and device development proposed in the PA to better address warfighter needs</p>		0.000	0.150	0.300	0.300
<p>(U) Engagement-level Modeling for HPM Weapons Applications (AFRL / UK) - The objective of this program would be to develop useful engagement modeling "modules" that could be used with little or no modification in USAF battlefield modeling and simulation (M&amp;S) exercises. As the HPM technology advances to the stage where useful weapons and other applications are available for use by US forces that are engaged in military actions it becomes necessary to have companion M&amp;S capability also available so that mission and war planners can include the HPM participation in the M&amp;S exercises that are performed before most actual engagements. AFRL has been working on the necessary mathematical tools to develop the required modules. There are currently "one-on-one" modules that are compatible with the engagement modeling world. AFRL has sponsored the development of the RF-PROTEC code that is the first serious player in the M&amp;S engagement code world. It's current capability is limited to straightforward scenarios with one HPM device and a very limited target set. There is a requirement to develop more complex modules that take into account the situation where there are "many" HPM weapons engaged against "many" potential targets. These "many-on-many"</p>		0.000	0.050	0.200	0.200

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(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b> modules are ultimately required for HPM weapons to be effectively integrated into modern battlefield M&S. The requirement for new and more advanced modules (or "plug-ins") also includes the requirement to address more scenarios where HPM weapons might be employed. This means looking at the utilization of HPM weapons in rural and urban environments and in special situations such as hardening command centers.					
(U) High-Cycle Fatigue Reduction (AFRL / UK) - The objective of this project is to demonstrate to TRL-6 UK-developed HCF/durability technologies in the US-provided XTE78/LF1 demonstrator engine. The main objective of the High Cycle Fatigue (HCF) Reduction project is to increase engine reliability, enhancing safety to users of gas turbine propulsion systems. This project will enhance the existing US National HCF Program and UK MOD efforts in HCF. The Project will increase the safety and cost effectiveness of airbreathing aircraft engines in both the US and UK by providing additional HCF-related data sources and validations of HCF-related methodologies, all aimed at reducing HCF-caused mishaps, and the costs and maintenance burdens associated with HCF-related corrective and preventive measures.	0.000	0.150	0.150	0.250	
(U) Hypersonic Flight Research and Development (AFRL / Australia) - The objectives of this effort are: (1) conduct hypersonic flight research experiments to mature select critical technologies required to develop future prompt global strike and operationally responsive space access systems; and, (2) develop on-board vehicle and propulsion instrumentation to significantly enrich the technology value of flight experiments. This program will consist of multiple research tasks to be jointly executed by several Directorates of the Air Force Research Laboratory and the Australian Defence Science and Technology Organization (DSTO). The scope of this effort includes key technologies for hypersonic, atmospheric flight including airbreathing propulsion, aerodynamics, aerothermodynamics, sensors, materials and structures, and advanced, non-intrusive, in-flight diagnostics.	0.000	0.500	0.500	0.600	
(U) US Theater Battle Management Core Systems (TBMCS) and NATO Air Command and Control System (ACCS) Interoperability analysis and demonstrations (AFRL / NATO) - The overarching objective of this proposed effort is to proactively design interoperability into the operational and technical architectures of the US Air Operations Center (AOC) and NATO's parallel Combined Air Operations Center (CAOC) construct, and to then develop, test and field middleware software that will support the successful prosecution of a combined/joint air operation. This 3-year co-operative effort will begin with a comprehensive study to examine the Command and Control Systems which are the operational backbone of the US AOC (Theater Battle Management Core Systems) and NATO (Air Command and Control System). The product of FY 06 activities will be a detailed analysis of each program's design,	0.000	0.050	0.050	0.000	

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BUDGET ACTIVITY 04 Advanced Component Development and Prototypes (ACD&P)	PE NUMBER AND TITLE 0603790F NATO Cooperative R&D	PROJECT NUMBER AND TITLE NATO Nato Coop R&D			
		<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>					
the identification of USMTF 2006 and AdatP-3 Baseline 14 message sets that will be implemented, message standards and rules application, data fields and elements structures, as well as data base designs. FY 07 efforts will concentrate on developing prototype middleware that will tested in US and NATO lab environments for potential fielding to provide a seamless exchange of NATO and US operational data used to plan and execute the air war. FY 08 funding will be to support remaining middleware development and to address network security issues and potential resolutions. In the end, the warfighters operating in coalition environments will be able to vastly reduce the time and duplicative effort currently required to manipulate multiple command and control and message standards to plan and execute the air war.					
(U) Study of Insensitive Explosives for High Speed Penetrators (AFRL / Germany) - The joint investigation is concentrated on understanding the changes in the high explosive (HE) and the effects of those changes due to forces acting on the explosive during hard impact. Preliminary studies indicate that that during the penetration event, explosive changes undergo structural changes and consequently, cause the explosive to become more sensitive.		0.000	0.275	0.050	0.075
(U) Integrally Bladed Rotor Repair Validation (AFRL / UK) - The objective of this project is to demonstrate to TRL-6 UK & US developed integrally bladed rotor repair (IBR) in US Provided spin pits and demonstrator engines. An additional objective is to jointly develop & validate best practices for evaluating damage thresholds for repair, repair methodologies, and post-repair re-validation.		0.000	0.035	0.050	0.150
(U) Coalition Airspace Information Sharing (CAIS) (AFRL / NATO) - This effort proposes to demonstrate coalition collaborative airspace management by developing and demonstrating a machine-to-machine connection between the US Joint AirSpace Management And Deconfliction (JASMAD) Net-centric Information Service and NATO's Airspace Manager (ASMAN) module with the Integrated Command and Control (ICC) system. The JASSMAD Advanced Technology Demonstration (ATD) will provide the Future Capabilities required in the Air and Space Operation Center (AOC) Weapon System (WS) and is a substantial improvement over the current capability.		0.000	0.000	0.000	0.600
(U) Distributed Collaboration for Network-Centric Command and Control (AFRL / Australia) - The recently promulgated doctrine of network-centric warfare implies that a dense networking of sensor and shooter nodes will promote enhanced situation awareness (SA) and self-synchronization of forces. The communication of this SA is expected to be achieved through the transmission of a common operational picture (COP) and by suites of collaboration technologies, most of which are commercial-off-the-shelf (COTS) products.		0.000	0.000	0.040	0.400
(U) Toxicity of Engineered Nanomaterials and Their Interaction with Biological systems (AFRL / India) -		0.000	0.000	0.080	0.550

Exhibit R-2a, RDT&E Project Justification

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BUDGET ACTIVITY <b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	PE NUMBER AND TITLE <b>0603790F NATO Cooperative R&amp;D</b>	PROJECT NUMBER AND TITLE <b>NATO Nato Coop R&amp;D</b>
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(U) <b><u>B. Accomplishments/Planned Program (\$ in Millions)</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
The main focus of the collaborative work in India will be animal toxicity studies required to extrapolate from in vitro to invivo toxicity health and safety standards. This research will also significantly aid development of predictive models of nanomaterial toxicity. Work to be conducted by AFRL will address definition of: how nonoparticles (NPs) are taken up by the cells: the physical characteristics (Size, Size Distribution, Aggregation, Purity, Chemical Composition, Surface Characteristics, Functionality. Zeta Potential, Stability Solubility) that impact nanomaterial interactiosn with biological systems; and the mechanisms of toxicity. Both organizations will collaborate to develop nanotoxicoinformatics tools to support nanomaterials R&D across a wide range of applications.				
(U) Mission Planning and NATO Tasking Interoperability (MPNTI) (ESC / UK) - US aircraft mission planning systems do not read nor parse NATO Air Tasking Order (ATO) and NATO Airspace Coordinations Order (ACO) message formats. US air combat tasking is published in the US Message Test Format (USMTF), while NATO uses the Allied Data Publication 3 (AdatP3) message format.	0.000	0.000	0.050	0.475
(U) US Theater Battle Management Core Systems (TBMCS) (ESC / NATO) - The objective of this effort is to implement a process/system which will enable multiple C2 systems, each loaded on separate, multiple security networks/domains, to exchange air C2 mission data amongst each of the systems in near-real-time.	0.000	0.000	0.050	0.670
(U) Management and administrative support and travel	0.100	0.100		
(U) Total Cost	3.842	4.080	4.280	4.370

(U) <b><u>C. Other Program Funding Summary (\$ in Millions)</u></b>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>	<u>FY 2010</u>	<u>FY 2011</u>	<u>FY 2012</u>	<u>FY 2013</u>	<u>Cost to</u>	<u>Total Cost</u>
	<u>Actual</u>	<u>Estimate</u>	<u>Complete</u>							
(U) Not Applicable.										

(U) **D. Acquisition Strategy**  
 A principal goal of the NATO Cooperative R&D program is to effectively utilize the aggregate resources invested by the US and our allies in conventional defense R&D. This program element provides the critical funding incentive needed to pursue ICRD&A agreements and helps to (a) leverage USAF and allied resources through cost sharing and economies of scale; (b) exploit the best US and allied technologies for equipping coalition forces; (c) demonstrate areas of commonality or interoperability with our allies; and (d) accelerate the availability of defense technology and systems. Candidate projects are reviewed and approved by the USD(AT&L). An international agreement defining project objectives, responsibilities and costs is required prior to release of funds. To obtain these funds and ensure service commitment, projects are selected from existing or new RDT&E programs funded in the Future Years Defense Plan (FYDP). Project offices must show matching funds and contributions from associated program elements and equitable allied funding. As appropriate, funding responsibility for out-year requirements and follow-on efforts are transferred to the project office and associated program elements. Most contracts are awarded after full and open competition.

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Exhibit R-3, RDT&E Project Cost Analysis											DATE			
											February 2007			
BUDGET ACTIVITY						PE NUMBER AND TITLE					PROJECT NUMBER AND TITLE			
04 Advanced Component Development and Prototypes (ACD&P)						0603790F NATO Cooperative R&D					NATO Nato Coop R&D			
(U) Cost Categories	Contract	Performing	Total	FY 2006	FY 2006	FY 2007	FY 2007	FY 2008	FY 2008	FY 2009	FY 2009	Cost to	Total Cost	Target
(Tailor to WBS, or System/Item Requirements)	Method &	Activity &	Prior to FY	Cost	Award	Cost	Award	Cost	Award	Cost	Award	Complete		Value of
(\$ in Millions)	Type	Location	2006		Date		Date		Date		Date			Contract
(U) <u>Product Development</u>														
Sytronics Dayton, OH	CPFF											Continuing	TBD	TBD
Boston College Boston, MA	CFSR											Continuing	TBD	TBD
RADEX Bedford, MA	CPFF											Continuing	TBD	TBD
Pacific Sierra Research Santa Monica, CA	CPFF											Continuing	TBD	TBD
CPI Fairfax, VA	CPFF											Continuing	TBD	TBD
U of Massachusetts Lowell, MA	CR											Continuing	TBD	TBD
KEO Consultants Brookline, MA	CPFF											Continuing	TBD	TBD
NW Research Associates Bellevue, WA	CPFF											Continuing	TBD	TBD
Visdyne Inc.	CPFF											Continuing	TBD	TBD
U of Texas Austin, TX	CPFF											Continuing	TBD	TBD
Applied Research Lab, U of Texas Austin, TX	CPFF											Continuing	TBD	TBD
Lockheed Martin Orlando, FL	CPFF											Continuing	TBD	TBD
Raytheon TI Systems	CPFF											Continuing	TBD	TBD
Boeing Seattle, WA	CPFF											Continuing	TBD	TBD
UES, Inc Dayton, OH	CPFF											Continuing	TBD	TBD
Pratt & Whitney West Palm Beach, FL	CPFF											Continuing	TBD	TBD
AFRL WPAFB, OH	TBD			3.266	Nov-06	3.395	Nov-07	2.200	Nov-08	2.100	Nov-09	Continuing	TBD	TBD
Boeing Long Beach, CA	CPFF											Continuing	TBD	TBD
Boeing Seattle, WA	CPFF											Continuing	TBD	TBD
Lockheed Marietta, GA	CPFF											Continuing	TBD	TBD
Northrop Hawthorne, CA	CPFF											Continuing	TBD	TBD
Selectech Dayton, OH	CPFF											Continuing	TBD	TBD
AFRL Eglin AFB, FL	TBD											Continuing	TBD	TBD
AFRL Hanscom AFB, MA	TBD											Continuing	TBD	TBD
AFRL Mesa, AZ	TBD											Continuing	TBD	TBD
AFRL Rome, NY	TBD											Continuing	TBD	TBD
None													0.000	
Subtotal Product Development			0.000	3.266		3.395		2.200		2.100		Continuing	TBD	TBD
Remarks:														
(U) <u>Support</u>														
AFRL Hanscom AFB, MA				0.476	Nov-06	0.585	Nov-07	2.080	Nov-08	2.270	Nov-09	Continuing	TBD	
AFRL WPAFB, OH												Continuing	TBD	
45th Space Wing Patrick AFB, FL	AF 185											Continuing	TBD	
AFRL Eglin AFB, FL												Continuing	TBD	
Pender Technology, TN	CR											Continuing	TBD	
Veridian Dayton, OH												Continuing	TBD	
None													0.000	
Subtotal Support			0.000	0.476		0.585		2.080		2.270		Continuing	TBD	0.000

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**Exhibit R-3, RDT&E Project Cost Analysis**

DATE

**February 2007**

BUDGET ACTIVITY <b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	PE NUMBER AND TITLE <b>0603790F NATO Cooperative R&amp;D</b>	PROJECT NUMBER AND TITLE <b>NATO Nato Coop R&amp;D</b>
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Remarks:										
(U) <u>Test &amp; Evaluation</u>										
Air Force Development Test Center, FL	PO						Continuing	TBD		
Sverdrup Technology, Inc TN	CPAF						Continuing	TBD		
Naval Air Warfare CenterPoint Mugu, CA	MIPR						Continuing	TBD		
Fora Laser System	PO						Continuing	TBD		
Arnold Engineering Development Center, TN	TBD						Continuing	TBD		
Fora laser system	PO							0.000	0.000	
Subtotal Test & Evaluation		0.000	0.000	0.000	0.000	0.000	Continuing	TBD	0.000	
Remarks:										
(U) <u>Management</u>										
Subtotal Management		0.000	0.100	0.100	0.000	0.000		0.000	0.200	0.000
Remarks:										
(U) Total Cost		0.000	3.842	4.080	4.280	4.370	Continuing	TBD	TBD	

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**Exhibit R-4, RDT&E Schedule Profile**

DATE  
**February 2007**

BUDGET ACTIVITY  
**04 Advanced Component Development and Prototypes (ACD&P)**

PE NUMBER AND TITLE  
**0603790F NATO Cooperative R&D**

PROJECT NUMBER AND TITLE  
**NATO Nato Coop R&D**

<b>Name of ICR&amp;D Project &amp; Int'l Agreement Schedule</b>	<b>Fiscal Year</b>	<b>Start Date</b>	<b>END IA</b>	<b>PE</b>
Distributed Mission Training	FY02	09/14/99	09/14/06	63790F
Optical Sensor Protection Development and Evaluation	FY03			63790F
Virtual Process Fit & Accommodation Consulting Tools	FY04	05/19/05	05/19/10	63790F
Coalition Mission Training	FY04	05/03/03	05/07/10	63790F
O2 Warrior	FY04	07/06/04	07/05/08	63790F
High-Power Microwave Narrowband Effects Investigations	FY04	03/26/02	03/25/07	63790F
Refractive Turbulence and Transient Electronic Disconnectivity	FY05			63790F
Aero-Engine Component Life Enhancement	FY05	10/09/01	10/08/10	63790F
Network-Centric Strike Controller	FY06			63790F
Operator and State Assessment and Aiding Implementation	FY06			63790F
Resilient Structural and Blast Suppression Systems for Blast Protection Research Program	FY06			63790F
Hard Target Defeat	FY06			63790F
Coalition-Interoperable SATCOM Data Broadcast Protocol	FY06			63790F
Multi-modal Situational Awareness Displays for Maneuvering Aircraft	FY06			63790F
International Mission Training Research	FY06	09/28/05	09/27/15	63790F
3-Dimensional Laser Radar Technology and Phenomenology	FY06			63790F
Policy Enabled Coalition Communication Environment (PECC)	FY06			63790F
Material and Technologies for Laser Protection	FY06			63790F
Strike Information Displays	FY06			63790F
Theater Battle Management Core Systems and NATO Air Command and Control System Interoperability Analysis and Demonstration	FY06			63790F
Theater Battle Management Core Systems and NATO Air Command and Control System Interoperability Analysis and Demonstration	FY07			63790F
Coalition/Joint Force Air Component Commander (C/JFACC) Battle Board	FY07			63790F
Development of Electro-Optic and Infrared Countermasures and Protection Measures	FY07			63790F
Engagement-level Modeling for HPM Weapons Applications	FY07			63790F
High-Cycle Fatigue Reduction	FY07			63790F
Hypersonic Flight Research and Development	FY07			63790F
Study of Inertive Explorives for High Speed Penetrators	FY07			63790F
Integrally Bladed Rotor Repair Validation	FY08			63790F
Coalition Airspace Information Sharing	FY08			63790F
Combat Laser Infrared Countermasures Proactive Survivability System (CLIPSS)	FY08			63790F
Distributed Collaboration for Network-Centric Command Control	FY08			63790F
Toxicity of Engineered Nanomaterials and Their Interaction with Biological Systems	FY08			63790F
Development and Testing of a Passive RF/ESM Surveillance Sensor	FY08			63790F
Virtual Munitions Design Environment	FY08			63790F
Virtual Science and Technology for Deployable DMO Simulations	FY08			63790F
Human Modeling for Injury Assessment from Blast (HMIAB)	FY08			63790F
Intelligent Hard Target Fuze	FY08			63790F
Mission Planning and NATO Tarking Interoperability (MPNTI)	FY08			63790F
Joint Surveillance Target Attack Radar System (JSTARS)	FY08			63790F
707 Wide Band Antenna	FY08			63790F
US Theater Battle Management Core Systems (TBMCS)	FY08			63790F

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Exhibit R-4 (PE 0603790F)

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Exhibit R-4a, RDT&E Schedule Detail		DATE February 2007		
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE		
<b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	<b>0603790F NATO Cooperative R&amp;D</b>	<b>NATO Nato Coop R&amp;D</b>		
	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
(U) <b>Schedule Profile</b>				
(U) Aero-Engine Component Life Extension	4Q			
(U) - Field testing	2Q			
(U) - Test report	1Q			
(U) Optical Sensor Protection Development and Evaluation		1Q		
(U) - Development, testing, and analyses	3Q			
(U) Policy Enabled Coalition Communication Environment		2Q		
(U) - Technology development	4Q			
(U) - Testing & Analysis	3Q			
(U) Network-Centric Strike Controller		4Q		
(U) - Testing & Analysis		3Q		
(U) Operator and State Assessment Aiding Implementation	2-3Q			
(U) - Technology Development	2Q			
(U) - Testing & Analysis	1Q			
(U) US Theater Battle Mgmt Core System and NATO ACCS signed	2Q			
(U) - Pre-study coordination activities	2-3Q			
(U) - Study contract award	1Q			
(U) Material and Technologies for Laser Protection		2Q		
(U) - Technology Development		3Q		
(U) Resilient Structural and Blast Suppression Systems for Blast Protection Research		2Q		
(U) - Technical report preparation		2Q		
(U) - Design methodology development		1Q		
(U) - Full-scale blast experiments	1Q			
(U) Refractive Turbulence and Transient Electronic Disconnectivity		1Q		
(U) - Technical Development	3Q			
(U) - Testing and analysis	2Q			
(U) Hard Target Defeat		2Q		
(U) - Technical report preparation		1Q		
(U) - Testing and analysis	4Q			
(U) Coalition-Interoperable SATCOM Data Broadcast Protocols		2Q		
(U) - Technical Development	3Q			
(U) - Testing and Analysis	2Q			
(U) Multi-modal Situational Awareness Displays for Maneuvering Aircraft		2Q		

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Exhibit R-4a (PE 0603790F)

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<b>Exhibit R-4a, RDT&amp;E Schedule Detail</b>		DATE <b>February 2007</b>
BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT NUMBER AND TITLE
<b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	<b>0603790F NATO Cooperative R&amp;D</b>	<b>NATO Nato Coop R&amp;D</b>
(U) - Technical Development	3Q	
(U) - Testing and Analysis	2Q	
(U) 3-Dimensional Laser Radar Technology and Phenomenology		2Q
(U) - Technical Development	3Q	
(U) - Testing and Analysis	2Q	
(U) Strike Information Displays		2Q
(U) - Technical Development	3Q	
(U) - Testing and Analysis	2Q	
(U) Coalition/Joint Force Air Component Commander (C/JFACC) Battle Board		2Q
(U) - Technical Development	3-4Q	
(U) - Testing and Analysis	4Q	
(U) Development of Electro-Optic & Infrared Countermeasures and Protection Mesaures		2Q
(U) - Technical Development	3Q	
(U) - Testing and Analysis	4Q	
(U) Engagement-level Modeling for HPM Weapons Applications		2Q
(U) - Technical Development	3-4Q	
(U) - Testing and Analysis	4Q	
(U) High-Cycle Fatigue Reduction		2-3Q
(U) - Technical Development	3Q	
(U) - Testing and Analysis	4Q	
(U) Hypersonic Flight Research and Development		2Q
(U) - Technical Development	2-3Q	
(U) - Testing and Analysis	4Q	
(U) US Theater Battle Management Core Systems (TBMCS)		2Q
(U) - Technical Development	3-4Q	
(U) - Testing and Analysis	4Q	
(U) International Mission Training Research	2Q	
(U) - Signed Agreement	2Q	
(U) US Theater Battle management Core Systems (TBMCS)		3Q
(U) - Technical Development		1Q
(U) Coalition Airspace Information Sharing (CAIS)		1Q
(U) - Signed Agreement		2-3Q
(U) USTBMCS		1Q

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Exhibit R-4a (PE 0603790F)

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<b>Exhibit R-4a, RDT&amp;E Schedule Detail</b>		DATE <b>February 2007</b>
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<b>BUDGET ACTIVITY</b> <b>04 Advanced Component Development and Prototypes (ACD&amp;P)</b>	<b>PE NUMBER AND TITLE</b> <b>0603790F NATO Cooperative R&amp;D</b>	<b>PROJECT NUMBER AND TITLE</b> <b>NATO Nato Coop R&amp;D</b>
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(U) - Signed Agreement	2-3Q
(U) Mission Planning and NATO Tasking Interoperability	1Q
(U) - Signed Agreement	2-3Q
(U) Study of Insensitive Explosives for High-Speed Penetrators	1Q
(U) - Signed Agreement	2-3Q
(U) Integrally Bladed Rotor Report Validation	1Q
(U) - Signed Agreement	2-3Q
(U) Toxicity of Nano-Engineered Materials	1Q
(U) - Signed Agreement	2-3Q
(U) Distributed Collaboration for Network Centric C2	1Q
(U) - Signed Agreement	2-3Q