ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601104A - University and Industry Research Centers**

	COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
	Total Program Element (PE) Cost	96175	95748	84034	87814	88321	89818	91904	93777
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4800	2598	2660	2732	2790	2847	2910	2974
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6541	7039	7168	7319	7478	7627	7795	7966
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2406	2598	3066	3630	4367	4457	4590	4626
H50	Comms & Networks Collab Tech Alliance (CTA)	7139	7509	7032	7198	7489	7572	7655	7812
H53	ADV DIS INTR SIM RSCH	2309	2077	1985	1996	2000	2000	2072	2118
H54	Micro-Autonomous Systems (MAST) CTA	5043	3947	7396	7661	8187	8205	8385	8570
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5945	6097	5550	5957	6061	6259	6413	6571
H59	UNIV CENTERS OF EXCEL	1787	1927	2877	3412	3479	3539	3615	3692
H62	ELECTROMECH/HYPER PHYS	5551	6139	6018	6154	6542	6672	6819	6969
H64	MATERIALS CENTER	2161	2669	2745	2823	2884	2941	3006	3072
H65	MICROELECTRONICS CTR	662	1053						
H73	NAT AUTO CENTER	4468	2848	2893	2949	2980	3002	3068	3136
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	6886	7330	7484	7698	7918	8079	8259	8443
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	4413	3971						
J12	NANOTECHNOLOGY	9520	9557	9897	10097	10432	10755	11105	11260
J13	UNIVERSITY AND INDUSTRY INITIATIVES (CA)	17144	13945						
J14	ECYBERMISSION	4609	4973	5118	5245	5359	5466	5586	5709
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	4791	6132	7184	7916	8278	8278	8460	8646
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE		2053	2977	2995				
J17	VERTICAL LIFT RESEARCH CENTER OF			1984	2032	2077	2119	2166	2213

	EXCELLENCE								
J19	NAT'L AUTO CENTER (CA)		1286						

A. Mission Description and Budget Item Justification: A significant portion of the work performed within this program directly supports Future Force requirements by providing research that supports enabling technologies for Future Force capabilities. Broadly, the work in this project falls into three categories: Collaborative Technology Alliances (CTAs), University Centers of Excellence (COE), and paradigm-shifting centers - University-Affiliated Research Centers (UARCs). The Army has formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs involve partnerships between industry, academia, and the Army Research Laboratory to incorporate the practicality of industry, the expansion of the boundaries of knowledge from universities, and Army scientist to shape mature and transition technology. CTAs have been competitively established in the areas of Advanced Sensors, Advanced Decision Architecture, Communications and Networks, Power and Energy, and Robotics. This program element (PE) includes the Army's COE, which focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, such as rotorcraft, automotive, microelectronics, materials, and information sciences. COEs couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in information sciences, materials science, electronics, automotive, and rotary wing technology. Also included is eCYBERMISSION, the Army's national web-based competition to stimulate interest in science, math, and technology among middle and high school students. This program element also includes the four Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. The Institute of Advanced Technology funds basic research in electromagnetics and hypervelocity physics. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies, focusing on enabling network centric-technologies, will broaden the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence address critical research areas for Army Transformation. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this PE is managed by: the Army Research Lab (ARL); the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC); the Simulation and Training Technology Center (STTC); and the US Army Research Institute for the Behavioral and Social Sciences (ARI).

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BUDGET ACTIVITY	PE NUMBER AND TITLE
1 - Basic research	**0601104A - University and Industry Research Centers**

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	100498	86416	90338	93203
Current BES/President's Budget (FY 2008/2009)	96175	95748	84034	87814
Total Adjustments	-4323	9332	-6304	-5389
Congressional Program Reductions		-5366		
Congressional Rescissions				
Congressional Increases		15400		
Reprogrammings	-4323	-702		
SBIR/STTR Transfer				
Adjustments to Budget Years			-6304	-5389

Fifteen FY07 congressional adds totaling $14761 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1532) Ctr for Ferroelectric Electr Photonic Nanodevices
($1293) Nanotubes Optimized for Ltwgt Exceptional Strength
($958) Rapid Deployable Visulaization forTrng & Sim
($959) Center for Advanced Sensors
($959) Ctr for Information Assurance and Cyberwarfare
($1246) National Security Network Testbed
($1245) Ctr for Education-Nanoscience & Nanotechnology Res
($959) National Center for Infotonics
($959) Army Corrosian Control: Inhibition & Detection
($288) Florida Collaborative Dev of Adv Materials for Def
($959) Integrated Sys in Sensing, Imaging & Comms Rsch
($959) Nanosensor Stagegate Accelerator - Benet Labs
($240) Transparent Nanocomposite Armor
($959) Western Hemisphere Security Analysis Ctr (WHSAC)
($1246) Automotive Research

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February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H04**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4800	2598	2660	2732	2790	2847	2910	2974

A. Mission Description and Budget Item Justification: Centers of Excellence have proven effective in harnessing a critical mass of university research expertise and focusing their intellectual capabilities on Army unique science and technology problems. The objective is to transition advances resulting from basic research to technology demonstration as rapidly as possible. This project takes that approach one step further by partnering the university researchers at Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) with Army Training and Doctrine Command (TRADOC) Battle Labs to gain first hand perspective of the end-user's needs. Through these centers, the Army user begins the collaboration with university researchers from the outset of the research. These Centers of Excellence will join with Army and industrial partners to accelerate the transition from research phase to actual technology demonstration. In addition, these Centers of Excellence will recruit, educate, and train outstanding students and post doctoral researchers in science and technology areas relevant to Army Transformation. This project was previously funded in PE 061104A Project H59 and is a restructuring of ongoing research into a distinct project for visibility and management. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work on this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
The HBCU/MI Centers of Excellence for Battlefield Capability Enhancements are: Tuskegee University, research on flexible extremities protection; NCA&T State University, research on flexible displays and predictive modeling of group situational awareness; Tennessee State University, research on sensor fusion; and Prairie View A&M University, research on Beyond-Line-of-Sight Lethality. Collaborations with TRADOC Battle Labs will help accelerate technology transitions to the battlefield. In FY06, devised promising stab resistance in new fabric composites; completed basic computational structure for predicting sensemaking (cognitive process experiments and collaborative decision making); showed growth of semiconductor materials on flexible substrates at room temperature; devised target-tracking using multiple sensors; devised a wireless tactical network. In FY07, devise improved stab resistance using new fabric designs; refine computer-based experimental sensemaking model test beds; continue investigation of semiconductor materials growth on flexible substrates; devise multi-modal model sensor networks; devise simulation test bed to determine network performance. In FY08, will refine fabric designs with new testing strategies; will validate sensemaking models with test command groups; will characterize semiconductor materials on flexible substrates for optical properties; will show use of multi-modal sensor network in urban terrain; will refine wireless network protocols using simulation test bed. In FY09, will devise enhanced protection capability of final fabric designs; will deliver deployable decision support programs for test command groups; will design and fabricate hybrid semiconductor devices on flexible substrates and evaluate environmental stability; will show full data-fusion for large-scale sensor networks; will show protocols for wireless sensor network.	2405	2525	2660	2732
This congressional add supports basic research at Lincoln University, a Historically Black University, for multiple years with no additional funding required to complete this project.	2395			
Small Business Innovative Research/Small Business Technology Transfer Programs		73		

Total	4800	2598	2660	2732

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February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H05**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6541	7039	7168	7319	7478	7627	7795	7966

A. Mission Description and Budget Item Justification: This project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center led by the University of California-Santa Barbara, and two major supporting partners, the California Institute of Technology and the Massachusetts Institute of Technology. The ICB is the Army's primary conduit for leveraging biotechnology for: 1) advanced sensors; 2) new electronic, magnetic, and optical materials; and 3) information processing and bioinspired network analysis. The objective is to perform sustained multidisciplinary basic research supporting technology to provide the Army with biomolecular sensor platforms with unprecedented sensitivity, reliability, and durability; higher-order arrays of functional electronic and optoelectronic components capable of self-assembly and with multi-functions; and new biological means to process, integrate, and network information. These sensor platforms will incorporate proteomics (large scale study of proteins) technology, DNA sequence identification and detection tools, and the capability for recognition of viral pathogens. A second ICB objective is to educate and train outstanding students and post doctoral researchers in revolutionary areas of science to support Army Transformation. The ICB has many industrial partners, such as IBM and SAIC, and has strong collaborations with Argonne, Lawrence Berkley, Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia National Laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army Medical Research and Materiel Command laboratories. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Institute for Collaborative Biotechnologies: In FY06 formulated fastest available method for generating binding peptides for Army biosensing, diagnostics, and therapeutics applications; devised the collective optical response of multi-chromophore macromolecules and DNA-specific electrode surfaces and microfabrication for the detection and identification of multiple DNA sequences for threat detection, biometrics, and Soldier status-analysis; adapted unique proteomics technology and diagnostic markers into microfluidics-based modified proteomics libraries for advanced analysis in early detection of human pathology; established the roles of interfaces for potential use of biological plus non-biological hybrid components in advanced electronic and photonic devices. In FY07, provide foundation for incorporation of deterministic and stochastic dynamic models from biological systems, improving engineered Army network robustness; use the power and selectivity of biomolecular recognition and accelerated genetic selection and rapid evolution for elaboration of growth-directing peptides for specific crystalline semiconductor materials and electrode bridges with potential for electronic device application; enable controlled surface functionalization and ligand display on, and integration into, materials for application in sensors, multi-functional materials, and device assembly; and devise genetically engineered microbial systems that efficiently incorporate unnatural amino acids into proteins for unique materials for the Army. In FY08, will establish biologically based development path toward flexible high-efficiency batteries and new high-efficiency solar energy materials; provide a means to greatly enhance sensitivity in detection of viral pathogens; and enable electronic detection of DNA. In FY09, will define a biocatalytically derived route to low-cost fuel and fuel-cell feedstock; characterize and further develop microfluidic chip-based bioseparation technology.	6541	6841	7168	7319
Small Business Innovative Research/Small Business Technology Transfer Programs		198		

Total	6541	7039	7168	7319

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H09**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2406	2598	3066	3630	4367	4457	4590	4626

A. Mission Description and Budget Item Justification: This project conducts basic research in areas that will expand the capabilities of intelligent mobile robotic systems for military applications with a focus on enhanced, innate intelligence, ultimately approaching that of a dog or other intelligent animal, to permit unmanned systems to function as productive members of a military team. Research is conducted in machine perception, including the exploration of sensor phenomenology, and the maturation of basic machine vision algorithms enabling future unmanned systems to more fully understand their local environment for enhanced mobility and tactical performance; intelligent control, including maturation of artificial intelligence techniques for robot behaviors permitting future systems to autonomously adapt, and alter their behavior to dynamic tactical situations; and understanding the interaction of humans with machines focusing upon intuitive control by Soldiers that minimizes cognitive burden. The program will conduct both analytic and experimental studies. Research products will be transitioned to the companion applied technology program, PE 0602618A H03, for integration and evaluation in test bed platforms and will form the scientific basis for new technology that will migrate into Army and Joint advanced and system development programs to provide highly capable unmanned systems for the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary, autonomous, highly mobile systems for the Future Force. Research focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. In FY06, explored multiple methodologies for detecting, classifying, tracking, and projecting potential trajectories of moving objects, including humans, from a moving platform and created the basis for evaluating likely courses of action based upon limited information as applied to local path planning for unmanned vehicles in dynamic environments. In FY07, extend perception research to explore algorithms that are specialized for application to urban environments and incorporate contextual information into planning processes to create a more natural (human-like) response to dynamic changes in the tactical environment. In FY08, will explore methodologies to permit unmanned systems to perform as co-combatants, examining approaches for real-time evaluation of multiple possible adversarial responses, each possessing differing levels of likelihood based upon considerations such as terrain, and a dynamic tactical environment that also includes friendly and non-combatant forces; expand the range of perception algorithms available for classification of structures found in the urban environment and explore methods to fuse detections from individual sensor modalities and/or algorithmic approaches. In FY09, will focus upon techniques for fusion of the key perception algorithms to enable an unmanned vehicle to maneuver with a high degree of autonomy in urban environments; evaluate the performance of both perception, and behavior algorithms in varied tactical environments.	2406	2525	3066	3630
Small Business Innovative Research/Small Business Technology Transfer Programs		73		
Total	2406	2598	3066	3630

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February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H50**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H50	Comms & Networks Collab Tech Alliance (CTA)	7139	7509	7032	7198	7489	7572	7655	7812

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium, the Communication and Networks Collaborative Technology Alliance (CTA) that was formed to leverage commercial research investments to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. The Future Force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The objectives include designing communications systems for survivable wireless mobile networks; providing signal processing for communications-on-the-move; secure jam-resistant communications; and tactical information protection. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of -the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of communications and networks technology to program element (PE) 0602783A (Computer and Software Technology). The results of this work will significantly affect Future Force communications/networking formulation efforts. This program will be re-focused to more strongly emphasize Information Assurance and Network Science as defined by the December 2005 National Research Council Board on Army Science and Technology study. When the International Technology Alliance on Network and Information Sciences (PE/project 0601104/J15) is established in 2006, joint planning of the research programs will prevent redundancies and leverage accomplishments from both programs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Survivable Wireless Mobile Networks: Perform research in dynamically self-configuring wireless network technologies that enables secure, scaleable, energy-efficient, and reliable communications for command on-the-move. Develop techniques to model, design, analyze, predict, and control the performance of mobile ad hoc networks. In FY06, devised and validated auto configuration protocols that allow mobile networks to adapt to dynamic conditions. In FY07, conduct analytical and experimental studies validating dynamic and survivable resource control to enable mobile networks to predictably exploit distributed network infrastructures. Devise and validate adaptive distributed control of physical, medium-access, and network layers based on statistical inferencing to adapt communications parameters for improved performance. In FY08, will devise formal models, abstractions, metrics, and validation techniques for understanding the behavior of large scale military mobile ad hoc networks. Will design techniques that combine social networking and network structure control functions in real time to dramatically increase the level of resource utilization in keeping with the stated intentions (outcomes) of a particular military objective. In FY09, will design networking techniques for sensing the networking operating environment, identifying the best networking functional components, and dynamically composing protocols for superior performance.	2743	2812	2751	2804
Signal Processing for Communication-on-the-Move: Perform research in signal processing techniques to enable reliable low-power multimedia communications among highly mobile users under adverse wireless conditions. In FY06, conducted analytic and experimental studies of Multi-Input, Multi-Output systems that are spectrally-efficient and robust for non-line-of-sight mobile communications. In FY07, conduct analytical and experimental studies of signal processing aided medium access control algorithms that improves communications performance while on-the-move. In FY08, will design and validate multi-input multi-output multi-carrier waveforms	1665	1701	1624	1651

that exploit non-contiguous spectrum during mobile operations. In FY09, will design optimal channel-adaptive distributed multiple access techniques to provide high capacity, interference-robust, multiple access networks for communications-on-the-move.				
Secure Jam-Resistant Communication: Perform research in secure, jam-resistant, multi-user communications effective in noisy/cluttered and hostile wireless environments enabling low probability of detection/intercept. In FY06, conducted analytical and experimental studies of frequency-hopping systems that enable robust and mobile anti-jam effectiveness. In FY07, devise and study sensor array processing and interference techniques that enable adaptive antennas for improved interference rejection and spectrum reuse. In FY08, will devise low power adaptive medium access control algorithms that are energy-efficient and support duty-cycling to extend the life of sensor networks. In FY09, will design signal separation techniques to mitigate packet collisions and improve signal detection for improved network performance.	1263	1261	1075	1054
Tactical Information Protection: Perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY06, conducted analytical and experimental studies of intrusion detection algorithms that are effective in mobile ad hoc networks with no concentration points where traffic can be analyzed. In FY07, devise and study security schemes for distributed servers supporting dynamic network infrastructures. Design energy-efficient and low-latency key management and trust algorithms to enable flexibility in group access control without reliance on strategic security services. In FY08, will design and evaluate formal-methods-based protocol specification intrusion detection techniques on mobile ad hoc networking protocols. In FY09, will design resilient clustering algorithms to provide a dynamic detection hierarchy to support detection and localization of attackers under mobile conditions.	1468	1523	1582	1689
Small Business Innovative Research/Small Business Technology Transfer Programs		212		
Total	7139	7509	7032	7198

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H53**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H53 ADV DIS INTR SIM RSCH	2309	2077	1985	1996	2000	2000	2072	2118

A. Mission Description and Budget Item Justification: This project supports Army critical research at the Army High Performance Computing Research Center (AHPCRC). Research at the AHPCRC is focused on the Light Combat Systems Survivability (LCSS), including: structural response of armored vehicles to perforating and non-perforating projectiles, investigating more efficient gun projectile and missile propulsion systems, evaluating materials suitable for armor/anti-armor applications, defense from chemical/biological agents, signature modeling, and associated enabling technologies. This project also supports the Robotics Collaborative Technology Alliance which explores new opportunities to enable revolutionary autonomous mobility of unmanned systems for the Future Force. This research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618, project H03 (Robotics Technology). The project will also address research focusing on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Perform research at the Army High Performance Computing Research Center (AHPCRC) requiring computationally intensive algorithms in the areas of projectile-target interaction, signature modeling, chemical/biological defense, nano-science and nano-mechanics, and scientific visualization enabling technologies that support the Future Force transition path. In FY06, integrated software for intrusion detection with Army Center for Intrusion Monitoring codes and validated the software for Army application; implemented new physics-based model to enhance interior ballistics prediction capability for Army application; designed multi-scale nanotechnologies modeling algorithm; implemented new analytical capability for modeling descent and terminal fragmentation of arrow shells. In FY07, incorporate infrastructure to allow for nanoscale optical, magnetic, and biosensors on a deployable chip; explore multi-sensory visualization approaches to better understand and process multivariate data; research algorithms for rigid and elastic multi-body dynamics analyses for air and ground vehicles; investigate new modeling methods for nonlinear computational structural mechanics. In FY08, will explore new interdisciplinary methods to evaluate lightweight combat systems, will implement data mining algorithms to assist different Army applications, will investigate and plan new computational approaches to analyze very large-scale networks for battlefield applications. In FY09, will implement interdisciplinary methods for analysis and evaluation of survivability of lightweight combat systems; will apply data mining algorithms to enhance and correlate Army scientific applications and experiments; will explore new multi-scale computational approaches for assisting micro-systems design.	2000	1650	1985	1996
Perform research that focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. In FY06, explored tracking of moving people from a moving platform in a cluttered environment and trajectory prediction. In FY07, investigate coupling of tracking and trajectory prediction algorithms with dynamic planning algorithms.	309	369		
Small Business Innovative Research/Small Business Technology Transfer Programs		58		
Total	2309	2077	1985	1996

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H54**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H54	Micro-Autonomous Systems (MAST) CTA	5043	3947	7396	7661	8187	8205	8385	8570

A. Mission Description and Budget Item Justification: This project supports two competitively selected industry/university consortia, the Advanced Sensor Collaborative Technology Alliance (CTA) and the Micro Autonomous Systems and Technology (MAST) CTA, that leverage world-class commercial research necessary to address Future Force and Army Transformation needs. The CTAs link a broad range of government technology agencies, as well as industrial and academic partners with the Army Research Lab (ARL). The Advanced Sensors CTA is focused on innovative research in three main technical areas: micro-sensors, electro-optic smart sensors, and advanced radar concepts. Payoff to the warfighter will be advanced sensing technologies to support Future Force requirements. Technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro-sensor networks; multi-domain smart sensors (including multi-spectral infrared focal plane arrays); a novel concept for laser radar (LADAR); multifunctional radar sensors; and sensor modeling and algorithms for automatic target recognition (ATR) through fusion of data from multiple sensors and signal processing. Work in the Advanced Sensors CTA accelerates the transition of technology to program element (PE) 0602120 (Sensors and Electronic Survivability). The MAST CTA will focus on innovative research in four main technical areas related to the coherent and collaborative operation of multiple micro autonomous platforms: microsystem mechanics, processing for autonomous operation, microelectronics, and platform integration. Payoff to the warfighter will be advanced technologies to support Future Force requirements in situational awareness. Both CTAs facilitate the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as to use state-of-the-art facilities and equipment at the participating organizations. The cited works are consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL). In FY08, this project (Advanced Sensors CTA) transitions to Micro Autonomous Systems and Technologies CTA and is restructured to include FY08 and FY09 funding from project J09 of this program element.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
This project has been restructured to increase the emphasis on microsensors and reduce the efforts in both the radar and electro-optics factors. As such, the following deliverables are planned to perform microsensor, electro-optics, and radar research focused on various passive and active sensors, algorithms, low-power signal processing, and autonomous sensor/network management for the unattended sensor network component, resulting in technology transfer and delivery of sensor nodes to applied research. In FY06, validated a 32x32 active imager array on a custom readout circuit, demonstrated a novel, multi-beam all-dielectric lens for phase array antennas, and completed a mathematical framework for decentralized detection, identification, and tracking of vehicles and people across a cluster of nodes. In FY07, fabricate a long wavelength infrared 320x256 gallium antimonide passive imager array, validate a highly robust Low Noise Amplifier Monolithic Microwave Integrated Circuit (MMIC) for use in hostile electromagnetic environments of the electronic battlefield, and experimentally validate autonomous sensor management capability.	5043	3836		
The MAST CTA will focus on innovative research related to the coherent and collaborative operation of multiple micro autonomous platforms to enhance situational awareness. In FY08, the MAST will investigate platform stability and control in high-disturbance environments; bio-inspired, bio-mimetic leg, and wing concepts with integrated sensors and actuators; autonomous and semi-autonomous navigation and control over a network; group cooperative behavior and planning; efficient sensing and information extraction and utilization; constrained information management within a node; distributed signal processing, including low complexity techniques for			7396	7661

distributed multi-modal sensing and fusion, dynamic collaborative processing accounting for sporadic sensing and sensor management, lightweight robust and possibly asymmetric networking, integrated cross-layer communications and network design, architecture analysis to understand fundamental limits, system modeling and simulation, and design tools capable of balancing and optimizing trade-offs in a microsystem architecture, technologies required for the coherent and collaborative operation of multiple micro autonomous platforms. Investigations may include vortex-dominated unsteady aerodynamics of flapping wings at low Reynolds numbers, high-force high-bandwidth large-displacement linear actuators, and autonomous and semi-autonomous navigation and control over a network. In FY09, will mature technologies required for the coherent and collaborative operation of multiple micro autonomous platforms. Investigations may include communications and networking, synthesis, and development of three-dimensional materials and circuit architectures, development of smart multifunctional structures, and materials, low power devices, hybrid power systems and power management, microsystems architectures modeling and simulation, and functional packaging.				
Small Business Innovative Research/Small Business Technology Transfer Programs		111		
Total	5043	3947	7396	7661

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H56**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5945	6097	5550	5957	6061	6259	6413	6571

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Advanced Decision Architecture Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class commercial research in support of the Future Force and Army transformation needs. The Future Force will require state-of-the-art user-centered decision support technologies to include user-interface concepts, design practices, and principles. These technologies will provide for real-time situational awareness, distributed commander-staff-subordinate collaboration and planning, and execution monitoring in high-tempo, high-stress battlefield environments at speeds that permit the commander and his staff to operate inside the enemy's decision cycle. This project will conduct an intensive and accelerated program to formulate, validate, and transition basic research to provide solutions for the many requirements for understanding situational awareness, expert decision making, team collaboration, the ability to display information in a way that facilitates knowledge assimilation on the battlefield, and visualization and decision support architectures. Research is conducted in four areas: cognitive process modeling and measurement, analytical tools for collaborative planning and execution, user adaptable interfaces, and auto-adaptive information presentation. The technical barriers associated with this project are: human-computer interface in an information rich environment; display configuration; real time visualization; information presentation; and control coupling. The CTA also facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of-the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of advanced decision architecture technology to PE 0602716 (Human Factors Engineering Technology) and program element (PE) 0602783 (Computer and Software Technology). This program will be re-focused to emphasize individual Soldier, squad, and platoon level tools and information and knowledge fusion. Research partnerships will be established with the Institute for Creative Technology (PE/project 0601104/J08) and the Flexible Display Center (PE/project 0602705/H17) to establish collaborative and synergistic research programs. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers): In FY06, investigated applicability of social network models of commander and staff interactions for organizational design. In FY07, validate decision architecture for information fusion, which uses diagrammatic reasoning as an aid to evaluate the commander's preferred course of action. In FY08, will extend and improve a system for the automatic generation of Cognitive Models of Situation Awareness (CMSA). In FY09, will validate software agent architecture for enhancing the performance of human teams using advanced artificial intelligence techniques including context-sensitive information sharing, automated development of shared situation awareness and recognition-primed decision support, a naturalistic decision making (NDM) technique used by experienced decision makers to quickly scan an array of displays or information and "instantly" know the best course of action to pursue.	1718	1420	1320	1400
Analytical tools for collaborative planning and execution: Create tools that effectively support teams in coordinating and collaborating to achieve mission success across the spectrum of operations. In FY06, designed and conducted experiments to examine parametric variations on decision-making processes and procedures and studied the use of advanced digital tools for continuous planning in a distributed environment. In FY07, complete prototype decision-making architecture for collaboration and visualization test bed. In FY08, will provide tools and techniques to foster better adaptive learning, expert decision-making, and teamwork. In FY09, will devise	1408	1408	1208	1343

theoretical foundations and empirical findings on the design of collaborative systems to make Soldiers more effective as sensors in the Brigade and Below Battlefield Awareness Network environment and to enhance Soldier-automation collaboration.				
User-adaptive interfaces: Explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning, and decision-making. In FY06, integrated advanced haptic (touch) displays into a multi-modal test bed and evaluated effect on Soldier performance. In FY07, integrate capability for multinational, multilingual communication in stability and support test bed. In FY08, will investigate interface technologies to fuse and visualize sensed information (persistent surveillance) as relevant tactical events to improve Commander's real time situational awareness. In FY09, will validate functional model of the capabilities of new sensor/network technologies as they could contribute to perceptual awareness including concepts such as trust.	1646	1724	1708	1902
Auto-adaptive information presentation: Investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY06, validated test bed for multi-modal information exchange and dynamic adaptation. In FY07, extend software agent systems to provide an agile computing infrastructure for brigade combat teams. In FY08, will experimentally test an agile computing infrastructure integrated with agent-based policy and domain services to enable efficient use of scarce computing and network resources and coordination of human-robot teams in realistic Army future combat system scenarios. In FY09, will devise a distributed system for real-time target tracking of multiple entities in an area under surveillance exploiting a reasoning-based approach to include diagrammatic reasoning, domain knowledge, and algorithmic solutions.	1173	1374	1314	1312
Small Business Innovative Research/Small Business Technology Transfer Programs		171		
Total	5945	6097	5550	5957

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H59**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H59 UNIV CENTERS OF EXCEL	1787	1927	2877	3412	3479	3539	3615	3692

A. Mission Description and Budget Item Justification: Army Centers of Excellence (COE) couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. The Rotorcraft Center of Excellence is the only program funded in this project in FY06 and FY07. This COE supports Army Transformation by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. Beginning in FY08, this project will fund the International Technology Centers (ITCs) and the Foreign Technology (and Science) Assessment Support (FTAS) program. The nine ITCs located in Australia, the United Kingdom, Canada, France, Germany, Japan, Chile, Argentina, and Singapore support the Army's goals of providing the best technology in the world to our warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC "technology finds" are submitted as technology information papers (TIPs) to various Army S&T customers including the Army Research Laboratory (ARL), the Research Development and Engineering Centers (RDECs) of the Research Development and Engineering Command (RDECOM), RDECOM technology Integrated Process Teams, the Rapid Equipping Force (REF), and others for evaluation and consideration for further research and development. The ITC TIPs also serve as input into the international section of the Army S&T Master Plan. The FTAS program builds upon the TIPs submitted by the ITCs. In some cases the TIP is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to fund basic research in these technology areas identified by the TIPs as having potential relevance to the Army's S&T plan. The research will provide information useful in making an early assessment of the technology's potential contributions to the Army's S&T strategy. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL) and Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
International Technology Centers (ITC)/Foreign Technology (and Science) Assessment Support (FTAS): In FYs 08 and 09, the ITCs will complete the developement of their international technology search process by utilizing technology roadmaps provided by the Research, Development, and Engineer Command's (REDCOM) technology Integrate Process Teams (IPTs) to focus on critical technology capability gaps. The ITCs will further refine their country-specific technology search strategies based upon the analysis of foreign Science and Technology (S&T) investment patterns in areas of technology relevant to the US Army. Technology search efforts will then focus on those countries and in those areas of technology having the greatest potential benefit to the US Army. In FYs 08 and 09, FTAS will evaluate progress on the initial program investments from FYs 06 and 07, and solicit new technology proposals for review and selection. The program will solicit technology projects focusing on the maturation of counter terrorism technologies, providing enhanced force protection, enhanced medical life saving projects and providing enhanced Soldier capabilities. A review of the lessons learned from the initial round of FTAS investments, including the selection and review process, will be utilized to improve the program. Prior to FY08, the ITC and FTAS efforts were funded in PE 0601102A, project H57.			2877	3412
Rotorcraft Centers of Excellence (RCOE): In FY06, the RCOE refocused efforts to address vertical lift technologies which will provide major cost reductions in heavy lift vehicles and developed active flow control concepts for improving rotorcraft performance and reducing	1787	1873		

noise and vibratory loads; investigated advanced adaptive flight control systems and autonomous control functionality; investigated low Reynolds number aerodynamics for small Unmanned Air Vehicle (UAV) design analysis and developed advanced concepts for rotorcraft UAV systems. In FY07, the RCOE are developing structures and materials concepts for lightweight composite rotor blades; investigating next generation carbon-nanotube/carbon-fiber composites for mechanical properties enhancement and real-time structural health monitoring; studying, experimentally and analytically, aerodynamic characteristics of active flaps and microflaps for reducing rotor vibration, power, and noise; and developing performance improvements in ducted-fan systems for vertical lift systems and UAVs. For FYs 08-09, this effort will be restructured into PE 0601104A project J17 for added focus and management oversight.				
Small Business Innovative Research/Small Business Technology Transfer Programs		54		
Total	1787	1927	2877	3412

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H62**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H62 ELECTROMECH/HYPER PHYS	5551	6139	6018	6154	6542	6672	6819	6969

A. Mission Description and Budget Item Justification: This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT) at the University of Texas, to conduct basic research in electromechanics and hypervelocity physics in support of electromagnetic (EM) guns. Of particular interest is EM power, EM launchers, EM integrated launch packages, and hypervelocity terminal ballistics. Advanced computational models are devised and/or applied to solve complex problems in each of these areas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power. The sponsored research provides the scientific underpinning for EM gun pulsed power including switching; addresses technical barriers associated with EM gun launcher life; and researches advanced technologies for hypervelocity target defeat. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapon systems development with applications for anti-armor, artillery, air defense, and the Future Force. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is monitored and guided by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Pulsed Power: In FY06, conducted component material experiments, matured a parallel silicon carbide (SiC) switch module, modeled pulsed power, and examined machine synchronization. In FY07, model electromagnetic, mechanical, and thermal properties of candidate EM pulsed power systems and define techniques to increase their efficiency. In FY08, will model and experimentally validate prototype alternate pulsed power systems. In FY09, will provide technology for large-scale solid state converters.	2151	2379	2500	2650
Launch: In FY06, incorporated launcher model into pulsed power model. In FY07, show long-life, multi-shot EM launcher operation. In FY08, will examine advanced materials for launcher components. In FY09, will examine thermal management of EM launchers.	1400	1587	1618	1700
Electromagnetic Lethality: In FY06, tested complete novel kinetic energy penetrator (NKEP) and incorporated NKEP into half-scale launch package for EM launch. In FY07, establish bounds on launch package parasitic mass; design, fabricate, and test full scale in-flight deployment mechanisms for second generation novel kinetic energy penetrators. In FY08, will measure material properties under short duration electrodynamic and structural loads; will examine the target interaction physics of reactive material during hypervelocity impact. In FY09, will complete and validate numerical model of armature physics including gouging and transition; will examine coupled high density/reactive materials during target interaction at hypervelocity.	2000	2000	1900	1804
Small Business Innovative Research/Small Business Technology Transfer Programs		173		
Total	5551	6139	6018	6154

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H64**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H64 MATERIALS CENTER	2161	2669	2745	2823	2884	2941	3006	3072

A. Mission Description and Budget Item Justification: This project concentrates scientific resources on materials research for lightweight vehicle protection and is executed through Cooperative Research Agreements (CRAs). The effort funds collaborative research in three Materials Science and Engineering Research Areas (MSERAs): (1) Composite Materials Research; (2) Advanced Metals and Ceramics Research; and (3) Polymer Materials Research. Each MSERA pursues thematic research thrusts that address topics pertinent to lightweight vehicle protection and that are aligned with the Army's strategic materials research vision enabling long-term synergistic collaboration between the Army Research Laboratory (ARL) scientists and university researchers. The Materials Cooperative Research Agreements provide for mutual exchange of personnel and sharing of research facilities with the University of Delaware, Johns Hopkins University, Rutgers University, Drexel University, and Virginia Tech. Lightweight, multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymer, and hybrid systems are emphasized. This project is closely coordinated with ARL in-house materials research projects (program element (PE) 0601102A, project H42) to promote effective and efficient transfer of fundamental scientific research addressing lightweight protective material requirements for the Future Force. The center accelerates the transition of technology to PE 0602105A (Materials Technology). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
In FY06, characterized fundamental behavior of multifunctional composite materials; devised materials concepts that utilize self-assembly methods to produce polymers, fibers, or coatings; and validated physics based models to predict the effects of microstructure on inorganic materials systems. In FY07, devise appropriate physics based models describing the attributes of multifunctional materials; determine the fundamental response of protective polymer based materials; devise new inorganic materials that incorporate microstructures designed for specific armor related properties. In FY08, will validate models for multifunctional composite attributes and show multifunctional capabilities in single composite material; devise schemes for synthesis of protective polymers with enhanced energy absorption; identify key materials parameters for the improved performance of metal matrix nanocomposite materials. In FY09, will utilize multifunctional composites to validate potential composite weight reductions; characterize and quantify performance of newly synthesized energy absorbing polymers; and validate effects of armor ceramic processing and materials selection on mechanical properties.	2161	2594	2745	2823
Small Business Innovative Research		75		
Total	2161	2669	2745	2823

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H73**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
H73 NAT AUTO CENTER	4468	2848	2893	2949	2980	3002	3068	3136

A. Mission Description and Budget Item Justification: The Center of Excellence for Automotive Research is a key element of the basic research component of the National Automotive Center (NAC), a business group within the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center is an innovative university/industry/government consortium leveraging commercial technology for potential application in Army vehicle systems through ongoing and new programs in automotive research, resulting in significant cost savings while maximizing technological achievement. The goal of this project is to significantly enhance the Army's transformation to the Future Force by the application of novel, high payoff technologies that can be phased in as improvements to vehicles over the next several decades. The research performed in this project contributes to formulating and establishing the basic scientific and engineering principles for these technologies. Efforts are fully coordinated and complementary to those performed by the NAC and TARDEC under program element (PE) 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University. Key industry partners include all major US automotive manufacturers and suppliers. The Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies and advances state-of-the-art modeling and simulation for the Army's future vehicular platforms. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Basic Research Plan (DBRP). Work in this project is performed by TARDEC, Warren, MI. FY05 Total for this R2 does not match FY07 President's Budget due to administrative error which excluded one congressional add.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Automotive Research Center (ARC): In FY06, formulated and analyzed modeling and simulation tools relating to systems engineering of advanced and alternative energy powered ground vehicles for improved vehicle fuel economy, reduced visual signature, reduced pollutant emissions through the use of advanced diesel and hybrid power trains, and investigated applications of fuel cell auxiliary power units and lightweight material structures; evaluated new concepts, hybrid architectures, component designs, and control strategies for duty cycles representing realistic missions of medium and large trucks, including off-road use of tactical trucks with the human in the loop. In FY07, evaluate and analyze models suitable for ground vehicle design decisions relative to vehicle reliability, reliability based design optimization, high mobility and fuel economy, high power density propulsion, thermal management and parasitic losses, advanced control, robust modeling, and validation of vehicle systems. In FY08, will refine and optimize computational models for ground vehicle characteristics including: fuel economy, acceleration, survivability, reliability, and cost effectiveness. Also in FY08, will perform unique advanced experimental validation of optimized models to assure proper predictions relative to actual real-world conditions. In FY09, will extend the applicability of the advanced models to future Army ground vehicle requirements in areas such as: elevated temperature and increased terrain severity, enhanced survivability, ultra-reliability, and general new global embedded constraints. Also during FY09, will perform new extended experimental model validations of these broadened areas of Army ground vehicle applicability, using unique and advanced instrumentation and efficient state-of-the-art data analysis procedures.	2794	2771	2893	2949
University Based Automotive Research: This one year congressional add continued development of modeling and simulation tools for military ground vehicles. No additional funds are required to complete this project.	1674			
Small Business Innovative Research/Small Business Technology Transfer Programs		77		

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J08**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J08 INSTITUTE FOR CREATIVE TECHNOLOGY	6886	7330	7484	7698	7918	8079	8259	8443

A. Mission Description and Budget Item Justification: This project supports simulation and training technology research at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, and distance learning. The ICT actively engages industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable entertainment technologies into military systems. The ICT also works with creative talent from the entertainment industry to adapt concepts of story and character to increase the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences. Creating a true synthesis of the creativity, technology, and capability of the industry and the R&D community is revolutionizing military training and mission rehearsal by making it more effective in terms of cost, time, range of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by performing basic research in modeling and simulation in accordance with the core competencies for the ICT University Affiliated Research Center (UARC). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training, modeling, and simulation solutions. Research includes investigation of techniques and methods to address the rapid development of synthetic environments that can be used for mission rehearsal and training of military operations. In FY06, explored the computational hardware and software approaches for representing the immersive environment using holographic imaging techniques. In FY07, investigate the timing, synchronization, and rendering techniques for augmenting the test beds with holographic imagery. In FY08, will create custom, multi-view, holographic display solutions for visualizing command data sets. In FY09, will investigate use of Organic Light Emitting Diodes, nano-technologies, and programmable matter (the creation of rudimentary elements which can be programmed into software for simulation components and innovative visual displays) in mixed reality immersive environments.	2641	2753	2884	2966
Conduct basic research in two significant aspects of immersive environments - graphics and sound. Research will improve computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations. Research into auditory aspects of immersion will provide the sound stimulus for increasing the realism for military training and simulation devices. In FY06, explored multi-view object and imaging techniques. Optimized audio engine performance and integrated with several projects. Investigated methods of harmonic warping of ambient sounds to create an "invisible" auditory score. Developed capability to capture moving or still images of objects or people and relight them so they can be seamlessly embedded in arbitrary environments. In FY07, investigate the concept of generalized reciprocity as it relates to how objects transform incident illumination into reflected light. Examine perceptual cues needed to produce 3D audio via hybrid headphone-loudspeaker techniques. Extend harmonic warping of ambient sounds to use beat tracking techniques to ensure smooth transitions of effects. In FY08, will	1545	1579	1674	1722

implement hybrid 3D audio system to create perception of auditory depth in mixed reality environments. Will develop facial and body animation techniques that can capture a person and then re-light and re-animate him or her in new environments. In FY09, will explore concepts for facial and body animation controlled by avatars in real time and investigate methods for development of virtual speakers in immersive environments.				
Techniques and human - virtual human interaction. In FY06, investigated an intelligent agent architecture concept that accounts for the emotional models, cultural/ethnic impact on verbal and non-verbal communication, synchronized verbal communication conceptual framework for intelligent agents to enable adaptation of the environment based on human and virtual human interactions. In FY07, explore and conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY08, will investigate techniques for appropriate modeling and social schema for avatar based crowd behaviors. In FY09, will assess adequacy of virtual human models against models of human behavior and use feedback to guide further research. Develop tools and techniques to speed creation and adaptation of virtual humans.	2700	2792	2926	3010
Small Business Innovative Research/Small Business Technology Transfer Programs		206		
Total	6886	7330	7484	7698

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J12**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J12 NANOTECHNOLOGY	9520	9557	9897	10097	10432	10755	11105	11260

A. Mission Description and Budget Item Justification: This project supports sustained multidisciplinary nanotechnology research for the Soldier at the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN emphasizes revolutionary materials research for advanced Soldier protection and survivability. The ISN works in close collaboration with several major industrial partners including Raytheon and DuPont, the Army Research Laboratory (ARL), the Army's Natick Soldier Center (NSC), and other Army Research Development and Engineering Command (RDECOM) centers in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support the Army Future Force Warfighter through research to devise nanotechnology-based solutions for the Soldier. This research emphasizes revolutionary materials research toward an advanced uniform concept. The future uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, biomedical monitoring, performance enhancement, and extremities protection. The objective is to lighten the Soldier's load through system integration and multifunctional devices while increasing survivability. The new technologies will be compatible with other Soldier requirements, including Soldier performance, limited power generation, integrated sensors, communication and display technologies, weapons systems, and expected extremes of temperature, humidity, storage lifetimes, damage, and spoilage. The work cited is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Lab (ARL). .

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Conduct research in Light-weight, Multifunctional Nanostructured Fibers and Materials. In FY06, the ISN theoretically demonstrated the existence of 2-dimensional designs for composite materials that simultaneously have complete photonic and phononic band gaps. Research on initiated Chemical Vapor Deposition (iCVD) showed that a wide range of homopolymers can be conformally deposited in ultra thin coatings (nominally 100 nm) on surfaces. Fundamental experimental and mechanistic modeling studies confirmed that iCVD polymerization occurs at the surface of the material being coated. In FY07, conduct limited fabrication of 2-D and 3-D polymeric structures that have complete band gaps for electromagnetic radiation and elastic waves; assess the light and sound scattering properties of these materials. Use iCVD to impart novel properties to limited numbers of various substrates of interest for EMI shielding and destruction of toxic substances. In FY08, will develop a theory of a new type of "lasing" based on stimulated emission of hypersound in dual band gap (sound and light) composite polymeric structures; identify optimized structures for photon (light) flow control, and measure sound propagation in select materials. In FY09, will use Monte Carlo simulation methods to optimize 2-D and 3-D structural configurations for simultaneous control of light and sound propagation and reflection; fabricate desired structures by interference lithography and test the resulting materials for the directional dependence of energy flow. Will develop mechanically robust iCVD coatings fully compatible with electro-spun mats that provide high surface area and a diversity of substrate materials..	1911	1839	2516	2565
Conduct research in Battle Suit Medicine and Blast and Ballistic Protection. In FY06, achieved new understanding of the anisotropic actuation mechanism in polypyrrole films that will give guidance on processing and design to attain higher electroactive strains. In FY07, conduct initial synthesis of families of flexible backbone/pendant group polymers showing promise for high absorption of mechanical energy. In FY08, will conduct low rate mechanical testing of mechanical energy absorption for promising polymers. In FY09, will	3894	3797	4865	4966

explore relation of molecular structural features to resultant toughness including high strain rate testing.				
- Conduct research on Soldier Survivability and Protection and Nanosystems Integration. In FY06, matured investigation of metal-insulator-semiconductor fibers for sensing temperature and detecting light of different wavelengths. In FY07, conduct initial synthesis and testing of polymers and components for transistors. In FY08, will investigate nano-engineered electronic devices for sensing. In FY09, will explore chemical sensing based upon nanoelectronic building blocks.	3715	3652	2516	2566
Small Business Innovative Research/Small Business Technology Transfer Programs		269		
Total	9520	9557	9897	10097

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J14**

COST (In Thousands)	FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J14 ECYBERMISSION	4609	4973	5118	5245	5359	5466	5586	5709

A. Mission Description and Budget Item Justification: This project supports eCYBERMISSION, a web-based science, math and technology competition designed to stimulate interest and encourage advanced education in these areas among middle and high school students nationwide. The project supports Army Transformation through the sponsorship of a nation-wide education competition that encourages the nation's youth to pursue advanced education and careers in Science, Mathematics, and Engineering, thereby providing a pool of technologically trained potential soldiers and civilians for the Army workforce of tomorrow. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, the Department of Defense Basic Research Plan (BRP), and supports the President's initiative for education. Work in this project is performed extramurally by the Army Research Laboratory (ARL). Note: This project was previously funded in PE 0601104A Project H59 and has been moved to Project J14 for increased visibility and management oversight.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
eCYBERMISSION is a national competition to stimulate interest in science, math and technology in middle and high school students. In FY06, continued full-scale competition to all middle school (grades 6-8) and 9th grade high school students across the country and Department of Defense Educational Activity (DoDEA) schools, with the goal of increased student and teacher participation beyond the results of FY05. In FY07, sustain eCYBERMISSION and continue implementing enhancements as necessary based on previous years' lessons learned. In FY08 and FY09, will continue competition and efforts to increase team participation.	4609	4833	5118	5245
Small Business Innovative Research/Small Business Technology Transfer Programs		140		
Total	4609	4973	5118	5245

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J15**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	4791	6132	7184	7916	8278	8278	8460	8646

A. Mission Description and Budget Item Justification: This project supports a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science research in the areas of network theory, system-of-systems security, sensor processing and delivery, and distributed coalition planning and decision making. The focus is on enhancing distributed, secure, and flexible decision-making to improve coalition operations, and developing the scientific foundations for complex and dynamic networked systems-of-systems to support the complex human, social, and technical interactions anticipated in future coalition operations. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) established a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences in FY06. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. This program supports the Future Force transition path of the Transformation Campaign Plan (TCP). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Perform fundamental network and information science research for US/UK coalition operations. In FY06, established the US/UK ITA in Network and Information Sciences. Investigated frameworks to describe interactions between network layer and application level data fusion for improved decision-making. Designed and analyzed cognitive medium access control algorithms for spectrum scavenging. Investigated bio-inspired information dissemination protocols for improved adaptability and robustness. In FY07, design and validate interoperability models for disparate networks using cross-layer adaptation methodologies for distributed resource allocation to optimize application specific metrics. Investigate efficient and adaptive security algorithms to enable formation and operation of secure, flexible coalition operation communities-of-interest. Establish initial ontologies for coalition structures and cultural models of planning. In FY08, will investigate mathematical frameworks to model the structure and behavior of wireless networks to establish theoretical limits on capacity, scalability, reliability, and energy-efficiency to understand the performance of command-and-control, sensor, and communication coalition networks. Will design protocols for automated policy negotiations and tools for refining high-level user-specified goals into low-level setting of components in coalition environments. Will devise and validate analytical networked fusion architectures based on semantic information. In FY09, will investigate models, theory, and algorithms for creating self-organizing wireless networks inspired by highly adaptive biological systems. Will investigate cognitive and socio-cultural factors on coalition command processes and coalition networks to enhance situational awareness and decision-making. Will establish and validate analytic frameworks, leading to tradeoffs between sensing, computing, communications, and actuation, for classes of wireless sensor networks.	4791	5960	7184	7916
Small Business Innovative Research/Small Business Technology Transfer Programs		172		
Total	4791	6132	7184	7916

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J16**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE		2053	2977	2995				

A. Mission Description and Budget Item Justification: This project conducts basic research in nano and micro technologies to improve the performance and effectiveness of portable electronic equipment for the warfighter. This will be accomplished by reducing power and weight while increasing real-time interactivity of vital information content between the warfighters and their environment. The Center for Nanotechnology and Microelectronics (CNAM) is a university research effort focusing on the development and application of nanotechnology that can be integrated with microelectronic systems while not duplicating existing nanoelectronics research programs. The objective is to accelerate the deployment of nanotechnology for military applications by focusing on applications where nanotechnology complements rather then replaces microelectronics. The research program will concentrate on four technology areas focused on resolving key issues associated with military applications of microelectronics and power electronics. Research thrusts include: 1) Thermal Management - the removal of heat from electronics and power electronics is the primary limit on the performance of small devices. Nanotechnology may improve the performance of thermal management systems by enhancing the cooling properties of materials, interfaces and fluids for microelectronics; 2) Hybrid nano/micro structures and devices - bottom-up self-assembly of nanoscale components onto/into microelectronic platforms can lead to electronic components that integrate nanoscale optical interconnects, produce significantly less waste heat, and integrate on-board sensing; 3) Nanotechnology-enhanced transparent electronic materials - transparent materials can be used for microelectronics, increasing the designers flexibility in integrating microelectronics into other systems; 4) Active Cooling - nanotechnology-based active cooling technology such as high efficiency thermoelectric coolers and nano-enhanced adsorption/desorption cooling can, in theory, cool microelectronics to temperatures below ambient or even to cryogenic temperatures, thus improving performance. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed extramurally by the Army Research Laboratory.

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
- Research thrusts include thermal management, hybrid nano/microstructures and devices, nanotechnology-enhanced transparent electronic materials, and active cooling for improved portable warfighter electronic equipment. In FY07, research enhanced materials for thermal management through tailoring the thermal conductivity of materials, fluids and reducing interface resistance; research low power nano-electronics; research nanotechnology-enhanced transparent electronic materials that may augment portable and flexible display technology; research advanced nanotechnology-enhanced cooling including thermoelectric coolers and adsorption/desorption cooling. In FY08, will research specialized thermal management techniques to provide improved cooling of army systems through the fabrication of materials with superior thermal conductivity and functionalized thermal interfaces to enhance heat transfer; will research novel nano-technology based sensors and electronics devices, including potentially lower power systems; will study nanotechnology-enhanced transparent electronic materials that may improve portable and flexible display technology; will investigate advanced nanotechnology-enhanced cooling techniques including thermoelectric and adsorption/desorption cooling. In FY09, will implement thermal management techniques that provide improved thermal conductivity and will study methods to functionalize the thermal interfaces to improve heat transfer; will fabricate novel nano-electronics for low power sensors and systems; will study nanotechnology-enhanced electronic materials that provide superior electrical capabilities; will research advanced nanotechnology-enhanced cooling techniques including		1995	2977	2995

thermoelectric and adsorption/desorption cooling.				
Small Business Innovative Research/Small Business Technology Transfer Programs		58		
Total		2053	2977	2995

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J17**

COST (In Thousands)		FY 2006 Actual	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
J17	VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE			1984	2032	2077	2119	2166	2213

A. Mission Description and Budget Item Justification: Vertical Lift Research Center of Excellence couples state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. Work will support Army Transformation by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles. The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Department of Defense Basic Research Plan (BRP). Work in this project is performed extramurally by the Army Research Laboratory (ARL) and the Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
Vertical Lift Research Center of Excellence - In FY08, will investigate high-lift airfoil concepts for delaying dynamic stall onset and reducing adverse pitching moments; and will develop data fusion and biomimetic materials for rotorcraft health monitoring systems. In FY09, will develop light-weight high-flexibility rotorcraft shafts using flexible matrix composites and active bearing controls; and will develop efficient and affordable joining concepts for high-stiffness, light-weight composites.			1984	2032
Total			1984	2032