ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
	Total Program Element (PE) Cost	100979	100498	86416	90338	93203	91842	93529
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4558	4937	2627	2681	2737	2790	2847
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	4835	6727	7118	7224	7332	7478	7627
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2401	2474	2627	2681	2737	2790	2847
H50	Comms & Networks Collab Tech Alliance (CTA)	7759	8062	7593	7837	7961	8139	8322
H53	ADV DIS INTR SIM RSCH	2363	2581	2750	2817	2883	2939	2999
H54	Advanced Sensors Collab Tech Alliance (CTA)	6122	6421	5791	5993	6077	6218	6362
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5849	6114	6165	6343	6718	6861	7009
H59	UNIV CENTERS OF EXCEL	6066	1837	1948	1999	2036	2077	2119
H62	ELECTROMECH/HYPER PHYS	5355	5709	6207	6315	6415	6542	6672
H64	MATERIALS CENTER	3075	2429	2699	2766	2828	2884	2941
H65	MICROELECTRONICS CTR	896	933	1065	1092	1116	1138	1161
H73	NAT AUTO CENTER	7419	4592	2880	2915	2954	2980	3002
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	10577	7082	7412	7642	7862	8018	8179
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5496	5566	5815	5961	6098	6219	6343
J12	NANOTECHNOLOGY	9093	9791	10414	10674	10915	11132	11355
J13	UNIVERSITY AND INDUSTRY INITIATIVES (CA)	19115	15575	0	0	0	0	0
J14	ECYBERMISSION	0	4740	5029	5158	5254	5359	5466
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	0	4928	6200	7240	8280	8278	8278
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE	0	0	2076	3000	3000	0	0

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 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 U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC); the Simulation & Training Technology Center (STTC); and the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI).

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

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

B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	100066	81953	85938
Current BES/President's Budget (FY 2007)	100021	100498	86416
Total Adjustments	-45	18545	478
Congressional Program Reductions		-441	
Congressional Rescissions		-1014	
Congressional Increases		20000	
Reprogrammings	-45		
SBIR/STTR Transfer			
Adjustments to Budget Years			478

Fourteen FY06 Congressional adds totaling $20000 were added to this PE.
Exhibit R2 Resource Table includes includes $958 in FY05 for a Congressional Add for Partnership for the Next Generation of Vehicles/TACOM which was not included in the data base lock.
FY06 Congressional adds with no R-2A (appropriated amount is shown):
($1200) Advanced Coating Systems for Ground-based Military Vehicles
($500) Advanced, Multifunctional Composites for Joint Rapid Airfield Construction
($1000) Advanced Sensors Research
($1000) Advanced Steel Casting Technology for Weapons Systems
($1700) Automotive Research
($2500) Centers of Excellence
($2000) Ferroelectric Electronic - Photonic Nanodevices
($1000) Nanoscience and Nanotechnology Research
($2000) Nanotubes Optimized for Lightweight Exceptional Strength Composite Materials
($1200) Next Generation Joining Technology Research
($1700) Photonics Research
($1200) Real Time Classification Through Wall Sensor
($2000) Strategic Defense Systems Manufacturing Technology Photonics Research
($1000) Visualization for Training and Simulation in Urban Terrains

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	4558	4937	2627	2681	2737	2790	2847

A. Mission Description and Budget Item Justification: Centers of Excellence have proven to be 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 the 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) Battlelabs 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 0601104A 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 2005	FY 2006	FY 2007
- In FY05, established the HBCU/MI Centers of Excellence for Battlefield Capability Enhancements: Tuskegee University - research on flexible extremities protection; North Carolina A&T University - research on flexible displays and human engineering research in cognitive strategies, for example "sense making"; Tennessee State University - research on sensor fusion; and Prairie View University - research on Beyond-Line-of-Sight. Continued to forge close collaborative working relationships with TRADOC Battle Labs and accelerate technology transitions to Army Labs/Centers and Industry. In FY06, will conduct rheological characterization studies of fabric composites for flexible extremities protection; investigate 2D stationary and non-stationary distributed sensors with varying operational modalities; characterize non-crystalline wide band gap materials for environmentally stable flexible displays; conduct cognitive process experiments for human-centric decision making. In FY07, will model and simulate wave propagation of shear thickening fluid/fabric composites for extremities protection; expand sensing taxonomy to 3D located sensors and combine with 2D and 3D non-stationary sensor nodes; characterize electrical and optical properties of organic multilayer films for flexible displays; model adaptivity of decision maker in dynamic situations.	2308	2473	2627
- The purpose of this Congressional add in FY05 and FY06 is to support basic research at Lincoln University, a Historically Black University. No additional funding is required to complete this project.	2250	2464	0
Total	4558	4937	2627

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February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	4835	6727	7118	7224	7332	7478	7627

A. Mission Description and Budget Item Justification: This Project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center located at the University of California-Santa Barbara, and two major subcontractors, 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 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. 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 2005	FY 2006	FY 2007
Institute for Collaborative Biotechnologies: In FY05, explored biologically derived and biologically inspired synthesis and processing for enhanced performance materials properties; investigated and leveraged design and characterization of biological networks as insight for battlefield networks. In FY06, will formulate fastest available method for generating binding peptides for Army biosensing, diagnostics and therapeutics applications; will devise the collective optical response of multichromophore macromolecules and DNA-specific electrode surfaces and microfabrication for detection and identification of multiple DNA sequences for threat, Identification Friend or Foe (IFF) and soldier status-analysis; will adapt unique proteomics technology and diagnostic markers into microfluidics-based modified proteomics libraries for advanced analysis in early detection of human pathology; and will establish the roles of interfaces for potential use of biological + non-biological hybrid components in advanced electronic and photonic devices. In FY07, will provide foundation for incorporation of deterministic and stochastic dynamic models from biological systems, endowing engineered Army networks with robustness; will 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; will enable controlled surface functionalization and ligand display on, and integration into, materials for application in sensors, multi-functional materials, and device assembly; and will devise genetically engineered microbial systems that efficiently incorporate unnatural amino acids into proteins for unique materials application for the Army.	4835	6727	7118
Total	4835	6727	7118

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February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2401	2474	2627	2681	2737	2790	2847

A. Mission Description and Budget Item Justification: This project conducts basic research in key scientific 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 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 research program, 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 2005	FY 2006	FY 2007
- Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary autonomous mobility for the Future Force. Research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618 (Robotics Technology). 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 FY05, focused on understanding sensor phenomenology and determined new methodologies to enable accurate terrain classification in the local environment permitting intelligent autonomous tactical movement through complex terrain. Specialized algorithms able to classify distinct objects, e.g., water, wire structures, embedded in a complex background to enable higher speed cross-country mobility required for Future Combat Systems unmanned ground elements were matured. Investigated control concepts that allow autonomous systems to adapt to dynamic environments and learn from past performance in a mixed manned/unmanned collaborative environment thus reducing the cognitive workload placed upon soldiers controlling unmanned systems. Characterized the performance of a probabilistic, genetic algorithm and market based algorithms in Modeling and Simulation evaluation framework for autonomous robot scout systems. In FY06, will compare adaptive capability of tactical behaviors to a baseline approach utilizing task decomposition/case-based machine behavior; and will perform assessment for Improvised Explosive Devices (IED) threat mitigation designed to stress both perception and control strategies, proving concept viability and mitigating the risk associated with meeting FCS objectives. In FY07, will evaluate tactical behavior of core algorithmic structures and determine performance of best features of each in various tactical behavior applications stressing performance in changing tactical situations in complex environments.	2401	2474	2627
Total	2401	2474	2627

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February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H50	Comms & Networks Collab Tech Alliance (CTA)	7759	8062	7593	7837	7961	8139	8322

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 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 NRC BAST study. When the International Technology Alliance on Network and Information Sciences (0601104/J15) is established in 2006, joint planning of the research programs will prevent redundancies. 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 2005	FY 2006	FY 2007
- 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. In FY05, validated self-organizing and auto configuring subnet protocols enabling persistent on-the-move communication sessions in highly mobile conditions. In FY06, will devise and validate auto configuration protocols that allow mobile networks to adapt to dynamic conditions. In FY07, will conduct analytical and experimental studies validating dynamic and survivable resource pooling to enable mobile networks to exploit distributed network infrastructures.	2668	2821	2812
- 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 FY05, conducted analytical and experimental studies validating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move. In FY06, will conduct 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, will conduct analytical and experimental studies of signal processing aided medium access control algorithms that improves communications performance while on-the-move.	1961	2015	1801
- 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 FY05, conducted analytical and experimental studies validating low probability of detection waveforms, interference mitigation techniques, and anti-jam modulation to enable survivable communications and spectrum reuse. Investigated ultra-violet non-line-of-sight sensor communications. In FY06, will conduct analytical and experimental studies of frequency-hopping systems that enable robust and mobile anti-jam effectiveness. In FY07, will devise and study sensor array processing and interference techniques that enable adaptive antennas for improved interference rejection and spectrum	1574	1613	1361

reuse.			
- Tactical Information Protection: perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY05, conducted analytical and experimental studies validating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection. In FY06, will conduct 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, will devise and study security schemes for distributed servers supporting dynamic network infrastructures.	1556	1613	1619
Total	7759	8062	7593

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February 2006

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

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H53	ADV DIS INTR SIM RSCH	2363	2581	2750	2817	2883	2939	2999

A. Mission Description and Budget Item Justification: This project supports Army critical research at the Army High Performance Computing Research Center (AHPCRC). The AHPCRC research is focused on the Future Force, 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 a long-term collaboration between the Army Research Laboratory and competitively selected Army Center of Excellence in Information Sciences (ACEIS). The objective of this center is to perform research in knowledge fusion technology in support of global and tactical battle command for the Future Force. The most significant technical barrier is determining how fusion can function usefully as a service in the rapidly evolving, universal distributed web environment to build systems to support reasoning and inference of human decision processes. Areas of emphasis include real-time and near-real-time multi-sensor fusion for situational awareness and threat prediction. A key problem to be solved is information overload. Major portions of the work of the ACEIS are performed at Clark Atlanta University and Morgan State University; both are HBCU institutions. 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 2005	FY 2006	FY 2007
- Perform research at the Army High Performance Computing Research Center (AHPCRC) that requires computationally intensive algorithms in the areas of projectile target interaction, signature modeling, chemical/biological defense, nano-science and nano-mechanics, and enabling technologies to include scientific visualization that support the Future Force transition path. In FY05, created novel computational algorithms for chemical-biological defense at the cell level; explored algorithms at nano-level and mechanics towards multifunctional nano-materials; explored coupled approaches for integrating Army meteorology models with electromagnetics; investigated new higher order techniques in mechanics and electromagnetics; explored scientific visualization approaches to meet new hardware, software, and user requirements. In FY06, will integrate software for intrusion detection and validate for Army application; will implement dial-up software to enhance interior ballistics and validate for Army application; and will explore nanotechnologies algorithm toward relevant Army applications. In FY07, will complete an 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; and will devise algorithms for flexible-rigid multi-body dynamics and new methods for nonlinear computational structural mechanics.	2000	2000	2000
- Perform research into knowledge fusion technologies and systems that enhance situational awareness and threat prediction on the battlefield to improve tactical and global battle command. In FY05, showed distributed streaming video fused with geographic data to present real-time battlefield on-request information delivery. In FY06, will extend research to include indexing and queries that cluster around time and space using superimposed visualization to enhance imagery. In FY07, will investigate additional heterogeneous multimedia data sources for potential extension and experimentation in a mobile environment.	363	581	750
Total	2363	2581	2750

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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 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H54	Advanced Sensors Collab Tech Alliance (CTA)	6122	6421	5791	5993	6077	6218	6362

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Advanced Sensor Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class commercial research necessary to address Future Force and Army Transformation needs. The CTA links a broad range of government technology agencies and industry/academia partners with the Army Research Lab (ARL). This Advanced Sensors CTA conducts innovative research focusing on three main technical areas: micro-sensors, electro-optic smart sensors, and advanced radar concepts. The payoff to the warfighter will be advanced sensing technologies to support Future Force requirements. The technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro sensor networks; multi-domain smart sensors (includes multi-spectral infrared focal plane arrays); a novel concept for laser radar (LADAR); multifunction radar sensors; and sensor modeling and algorithms for automatic target recognition (ATR) involving fusion of data from multiple sensors and signal processing. 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. Work in this CTA accelerates the transition of technology to PE 0602120 (Sensors and Electronic Survivability). 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 2005	FY 2006	FY 2007
- 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 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. For FY06, will complete a mathematical framework for decentralized detection, identification and tracking of vehicles and people across a cluster of nodes. For FY07, will experimentally validate autonomous sensor management capability.	2448	2569	2367
- Perform electro-optics research focused on infrared sensors, laser radar, hyperspectral imaging, and automatic target recognition algorithms for improved situational awareness and targeting. In FY05, devised prototype 8x8-pixel integrated active/passive imager; fabricated a medium wavelength infrared (MWIR) 320 x 256 gallium antimonide passive imaging array; validated mercury cadmium telluride MWIR passive imaging array with operating temperature of 120 Kelvin. In FY06, will validate a 32 x 32 active imager on custom readout circuit. In FY 07, will fabricate a long wavelength infrared 320x256 gallium antimonide passive array.	2143	2247	2024
- Perform radar research focused on low-cost electronically scanned antennas; integration of analog and digital components, advanced materials and device designs; and system studies to increase radar performance and reduce the detection of FCS platforms. In FY05, verified low-power Micro-Electrical-Mechanical System (MEMS) phase shifters for electronically scanned antennas. In FY06, will show a novel, multi-beam all dielectric lens for phase array antennas. In FY07, will prove out a highly robust Low Noise Amplifier Monolithic Microwave Integrated Circuit (MMIC) for use in hostile electromagnetic environments of the electronic battlefield.	1531	1605	1400
Total	6122	6421	5791

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

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H56	Adv Decision Arch Collab Tech Alliance (CTA)	5849	6114	6165	6343	6718	6861	7009

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 that will provide real-time situation awareness, distributed commander-staff-subordinate collaboration and planning, and execution monitoring in a high tempo, high stress battlefield environment with 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 situation 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; architecture; 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 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 (0601104/J08) and the Flexible Display Center (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 2005	FY 2006	FY 2007
- Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers). In FY05, validated computational models of cognitive processing to include models which predict operator performance while interacting with graphic displays. In FY06, will investigate applicability of social network models of commander and staff interactions for organizational design. In FY07, will validate architecture for information fusion, which uses diagrammatic reasoning as an aid to evaluate the commander's preferred course of action.	2162	2262	2418
- 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 FY05, integrated concepts, equipment, and software to examine multi-national coalition collaboration in a stability and support operation. In FY06, will design and complete experiments to examine variations on decision-making processes and procedures and the use of advanced digital tools for continuous planning in a distributed environment. In FY07, will complete prototype architecture for collaboration and visualization test bed.	1145	1193	1099
- User-adaptive interfaces: explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning and decision-making. In FY05, provided solutions for identification and fusion of information necessary to make and control decisions from generally distributed and disparate databases with varied data uncertainties. In FY06, will integrate advanced haptic (touch) displays	1578	1651	1751

into a multi-modal test bed and evaluate effect on soldier performance. In FY07, will integrate capability for multinational, multilingual communication in stability and support test bed.			
- Auto-adaptive information presentation: investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY05, validated baseline system for improving the flexibility of Future Combat Systems (FCS) through dynamically reconfigurable software agent systems. In FY06, will validate test bed for multi-modal information exchange and dynamic adaptation. In FY07, will extend software agent systems to provide an agile computing infrastructure for Unit of Action.	964	1008	897
Total	5849	6114	6165

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H59 UNIV CENTERS OF EXCEL	6066	1837	1948	1999	2036	2077	2119

A. Mission Description and Budget Item Justification: Army Centers of Excellence 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. This project supports the Rotorcraft Center of Excellence and 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. Starting in FY06, the eCYBERMISSION effort will be restructured to Project J14 for increased visibility and management oversight, leaving the Rotorcraft Center of Excellence as the only program funded in this project in FY06 and 07. In FY06 and FY07, this project 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 Aviation and Missile Research, Development, and Engineering Center (AMRDEC).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
eCYBERMISSION national competition to stimulate interest in science, mathematics and technology in middle and high school students. In FY 05, sustained eCYBERMISSION and implemented enhancements as necessary based on previous years' lessons learned and expanded student and teacher participation. For FY06, this effort was restructured into PE 0601104A Project J14 for increased visibility and management oversight.	4311	0	0
Rotorcraft Centers of Excellence. In FY05, investigated limit detection and limit avoidance methods for carefree maneuvering. Devised experimental and computational analysis capabilities on rotor wakes and tip vortices. In FY06, refocus efforts to address vertical lift technologies which will provide major cost reductions in heavy lift vehicles. Develop active flow control concepts for improving rotorcraft performance and reducing noise and vibratory loads. Investigate advanced adaptive flight control systems and autonomous control functionality. Investigate low Reynolds number aerodynamics for small Unmanned Air Vehicle (UAV) design analysis. Develop advanced concepts for rotorcraft UAV systems. In FY07, will investigate high-lift airfoil concepts for delaying dynamic stall onset and reducing adverse pitching moments; will develop data fusion and biomimetic materials for rotorcraft health monitoring systems; 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.	1755	1837	1948
Total	6066	1837	1948

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H62 ELECTROMECH/HYPER PHYS	5355	5709	6207	6315	6415	6542	6672

A. Mission Description and Budget Item Justification: This project funds Army basic research in electromechanics and hypervelocity physics relating to electromechanical components (electromagnetic launchers and power supplies) for applications to electromagnetic (EM) guns. Additionally, this project provides for research, evaluation and computer modeling of advanced hypervelocity projectiles. This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT), at the University of Texas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power, materials and techniques to achieve extended rail life, and on establishing the utility of hypervelocity projectiles. This project will research underpinning technologies for EM gun pulsed power; address technical barriers associated with EM gun launch; and research 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 2005	FY 2006	FY 2007
- Pulsed Power: In FY05, included thermal effects in parametric model; analyzed constitutive behavior of candidate materials in short EM pulse testers; and matured advanced topology Silicon Carbide(SiC) switches. In FY06, will conduct component material experiments and mature a parallel SiC switch module. In FY07, will model electromagnetic, mechanical and thermal properties of candidate EM pulsed power systems.	2087	2168	2386
- Launch: In FY05, investigated novel, high efficiency launcher configurations and developed model of sliding electric contact. In FY06, will incorporate launcher model into pulsed power model. In FY07, will show long-life, multi-shot EM launcher operation.	1232	1471	1476
- Electromagnetic Lethality: In FY05, evaluated concepts for enhanced behind-armor debris and evaluated against full-scale targets. In FY06, will flight test complete novel kinetic energy penetrator (NKEP) and incorporate NKEP into half-scale launch package for EM launch. In FY07, will prove NKEP launch from full-scale EM launcher.	2036	2070	2345
Total	5355	5709	6207

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H64 MATERIALS CENTER	3075	2429	2699	2766	2828	2884	2941

A. Mission Description and Budget Item Justification: This project concentrates scientific resources on research to advance innovative materials technologies and exploit breakthroughs in materials science and engineering through Materials Cooperative Research Agreements (MCRAs). MCRAs promote long-term synergistic collaboration between the Army Research Laboratory (ARL) scientists and university researchers. The MCRAs provide for mutual exchange of personnel and sharing of research facilities with U. Delaware, Johns Hopkins U., Rutgers U., and U. Massachusetts. The MCRAs focus research on armor, anti-armor, personnel protection, ground vehicle, rotorcraft and tactical missile applications. Lightweight, multi-functional composites, advanced armor ceramics, bulk amorphous metals, nanomaterials technology, and new polymer hybrid materials for flexible extremities (combat warrior) protection are emphasized. Closely coordinated with ARL in-house materials research projects (PE 0601102A, Project H42), this effort enables the effective and efficient transfer of fundamental scientific research to address 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 2005	FY 2006	FY 2007
In FY05, devised electro-optical composite structural materials; explored practical strategies to scale-up synthesis and processing of hierarchical polymers and polymer-inorganic hybrid materials; and devised physics based models to predict the effects of microstructure on the behavior of metallic and ceramic material systems under dynamic loading conditions. In FY06, will characterize fundamental behavior of multifunctional composite materials; will devise materials concepts that utilize self-assembly methods to produce polymers, fibers, or coatings with unprecedented properties; and will validate physics based models to predict the effects of microstructure on inorganic materials systems. In FY07, will devise appropriate physics based models that describe the attributes of multifunctional materials; will determine the fundamental response of hierarchical polymer based materials; will devise new inorganic materials that incorporate microstructures designed for specific armor related properties.	2249	2429	2699
Composite Materials Research. The objective of this Congressional Add is to perform composite materials research. In FY05, advanced the fundamental composite materials research ongoing at the University of Delaware. No additional funding is required to complete this project.	826	0	0
Total	3075	2429	2699

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**H65**

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H65 MICROELECTRONICS CTR	896	933	1065	1092	1116	1138	1161

A. Mission Description and Budget Item Justification: This project conducts basic research in the area of micro/nano electronics and photonics which have broad application to many enduring Army requirements, including power and energy (from soldier micro power to high power high temperature electronics for electric vehicles), prognostics and diagnostics, networked microsensors, radio frequency electronics for secure communications, chemical-biological detection and electro-optical sensing. The focus will be on increased integration of these heterogeneous technologies by functionalizing materials to enhance sensing, processing, and communications. The benefits and impact to the Warfighter will be to provide basic semiconductor electronics research to support the required electronics for future army applications - both mounted and dismounted. This includes the research to support cost effective, smaller, lighter weight semiconductor electronics that can operate in harsh environments with increased reliability. This basic research effort is conducted through a cooperative agreement between the U.S. Army Research Laboratory and academia, which includes: (1) basic research projects pairing an Army Research Laboratory principal investigator and a principal investigator from academia; (2) the undergraduate student education program, which brings in high quality students to learn the principles of basic research; and (3) a graduate fellowship program. This agreement funds academics to solve current technical barriers and cultivates future talent. Technical barriers include: (1) identifying, understanding and resolving materials defects that can dramatically affect device performance; (2) identifying appropriate materials candidates and device designs in order to investigate devices that can operate under a variety of harsh conditions required by military applications, such as, high power, high temperature, intense vibration and corrosive environments; (3) associated micro-power issues; 4) thermal management; and 5) scaling issues associated with shrinking device sizes from the macro scale to the micro/nano scale. This project will serve to enhance the survivability, lethality, and mobility, while reducing logistics, of future Army platforms. This center accelerates the transition of microelectronics technology to PE 0602705A(Electronics and Electronic Devices). 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 2005	FY 2006	FY 2007
- The objective of this effort is to conduct basic research in the area micro/nano electronics and photonics and the integration of these heterogeneous technologies. The research supports future army applications and requirements for electronics that are cost effective, smaller, lighter, and that can operate under realistic military environments including high temperature, high power, intense vibration and corrosion while increasing reliability, enabling future army applications to meet the demands of a lighter weight force with increased/improved capabilities. In FY05, investigated Aluminum Nitride (AlN) as an alternative passivation dielectric to Silicon Dioxide (SiO2) for Silicon Carbide (SiC) power devices that operate at high temperatures (300 degrees Celsius and above). State-of-the-art SiC Metal Oxide Semiconductor Field Effects Transistor (MOSFETs) for high power and temperature electronics were successfully modeled at room temperature. Fabricated PZT (lead zirconium titanate) based Micro Electro-Mechanical Systems (MEMS) test structures and measured mechanical properties at the micrometer scale. In FY06, will investigate applications of focused ion beam nanofabrication and other nanofabrication techniques to novel devices for general applicability to a wide array of required Army nanoscale electronic devices. Investigate the use of carbon nanotubes for thermal management in high power high temperature electronics. In FY07, mature interface electronics for PZT piezo-ceramic-based MEMS sensors and actuators with Si-based and other semiconductor devices. Specifically, will explore the ARL developed pressure sensor and shock sensors for prognostics and diagnostics.	896	933	1065
Total	896	933	1065

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
H73 NAT AUTO CENTER	7419	4592	2880	2915	2954	2980	3002

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 U.S. 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 U.S. automotive manufacturers and suppliers. Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies relative to the Future Combat System (FCS) vehicular platforms. This effort advances state-of-the-art modeling and simulation for the Army's automotive technologies with strong emphasis on the Army's FCS program. 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 FY07PB due to administrative error which excluded one congressional add.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Automotive Research Center (ARC): In FY05, evaluated and analyzed models suitable for ground vehicle design decisions relative to collision avoidance warning systems, rollover warning, active yaw control, path departure, wireless intelligence systems, and advanced propulsion systems. In FY06, formulate and analyze 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 potential applications of fuel cell auxiliary power units and lightweight material structures; evaluate 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, will 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.	2867	2918	2880
University Based Automotive Research. This one year Congressional add developed modeling and simulation tools for military ground vehicles. No additional funds are required to complete this project.	3594	0	0
Partnership for the Next Generation of Vehicles / TACOM: This one-year Congressional add performed fundamental research that may improve the fuel economy in the Army's current and future fleet of ground vehicles. No additional funds are required to complete this project.	958	0	0
University Based Automotive Research. This one year Congressional add continues developement of modeling and simulation tools for	0	1674	0

military ground vehicles. No additional funds are required to complete this project.			
Total	7419	4592	2880

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	10577	7082	7412	7642	7862	8018	8179

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 capabilities 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, the types 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training and 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 FY05, investigated hardware and software solutions to timing and processing of multimodal, synchronized, queued media in synthetic environments, including blending virtual and physical objects into the mixed reality aspects of the test beds. In FY 06, will explore the computational hardware and software approaches for representing the immersive environment using holographic imaging techniques. In FY 07, will investigate the timing, synchronization and rendering techniques for augmenting the test beds with holographic imagery.	5648	2698	2849
- 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 FY05, explored techniques for the sonification (using sound, alone or in combination with visual imaging techniques) of data; investigated the recovery of shape and reflectivity for highly reflective objects, and investigated sound as a source of emotion in an immersive environment. In FY 06, will explore Multiview Object and Imaging techniques; and will examine sound cancellation techniques to improve auditory cues in noisy environments. In FY 07, will investigate the concept of generalized reciprocity as it relates to how objects transform incident illumination into reflected light; and will extend the concept of virtual loudspeakers to address multiple participants in a given mixed reality setting.	2427	1645	1675
techniques and human - virtual human interaction. In FY07, will explore a - Conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY05, completed draft specification	2502	2739	2888

of data elements and parameters for non-verbal communications techniques; and integrated emotional models and timing constraints into the draft specification. In FY 06, will investigate 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.			
Total	10577	7082	7412

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - Basic research	**0601104A - University and Industry Research Centers**	**J09**

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5496	5566	5815	5961	6098	6219	6343

A. Mission Description and Budget Item Justification: This project supports the Collaborative Technology Alliance (CTA) in Power and Energy Technologies. This CTA is a long-term collaboration between the Army Research Laboratory (ARL) and a competitively selected industry/university consortium for the purpose of leveraging world-class commercial research relevant to Army needs. Power and energy research supports lightweight, compact power for the individual Soldier, and energy conversion and control technologies for advanced electric mobility, survivability, and lethality applications - such as hybrid electric drive, electromagnetic armor, and electro-thermal-chemical gun - for fuel efficient Future Force Systems including manned and unmanned platforms. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming logistics fuels to generate fuel for fuel cells, and reducing the size and weight of electric power components and systems. The CTA focuses on three main technical areas: portable compact power sources (non-electrochemical), fuel cells and fuel reforming, and hybrid electric propulsion and pulsed power for survivability and lethality. These technologies are fundamental elements required to realize the Army Transformation and support the Future Force. The research in pulsed power and hybrid electric is done in coordination with the U.S. Army Tank-Automotive Research, Development and Engineering Center (TARDEC). 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. Work in this CTA accelerates the transition of technology to PE 0602705 (Electronics and Electronic Devices). 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 Lab (ARL).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Research, design, investigate and characterize micro electromechanical sytems (MEMS) based button sized gas turbine generator as a battery replacement for the dismounted Soldier of the Future Force. In FY05, produced electric power from high speed micro-generators for the first time, implemented a height variation capability in a micro-compressor, and designed a self-sustaining micro-gas turbine engine. In FY06, will fabricate and evaluate first micro-gas turbine engine. In FY07, will design and fabricate first micro-gas turbine engine operating on liquid fuel.	2145	2171	2276
- Research, investigation and characterization of novel fuel cells/components and logistic fuel reformation techniques to produce electricity for the dismounted soldiers of the Future Force, as well as produce electricity for vehicle prime power and accessory power for the Future Combat Systems. In FY05, integrated a catalytic partial oxidation fuel reformer with a solid oxide fuel cell designed to operate with partially reformed logistics fuels for vehicle and robotic platforms, and implemented in test rig. In FY06, will validate a compact direct methanol fueled 20W cell with improved performance over current state of the art. Determine the appropriate silicon carbide switch for different applications from the choices of a bipolar junction transistor (BJT), a metal oxide semiconductor field effect transistor (MOSFET) or an insulated gate bipolar transistor (IGBT). In FY07, will validate a 'bench top' solid oxide fuel cell operating on Army Logistics fuel without the addition of water.	3351	3395	3539
Total	5496	5566	5815

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J12 NANOTECHNOLOGY	9093	9791	10414	10674	10915	11132	11355

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. Computational models will be created that predict the Soldier's performance with the new technologies. 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 ARL and by visiting RDECOM scientists.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Conduct research in nano-based multifunctional materials for Soldier protection. In FY05, devised innovative materials processes and techniques to construct high performance layered structures to provide multifunctionality, including waterproofing, microbiocidal protection, and sensing, for light-weight fabrics and non-woven materials to improve Soldier protection. In FY06, will create hierarchical structures which demonstrate a range of material properties and improved protection against various Soldier threats. In FY07, will provide materials for evaluation that have improved survivability capabilities with nano-tailored surfaces, to provide capabilities such as nutrient delivery, water harvesting, and moisture repellency.	1868	2011	2139
- Conduct research in nano-structured polymer actuators to improve Soldier performance. In FY05, explored biomimetic muscular and structural behavior with potential to provide new approaches to outperform natural systems. In FY06, will characterize elastomeric, electrical and mechanical properties experimentally and with advanced modeling and simulation. In FY07, will create prototype hierarchical structures that deflect strains and stresses resulting from environmental and man-made threats while also providing improved performance.	3707	3994	4247
- Conduct research on integration, fabrication and modeling of nano-structured materials to create mechanically-active devices and sensors. In FY05, integrated new measurement and characterization research, including femtosecond laser characterization; and proved out and enhanced innovative methodologies to transition breakthroughs to Army labs/centers and industrial partners. In FY06, will begin fabrication of model systems of two or more nano-components to provide useful macro capabilities; and will use modeling and simulation to advance systems architecture for integrating multiple, nano-enabled survivability capabilities into Soldier systems. In FY07, will integrate subassemblies into larger assemblies to assess potential benefit for improved survivability.	3518	3786	4028

Total	9093	9791	10414

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J14 ECYBERMISSION	0	4740	5029	5158	5254	5359	5466

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 is a restructuring of ongoing research into a distinct project for increased visibility and management oversight

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- In FY05, this effort was funded in this Program Element under Project H59. eCYBERMISSION is a national competition to stimulate interest in science, math and technology in middle and high school students. In FY06, will continue 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 increasing student and teacher participation beyond the results of FY05. In FY07, will sustain eCYBERMISSION and implement enhancements as necessary based on previous years' lessons learned.	0	4740	5029
Total	0	4740	5029

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

	COST (In Thousands)	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J15	NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	0	4928	6200	7240	8280	8278	8278

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 collaborative fundamental research on topics relevant to US/UK military requirements. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) will establish a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. The "Network and Information Sciences" scope includes basic research into sensors exploitation, human dimension, and networking technologies. 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 by the Army Research Laboratory.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
- Network & Information Sciences ITA: Perform research into fundamental scientific underpinnings and theory for application to network and information science in the areas of network theory, security across a system of systems, sensor processing and information exploitation, and distributed coalition planning and decision making. In FY06, will award a competitive procurement establishing the US/UK International Technology Alliance in Network and Information Sciences for fundamental research into sensors exploitation, human dimension (distributed coalition decision-making), and networking technologies. In FY07, will conduct analytical and experimental studies in network theory and the interaction of networks, information exploitation and distributed decision making.	0	4928	6200
Total	0	4928	6200

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

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

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
J16	NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE	0	0	2076	3000	3000	0	0

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 of nanotechnology that can be used to integrate with microscale systems. The objective is not to duplicate existing nano electronics research programs but to focus on applications where nanotechnology can be integrated into microelectronics systems while not necessarily replacing microelectronics with nano electronics. By focusing on applications where nanotechnology complements rather then replaces microelectronics we hope to accelerate the deployment of nanotechnology for military applications. The research program will concentrate on four technologies 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 a primary limit on the performance of small devices. Nanotechnology may improve the performance of thermal management systems by enhancing the properties of materials, interfaces and fluids for microelectronics cooling; 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, even to cryogenic temperatures 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).

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
In FY07, will research enhanced materials for thermal management for tailoring the thermal conductivity of materials, fluids and reducing interface resistance; will research low power nano-electronics; will research nanotechnology-enhanced transparent electronic materials that may enhance portable and flexible display technology; will research advanced nanotechnology-enhanced cooling including thermoelectric coolers and adsorption/desorption cooling.	0	0	2076
Total	0	0	2076