ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2004

BUDGET ACTIVITY
1 - Basic research

PE NUMBER AND TITLE
0601104A - University and Industry Research Centers

	COST (In Thousands)	FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
	Total Program Element (PE) Cost	84237	99786	77658	76705	80157	82034	83816
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	0	0	2509	2540	2574	2624	2677
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	0	0	4824	4885	4949	5045	5149
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	0	0	2509	2541	2574	2624	2677
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7476	8135	8102	8887	9633	9864	10085
H53	ADV DIS INTR SIM RSCH	2431	2541	2468	2650	2694	2757	2820
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	5789	6374	6393	7202	7969	8160	8342
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5659	6164	6108	6584	7035	7204	7366
H59	UNIV CENTERS OF EXCEL	11972	21583	6561	6673	6753	6920	7045
H62	ELECTROMECH/HYPER PHYS	8213	5819	5591	5864	6081	6181	6276
H64	MATERIALS CENTER	2727	3156	2385	2495	2644	2707	2767
H65	MICROELECTRONICS CTR	922	964	936	958	1044	1069	1092
H73	NAT AUTO CENTER	5119	8069	2992	3077	3134	3208	3277
HA6	ARMOR MATERIALS DESIGN - LASER-BASED MATERIAL PROC	1191	0	0	0	0	0	0
HA7	DENDRIMER NANOTECHNOLOGY RESEARCH	3335	0	0	0	0	0	0
HA8	FERROELECTRIC MATERIALS NANOFABRICATION	952	0	0	0	0	0	0
HA9	JIDOKA PROJECT	1430	0	0	0	0	0	0
HB3	IMMERSIVE ENVIRONMENTS BASIC RSCH INITIATIVES (CA)	0	1388	0	0	0	0	0
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	12230	11998	11046	7184	7173	7389	7597

J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5644	5901	5739	5716	5697	5835	5966
J12	NANOTECHNOLOGY	9147	10753	9495	9449	10203	10447	10680
J13	UNIVERSITY AND INDUSTRY INITIATIVES (CA)	0	6941	0	0	0	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 supporting enabling technologies for Future Force capabilities. Broadly, the work in this project falls into three catagories: Collaborative Technology Alliances (CTAs), University Centers of Excellence, and paradigm-shifting centers - University-Affiliated Research Centers (UARCs).

CTAs are innovative alliances among government, industry and academic organizations to exploit scientific and technological breakthroughs and to transition these breakthroughs to exploratory development and applied research. 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 Centers of Excellence, which 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 materials science, electronics 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 Institute for Advanced Technology (IAT), Institute for Soldier Nanotechnologies (ISN), the Institute for Collaborative Biotechnologies (ICB) and the Institute for Creative Technologies (ICT). The IAT funds basic research in electromagnetics and hypervelocity physics. The ISN will emphasize revolutionary materials research for advanced soldier protection and survivability. The Institute for Collaborative Biotechnologies will broaden the Army's use of biotechnology to the development of materials, sensors, and information processing. The ICT is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and design. 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 program element contains no duplication with any effort within the Military Departments. 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).

B. Program Change Summary	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2004)	83310	84816	79750
Current Budget (FY 2005 PB)	84237	99786	77658
Total Adjustments	927	14970	-2092
Congressional program reductions		-856	
Congressional rescissions			
Congressional increases		15826	
Reprogrammings	927		
SBIR/STTR Transfer			
Adjustments to Budget Years			-2092

Significant Change Explanation:
FY04 - Eleven FY04 Congressional Adds totaling $15826 were added to this PE.

FY04 Congressional Adds with no R-2A:
($1348) Institute for Creative Technologies, Project HB3. The purpose of this one year Congressional add is fund basic research supporting an enhanced simulation capability at Fort Sill. No additional funding is required to complete this project.

($2890) Ferroelectric Electronic - Photonic Nanodevices, Project J13. The purpose of this one year Congressional add is to perform research in ferroelectric and photonic devices. No additional funding is required to complete this project.

($963) Data Analysis and Conversion, Project J13. The purpose of this one year Congressional add is to perform research in data analysis and conversion. No additional funding is required to complete this project.

($962) Eye and Sensor Protection Against Laser Source, Project J13. The purpose of this one year Congressional add is to perform research in eye and sensor protection against lasers. No additional funding is required to complete this project.

($481) Nanotubes Optimized for Lightweight Exceptional Strength, Project J13.

The purpose of this one year Congressional add is to perform research in nanotubes. No additional funding is required to complete this project.

($962) Rapidly Deployable Visualization for Training and Simulation, Project J13. The purpose of this one year Congressional add is to perform research supporting deployable visualization for training and simulation. No additional funding is required to complete this project.

($481) Small Trailer Corrosion Prevention Program, Project J13. The purpose of this one year Congressional add is to fund basic research in corrosion prevention. No additional funding is required to complete this project.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H04	HBCU/MI CENTERS - TRADOC BATTLELABS	0	0	2509	2540	2574	2624	2677

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 TRADOC Battlelabs to gain first hand perspective of the end-user's needs. Through these Centers, to be established in July 2004, 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 vital to 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 Defense Technology Area Plan (DTAP).

NOTE: This project was previously funded in PE 611104A Project H59 and is a restructuring of ongoing research into a distinct project for visibility and management.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- This program was initiated in FY04 in this PE under Project BH59. In FY05, continue the five HBCU/MI Centers of Excellence for Battlefield Capability Enhancements focused on one of the following topics: sensor fusion; Integrated Analysis for Vertical Take-Off and Landing Vehicles; Lines of Sight/Beyond Line of Sight Lethality, Lightweight Fuel Efficient Heavy Fuel Engines for UAVs; Flexible Extremities Protection; Mounted/Dismounted Maneuver; Human Engineering research in Cognitive Strategies: "Sense Making" and "Modeling in Effects of Training on Performance and Readiness. Continue to forge close collaborative working relationships with TRADOC Battle Labs and accelerate technology transitions to Army labs/centers and industry.	0	0	2509
Totals	0	0	2509

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H05	INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	0	0	4824	4885	4949	5045	5149

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 the latest developments in bio-inspired routes to advanced sensors; new electronic, magnetic and optical materials; and new routes to information processing. The objective is to perform 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 for Army Transformation. ICB has many industrial partners such as IBM and SAIC, and it is has strong collaborations with six National laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army materiel and medical research laboratories. 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 by the Army Research Laboratory (ARL).

NOTE: This project was previously funded in PE 611104A Project H59 and is a restructuring of ongoing research into a distinct project for visibility and management.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Institute for Collaborative Biotechnologies: In FY03 and FY04, this program was funded in this PE under Project BH59. In FY05, identify photodynamic protein-based molecular memory for rapid and accurate information processing and storage, and biologically derived and biologically inspired synthesis and processing for enhanced performance materials properties; network effort(s): investigate mathematical approaches to the design and characterization of battlefield networks by leveraging network science based on biological networks.	0	0	4824
Totals	0	0	4824

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H09	ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	0	0	2509	2541	2574	2624	2677

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. Research will be conducted in perception, including the exploration of sensor phenomenology and the maturation of basic machine vision algorithms, intelligent control, including maturation of artificial intelligence techniques for robot behaviors, and understanding the interaction of humans with machines. The program will conduct both analytic and experimental studies. Research products will be transitioned to the companion applied research program, 62618 H03, for integration and evaluation in testbed platforms. The program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

This project was previously funded in PE 601104A H59 and is a restructuring of on-going research into a distinct project for visibility and management.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary autonomous mobility for the Future Force. Research conducted as an integral part of the larger Army Robotics Program. In FY05, prove promising technologies in the areas of advanced sensors for autonomous mobility, models of human-robot interaction, and tools for the analysis of robotic vehicle survivability and transition to semi and near autonomous robotic technology programs.	0	0	2509
Totals	0	0	2509

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	7476	8135	8102	8887	9633	9864	10085

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium, the Collaborative Technology Alliance (CTA) that was formed 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; tactical information protection. The results of this work will significantly affect Future Force communications/networking development efforts. The program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- 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 FY 03, investigated and assessed routing, media access control, and auto configuration algorithms to enable energy-efficient communications for mobile networks. In FY 04, integrate self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions. In FY 05, validate self-organizing and auto configuring subnet protocols that enable persistent on-the-move communication sessions in highly mobile conditions.	2533	2682	2787
- 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 FY 03, investigated and assessed multiple access and advanced modulation schemes that enable communications under dynamic wireless conditions. In FY 04, conduct analytical and experimental studies investigating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move. In FY 05, conduct analytical and experimental studies validating high performance multiple access techniques and high spectral efficiency modulation schemes for communications on the move.	1882	1966	2048

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- 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 FY 03, investigated and assessed low probability of detection waveforms and interference mitigation techniques. In FY 04, conduct analytical and experimental studies investigating low probability of detection waveforms, interference mitigation techniques, and anti-jam modulation to enable survivable communications and spectrum reuse. In FY 05, conduct analytical and experimental studies validating low probability of detection waveforms, interference mitigation techniques, and anti-jam modulation to enable survivable communications and spectrum reuse.	1560	1653	1643
- Tactical Information Protection: perform research in scaleable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY 03, investigated and assessed trust establishment, key management, and intrusion detection techniques for very resource-constrained and highly mobile ad hoc networks. In FY 04, conduct analytical and experimental studies investigating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection. In FY 05, conduct analytical and experimental studies validating a highly efficient and noise robust security suite with distributed trust, distributed key management, and intrusion detection.	1501	1598	1624
Small Business Innovative Research/Small Business Technology Transfer Programs	0	236	0
Totals	7476	8135	8102

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H53	ADV DIS INTR SIM RSCH	2431	2541	2468	2650	2694	2757	2820

A. Mission Description and Budget Item Justification: This project supports a long-term collaboration between the Army Research Laboratory and a competitively selected Army Center of Excellence in Information Sciences (ACEIS). The objective of the center is to perform research in information technology in support of mobile command and control for the Future Force. Implementation and integration of future command and control system Commander/User requirements with architectures which utilize distributed enterprise database methodologies are the most significant technical barriers. Areas of emphasis include interactive and intelligent systems, database and information systems, and distributed and parallel processing systems. A major portion of the work of the ACEIS is performed at the Clark Atlanta University, a HBCU institution. This project also supports Army critical research at the Army High Performance Computer Research Center focused on the Future Force, including: structural response of armored vehicles to perforating and nonperforating 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. The program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Perform research into information exchange and retrieval systems that enhance information fusion on the battlefield to improve knowledge management for mobile command and control. In FY03, evolved analytical database techniques to query different databases for pertinent information. In FY04, perform experiments on distributed databases using intelligent agent technologies; and in FY05, evaluate information retrieval agent techniques on databases used in battlefield situations.	739	803	839

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- 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 FY03, applied computational tools, such as data mining for intrusion detection and to test data and extract patterns useful for identification of possible intrusions; matured dynamic partitioning methods and numerical approaches for the design of Army vehicles and other structures subjected to contact and penetration; evaluated computational approaches for chemical-biological defense, Army meteorology computational models, and explored computational nano-sciences for relevant Army applications. In FY04, create interdisciplinary tools and validate integration of chem-bio defense propagation with Army meteorology models to include data mining approaches for chemical-biological models and weather models; integrate intrusion detection software into Army systems; create algorithms for computational nanomechanics; validate computational fluid dynamics and structural mechanics approaches with relevant Army applications. In FY05, create novel computational algorithms for chemical-biological defense at the nano-cell level; explore algorithms at nano-level and mechanics towards multifunctional nano-material; explore coupled approaches for integrating Army meteorology models with electromagnetics; investigate new scalable higher order techniques in mechanics and electromagnetics; explore scientific visualization approaches to meet new hardware, software, and user requirements.	1692	1664	1629
Small Business Innovative Research/Small Business Technology Transfer Programs	0	74	0
Totals	2431	2541	2468

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	5789	6374	6393	7202	7969	8160	8342

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class research relevant to the needs of the Future Force and Army Transformation needs. This CTA links a broad range of government technology agencies and industry/academia partners with ARL. The CTA conducts innovative research focusing on three main technical areas: micro-sensors, electro-optic smart sensors, and advanced radar concepts to support the Future Force's requirement for advanced sensing technologies. The technical areas addressed under this project include overcoming technical barriers associated with: autonomous calibration and management of micro sensor networks; multidomain smart sensors (includes multispectral 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 program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Perform microsensor research focused on sensors, algorithms, low-power signal processing, and autonomous sensor/network management for the unattended sensor network component of FCS, resulting in technology transfer and delivery of sensor nodes to applied research. In FY03, improved signal processing algorithms for better detection of slow-moving vehicles and personnel, and validated these algorithms in outdoor tests. In FY04, evaluate 100x reduction of sensor network power budget to increase sensor operational lifetime. In FY05, complete self-calibrating sensor fields to increase system performance with reduced user interaction.	2273	2480	2565
- Perform electro-optics research focused on infrared sensors, laser radar, hyperspectral imaging, and automatic target recognition algorithms for improved situational awareness and targeting by FCS platforms. In FY03, achieved first-ever crystal growth and quantified new material for high-performance infrared hyperspectral imager. In FY04, devise and characterize separate passive infrared imager and active laser radar imager. In FY05, devise prototype integrated active/passive imager.	2039	2165	2223

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- 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 FY03, fabricated and devised a prototype lens/filter array for radar beam steering. In FY04, complete the electronically-scanned antenna subsystem comprised of low-cost phase control modules. In FY05, verify low-power MEMS phase shifters for electronically-scanned antennas.	1477	1544	1605
Small Business Innovative Research/Small Business Technology Transfer Programs	0	185	0
Totals	5789	6374	6393

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5659	6164	6108	6584	7035	7204	7366

A. Mission Description and Budget Item Justification: This project supports a competitively selected industry/university consortium, the Collaborative Technology Alliance (CTA), for the purpose of leveraging world-class research relevant to the needs of the Future Force and Army Transformation needs. This CTA links a broad range of government technology agencies and industry/academia partners with ARL. The CTA conducts innovative research focusing on the following technical areas: state-of-the-art information technology applications for responsive situational awareness, distributed commander-staff-subordinate collaboration, and planning and execution monitoring in a high tempo, high stress environment. The objective of the CTA is human-centered, automated support of individual and distributed team information processing and decision-making to achieve information dominance and decision supremacy. 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 program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers. In FY03, identified key effects on the military decision process of transitioning from plan-centric to intent-centric command and control. In FY04, devise basic architecture for allowing the actions of intelligent agents to be influenced by commander's critical information requirements and Operational Tempo (OPTEMPO). In FY05, establish guidelines for Command and Control (C2) of intelligent agents to allow the Army to perform C2 functions better and faster than our opponents in conflicts of any intensity under any conditions.	1961	2178	2260

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- 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 FY03, created guidelines and tools to support collaboration and decision making in co-located and distributed teams. In FY04, evaluate cognitively based methods and procedures for improved situation awareness and team collaboration and decision making in a distributed environment. In FY05, extend this evaluation to include effective collaborations among human team members and between these teams and intelligent system aids designed to support Future Force command and control.	1186	1208	1195
- User-adaptive interfaces: explore ideas, frameworks, and technologies which assist the soldier in understanding, problem solving, planning and decision-making. In FY03, improved methods of displaying relevant information in different modalities (visual, auditory, and haptic). In FY04, evaluate prototype display architecture for enhancing situation awareness among co-located and distributed teams. In FY05, provide solutions for identification and fusion of information necessary to make and control decisions from generally distributed and disparate databases with varied data uncertainties.	1540	1580	1647
- Auto-adaptive information presentation: investigate how to make autonomous machines team players with their human partners or supervisors in war fighting operations. In FY03, determined new forms of feedback in response to priority information requirements in a RSTA (Reconnaissance, Intelligence, Surveillance, and Target Acquisition) tasks. In FY04, evaluate cross adaptation architecture in which all agents contribute information, test, update and correct a common picture or understanding about intentions, assessments and future activities. In FY05, validate baseline system for improving the flexibility of FCS through dynamically reconfigurable software agent systems.	972	1019	1006
Small Business Innovative Research/Small Business Technology Transfer Programs	0	179	0
Totals	5659	6164	6108

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H59	UNIV CENTERS OF EXCEL	11972	21583	6561	6673	6753	6920	7045

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 in Army Transformational areas. Army Centers supported within this project are the Rotorcraft Center of Excellence, a Collaborative Technology Alliance in Robotics, an Institute for Collaborative Biotechnologies established in FY03, and in FY04 HBCU/MI Center of Excellence focused on countermine research. This program element funds 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. This project supports Army Transformation by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles; by advancing perception and intelligent control research for robotics, and by raising the visibility of the Army's commitment to America's youth and their pursuit of science and mathematics. The project also 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 soldiers and civilians for the Army workforce of tomorrow. The program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
eCybermission national competition to stimulate interest in science, math and technology in middle and high schools. In FY03, launched eCYBERMISSION for seventh and eighth grade students nationwide. In FY04, conduct full-scale launch of competition to all middle school (grades 6-8) and 9th grade high school students across the country. In FY 05, sustain eCYBERMISSION and implement enhancements as necessary based on previous years' lessons learned.	4434	4771	4729

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
In FY04, establish five HBCU/MI Centers of Excellence for Battlefield Capability Enhancements. The centers' focus areas will be selected from the following topics: sensor fusion; Integrated Analysis for Vertical Take-Off and Landing Vehicles; Lines of Sight/Beyond Line of Sight Lethality, Lightweight Fuel Efficient Heavy Fuel Engines for UAVs; Flexible Extremities Protection; Mounted/Dismounted Maneuver; Human Engineering research in Cognitive Strategies: "Sense Making" and "Modeling in Effects of Training on Performance and Readiness . Each center will establish a close collaborative working relationship with one or more TRADOC Battlelabs, industry and Army labs. The Battlelabs will provide a hands-on real-world operational perspective to the centers' researchers. In FY05, continue the centers' research and, working in collaboration with the TRADOC Battlelabs, accelerate technology transitions to Army labs/centers and industry. In FY05 this effort will be restructured into Program Element 0601104 Project H04 for increased visibility and management oversight.	0	2384	0
Robotics Collaborative Technology Alliance: Explore new opportunities to enable revolutionary autonomous mobility for the Future Force. Research conducted as an integral part of the larger Army Robotics Program. In FY04, conduct research in advanced sensors for autonomous mobility, modeling of human-robot interaction, and creation of tools for the analysis of robotic vehicle survivability. In FY05, this effort will be transferred to project H09 for increased visibility and management oversight.	0	2384	0
Institute for Collaborative Biotechnologies: In FY03, established an Army University Affiliated Research Center, the Institute for Collaborative Biotechnologies, to harness the enormous new opportunities that exist among the biological, information, physical and engineering sciences. The research focus is in biotechnology for sensors, electronics and information processing. In FY04, identify novel biocomputation approaches to information processing, using information content of macromolecules and their interactions, self-assembly processes for molecular manufacture of ultra-high density electromagnetic optical materials. In FY05, this effort will be transferred to project H05 for increased visibility and management oversight.	2294	8109	0

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
Rotorcraft Centers of Excellence. In FY03, established semi-active damping control concepts for rotor systems. Devised innovative concepts for micro-rotorcraft or small UAV. Investigated aeromechanical stability and whirl flutter using blade-embedded elastomeric mass dampers. Conducted simulations of unsteady flow rotor interactions to predict dynamic loading in a turbulent environment. Devised passive noise reduction blade design concepts using Computational Fluid Dynamics. In FY04, investigate elastically tailored smart composite rotor blades. Investigate innovative design, and conduct fundamental analysis of micro-rotorcraft and UAVs. Devise a smart materials based actively conformable rotor airfoil. Investigate passive and semi-active reduction concepts of gearbox vibration and noise. Investigate active rotorcraft blade tip concepts for tip vortex core modifications using smart structures. In FY05, investigate limit detection and limit avoidance methods for carefree maneuvering. Devise experimental and computational analysis capabilities on rotor wakes and tip vortices.	1988	1865	1832
Institute for Soldier Nanotechnologies: In FY03, conducted research in seven technical areas including mechanically active materials, devices and exoskeletons to enhance soldier performance, sensors and CB agent protection, soldier medical technology, materials and fabrication, modeling and simulation and outreach and teaming. This effort has been transferred to project J12 for increased visibility and management oversight.	563	0	0
University Countermine Research Center: Undertake a broad spectrum of fundamental research into the environmental phenomenology of landmine detection. The center collaborates with existing and emerging Army R&D efforts to develop comprehensive geophysical and environmental characterization capabilities that can be integrated with sensor predictive models to detect the signature of landmines.	2693	0	0
Army Centers of Excellence. The purpose of this one year Congressional add is to fund basic research at an Historically Black College and University/Minority Institution (HBCU-MI) in cooperation with TRADOC Battle Laboratories. No additional funding is required to complete this project.	0	1444	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	626	0
Totals	11972	21583	6561

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H62	ELECTROMECH/HYPER PHYS	8213	5819	5591	5864	6081	6181	6276

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 Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Pulsed Power - In FY03, established prime pulsed power option and matured high power silicon carbide (SiC) switch approach using existing technology. In FY04, perform experiments to establish utility of inductive pulsed power systems and perform experiments to establish performance of high power switches. In FY05, experimentally validate improved high strength, high conductivity field coil material.	1704	2050	2180
Launcher - In FY03, established a launcher rail configuration that eliminates launch package armature transition to a plasma, thus proving feasibility of maintaining launch package integrity. In FY04, establish performance of non-transitioning EM launch package armatures and investigate improved materials to solve technical barriers to EM launch. In FY05, provide complete model of electromagnetic, structural, and thermal processes in EM launch.	2165	1500	1286
Launcher Package (Projectile) - In FY03, showed ability of hypervelocity novel kinetic energy penetrators to defeat selected heavy armor threats. In FY04, launch a robust novel kinetic energy penetrator from an EM gun against one half scale heavy armor targets. In FY05, numerically establish optimal EM novel kinetic energy penetration concept and provide results to EM Gun Technology Program.	2132	2100	2125

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
EM Gun Concepts - Define integration approaches for EM gun technologies on future platforms. In FY03, constructed a mobile hybrid electric test bed to examine EM gun power sharing.	2212	0	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	169	0
Totals	8213	5819	5591

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H64	MATERIALS CENTER	2727	3156	2385	2495	2644	2707	2767

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 program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
In FY03, devised new material formulations that significantly enhance ballistic performance of lightweight fabrics and composites for personnel and vehicle survivability and established new theoretical basis for failure of boron carbide ceramics at ballistic rates. In FY04, devise techniques to exhibit improved electrical, optical, and power-generating properties from composite materials to enable multi-functional capabilities for Future Force platform survivability; devise theory and design criteria for generating hybrid materials and conduct experimental studies to verify models and show benefits for Objective Force Warrior applications; and devise processing of nano-scale metallics and ceramics envisioned for use in Future Force. In FY05, devise electro-optical composite structural materials; explore practical strategies to scale-up synthesis and processing of hierarchical polymers and polymer-inorganic hybrid materials; and devise physics based models to predict the effects of microstructure on the behavior of metallic and ceramic material systems under dynamic loading conditions.	1936	2269	2385
Composite Materials Research. The objective of this Congressional Add is to enhance the fundamental composite materials research ongoing at the University of Delaware. In FY03, developed novel concepts for energy storage in multifunctional composite materials. FY04, mature energy storage materials and explore options for incorporation into load bearing structures. No additional funding is required to complete this project.	791	795	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	92	0
Totals	2727	3156	2385

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
H73	NAT AUTO CENTER	5119	8069	2992	3077	3134	3208	3277

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 at 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 advanced vehicle technologies. This goal will be accomplished through the insertion of leap ahead technologies in phased improvements over the next several decades. The research performed in this project contributes to formulating and establishing the basic principles for these leap ahead technologies. Selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University, while key industry partners include the major U.S. automotive manufacturers and suppliers. The program element contains no duplication with any effort within the Military Departments. 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 by TARDEC, Warren, MI.

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
Automotive Research Center (ARC) - The goal of this effort is to advance state-of-the-art simulation and modeling of future Army automotive technologies, with strong emphasis on targeting the Army's Future Combat Systems (FCS) program. The ARC will also formulate and evaluate future advanced automotive technologies relative to future FCS vehicular platforms. In FY03, completed final validation and implementation of future FCS mobility and propulsion predictive algorithms, and optimized the overall Army ground vehicle simulation network. In FY04, complete final optimization of the Army's overall ground vehicle simulation network and implement a mathematical framework capable of accepting modular subroutines in all generic automotive areas. Evaluate and analyze systems for intelligent remote monitoring, guidance, and control to be used for unmanned autonomous and semi-autonomous FCS ground vehicles. Integrate newly matured advanced automotive technology algorithms within the overall simulation network. In FY05, evaluate and analyze 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, including piston engines, alternate fuels, hybrid vehicles, and fuel cells. Advanced and unique concepts in these areas will be researched and optimized for future Army vehicle implementation in programs like the FCS effort.	2504	2925	2992
This one year Congressional Add conducted basic research in the area of military and commercial ground vehicle modeling and simulation. The eight university consortium consisted of Michigan, Wayne State, Oakland, Alaska, Iowa, Wisconsin, Clemson and Tennessee. No additional funding is required to complete this project.	2615	0	0
University Based Automotive Research. The purpose of this one year Congressional add is to develop modeling and simulation tools and leverage commercial technologies for potential application in Army vehicle systems through on-going and new programs in auto research. No additional funds are required to complete this project.	0	2023	0
TACOM Automotive Research Center University Research. The purpose of this one year Congressional add is to focus on alternative propulsion systems during development of modeling and simulation tools and leveraging commercial technologies for potential application in Army vehicle systems. No additional funds are required to complete this project.	0	2889	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	232	0
Totals	5119	8069	2992

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	12230	11998	11046	7184	7173	7389	7597

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 will serve 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 in order to adapt their concepts of story and character to increasing 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. The program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- 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 FY03, designed the constructs for the test beds and specified content media including photo-realistic structures, primary and background sound cues, and odors, and tested the integration techniques and media for proper synchronization and identified shortfalls. In FY04, complete the specification of algorithms and architecture constructs for the proof of concept test beds and address computational efficiency and stability issues, devise new techniques to enhance the immersiveness of the prototypes. In FY05, investigate 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.	5361	5512	5901
- Conduct basic research in the two most 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 FY03, improved fidelity of rendering techniques for compositing real objects into virtual environments and achieved matching lighting effects including shadows and bounced light, and extended audio processing algorithms to permit two participants in a given training setting to experience proper sound cues based on their positions relative to the sound sources. In FY04, devise computationally efficient techniques for applying global illumination to synthetic objects. Extend research into second order effects of natural lighting on real persons in synthetic environments. In FY05, extend the concept of virtual loudspeakers to address multiple participants in a given mixed reality setting. Examine sound cancellation techniques to improve auditory cues in noisy environments. Combine new lighting techniques and sound algorithms to make preliminary assessment of their combined impact on immersion.	1666	2623	2533

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Conduct research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness. In FY03, investigated the synchronization of speech and gesture in virtual characters to address non-verbal aspects of communications, and advanced speech understanding and text-to-speech processing to permit human to computer interactions in noisy environments. In FY04, complete draft specification of data elements and parameters to permit synchronized verbal communications techniques for virtual characters to interact with soldiers in education and training situations. Conduct research on the impact that modeling the emotional aspects of verbal and non-verbal communications for virtual humans will have on interaction with human participants. In FY05, complete draft specification of data elements and parameters for non-verbal communications techniques. Integrate emotional models and timing constraints into the draft specification.	1867	3515	2612
- The objective of this one-year Congressional Add was to conduct basic research in immersive environments to achieve efficient and affordable training and modeling simulation solutions at Fort Sill. No additional funding is required to complete this project.	3336	0	0
Small Business Innovative Research/Small Business Technology Transfer Programs	0	348	0
Totals	12230	11998	11046

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	5644	5901	5739	5716	5697	5835	5966

A. Mission Description and Budget Item Justification: This project supports a 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 research relevant to Army needs. Power and energy research supporting 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 Combat Systems (FCS) vehicles and robotic platforms. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming of 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 program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- Research, investigation and characterization of a micro electro mechanical system (MEMS) based micro-gas turbine generator for producing electricity for the dismounted soldier of the Future Force. In FY03, the MEMS processing to build 3D compressor geometries was created and a more efficient magnetic generator design was devised. In FY04, test the micro gas turbine using hydrogen as fuel. In FY05, design 2nd generation engine with non-magnetic generator, turbine film cooling and test hydrocarbon-fueled turbojet.	2148	2204	2280

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- Research, investigation and characterization of novel fuel cells/components and logistic fuel reformation techniques for producing electricity for the dismounted soldiers of the Future Force as well as producing electricity for vehicle prime power and accessory power for the Future Combat System. In FY03 created a 1-2 W prototype of a reformed hydrogen fuel cell integrated with a methanol fuel processor. In FY04, mature a 20 watt fuel cell using reformed-methanol as fuel for soldier power applications. In FY05, integrate 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.	1835	1846	1869
- Research in support of the FCS program by reducing the size and weight of the electronic components and increasing their efficiency by replacing silicon semiconductor devices in the electronic systems and subsystems with those made from silicon carbide. In FY03 determined the benefits of replacing silicon diodes with silicon carbide diodes in DC - DC converter circuits used for electromagnetic armor and electro-thermal chemical guns, and in matrix converters for on-vehicle power conversion and conditioning. In FY04, test and evaluate hybrid Silicon/Silicon Carbide switch modules in DC-DC converters for hybrid electric vehicle mobility applications. In FY05, research, develop and characterize of Silicon Carbide devices and switches while working to implement these in various types of converters/invertors needed for mobility, survivability and lethality applications within the Future Combat System and the Future Force.	1661	1680	1590
Small Business Innovative Research/Small Business Technology Transfer Programs	0	171	0
Totals	5644	5901	5739

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2004

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

COST (In Thousands)		FY 2003 Actual	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
J12	NANOTECHNOLOGY	9147	10753	9495	9449	10203	10447	10680

A. Mission Description and Budget Item Justification: This project supports nanotechnology research for the soldier at Massachusetts Institute of Technology Institute for Soldier Nanotechnologies (ISN). The ISN emphasizes revolutionary materials research toward advanced soldier protection and survivability. ISN works in close collaboration with several major industrial partners including DuPont and Raytheon, the Army Research Laboratory (ARL), the Army's Natick Soldier Center (NSC), and other Army Research Development and Engineering Centers (RDECs) in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support the Army Future Force war fighter through research to devise nanometer-scale science and technology 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, chameleonic color changes, biomedical monitoring, and extremities protection. The objective is to lighten the soldier's load through system integration and multifunctional devices while increasing his survivability and lethality. Computational models will be created that predict the soldier's performance with the new technologies. The new technologies will be compatible with the other 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 program element contains no duplication with any effort within the Military Departments. 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 by the Army Research Laboratory (ARL).

Accomplishments/Planned Program	FY 2003	FY 2004	FY 2005
- In FY03, performed research to devise mechanical behavior models of high performance fabrics to provide fundamental understanding of energy absorbing materials. In FY04, conduct research on nano-based materials and membranes for individual climate control. In FY05, devise innovative processes and techniques to construct high performance fabrics and multi-layered composite materials.	1782	1895	1950
- In FY03, performed research to devise high power, high force nanostructures polymer actuators utilizing promising properties exhibited by carbon nanotube technology. In FY04, integrate actuators with sensors with the goal of improving upon force achieved by human muscle. In FY05, investigate biomimetic muscle behavior with potential to provide new approaches to outperform natural systems.	3606	3740	3873

Accomplishments/Planned Program (continued)	FY 2003	FY 2004	FY 2005
- FY03 was the first full year of operation. Formed seven research teams to conduct research in mechanically active materials, devices and exoskeletons, sensors and chemical-biological (CB) agent protection, soldier medical nanotechnology, materials processing and fabrication and other areas. Formalized collaborative research agreements with industry partners. In FY04, continue research in 40+ research projects begun in FY03. Investigate techniques and membranes for water purification/filtration. Establish innovative methodology to transition breakthroughs to Army labs/centers and industrial partners. In FY05, devise variable stiffness materials with goal of 100-fold change in stiffness for use in physiological protection (e.g. field applied splints).	3759	4806	3672
Small Business Innovative Research/Small Business Technology Transfer Programs	0	312	0
Totals	9147	10753	9495