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

February 2002

BUDGET ACTIVITY
1 - Basic research

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

	COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
	Total Program Element (PE) Cost	58120	73054	74855	70487	71211	69657	73505
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9384	7875	8107	8280	8465	9314	10107
H53	ADV DIS INTR SIM RSCH	2638	2569	2594	2587	2579	2778	2826
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9574	6084	6306	6488	6680	7548	8361
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5724	6020	6168	6274	6382	6901	7382
H59	UNIV CENTERS OF EXCEL	2166	19229	11977	11954	11937	7042	7077
H62	ELECTROMECH/HYPER PHYS	9434	7911	7948	7923	7942	8347	8680
H64	MATERIALS CENTER	2462	2155	2267	2379	2491	2615	2774
H65	MICROELECTRONICS CTR	949	983	986	981	978	1004	1095
H73	NAT AUTO CENTER	6646	2944	3042	3080	3133	3231	3295
H7A	SCIENCE-BASED REGULATORY COMPLIANCE STUDY	961	0	0	0	0	0	0
HA1	GLOBAL INFORMATION PORTAL	0	1000	0	0	0	0	0
HA2	THERMAL FLUID DESIGN TOOL	0	1000	0	0	0	0	0
HA3	VIRTUAL PARTS ENGINEERING RESEARCH CENTER	0	1000	0	0	0	0	0
HA5	CENTER FOR OPTICS MANUFACTURING	0	1500	0	0	0	0	0
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	8182	6806	9463	4589	4707	4982	5225
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	5978	6021	6007	5996	5991	5978
J12	NANOTECHNOLOGY	0	0	9976	9945	9921	9904	10705

A. Mission Description and Budget Item Justification: This program element leverages research in the private sector through Federated

Laboratories, Collaborative Technology Alliances (CTA), Centers of Excellence, and the University Affiliated Research Centers. A significant portion of the work performed within this program directly supports Objective Force requirements by providing the enabling technologies which will make development of Objective Force equipment possible. Collaborative Technology Alliance (CTA) are innovative alliances built on the highly successful Federated Laboratory program of the Army Research Laboratory (ARL) which were completed in late FY01. The CTAs will establish 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 will be competitively established in the areas of Advanced Sensors, Advanced Decision Architecture, Communications and Networks, Power and Energy, and one applied research CTA in 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. The Army's Institute of Creative Technologies (ICT) is also included in this program element. The ICT is a partnership with academia and the entertainment industry 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. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

B. Program Change Summary	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2002 PB)	59316	69147	49993
Appropriated Value	59865	73647	0
Adjustments to Appropriated Value	0	0	0
a. Congressional General Reductions	0	-593	0
b. SBIR / STTR	-1760	0	0
c. Omnibus or Other Above Threshold Reductions	0	0	0
d. Below Threshold Reprogramming	564	0	0
e. Rescissions	-549	0	0
Adjustments to Budget Years Since FY2002 PB	0	0	24862
Current Budget Submit (FY 2003 PB)	58120	73054	74855

Change Summary Explanation:

FY03 funding increase of (+24862) enhances the Army basic research program in Project H59 University and Independent Research Centers by creating a Biotechnology Center of Excellence for basic reseach into the use of biotechnology to support the Objective Force Warrier; Project J09 A Power and Energy Collaborative Technical Alliance to leverage world class research efforts for lightweight and compact energy conversion and control technologies; and to expand Project J08 the research efforts at the Institute of Creative Technology in support of the Objective Force.

FY02 Congressional Adds were made for Project HA1 (+1000) to support the Global Information Portal project; Project HA2 (+1000) to support Thermal Fluid Design Tool development; Project HA3 (+1000) to support Virtual Parts Engineering Research; and HA5 (+1500) to support a Center For Optics Manufacturing

Project with no R-2A:

Project H65
- FY02 Funding = $983 Microelectronics Center of Excellence (H65): This program allows the Army to leverage extensive scientific manpower and knowledge of the universities to conduct innovative research and exploit new concepts in solid state physics, electrical engineering, photonics, microelectromechanical systems (MEMS) and the use of chemical/electrochemical engineering to produce microelectronic devices to support specific Army needs.

Project HA1
- FY02 Funding = $1000 Global Information Portal : The objective of this one year Congressional add is to study the technologies necessary to create a Global Information Portal for distribution of Military information in a secure and real time manner. No additional funding is required to complete this project.

Project HA2
- FY02 Funding = $1000 Thermal Fluid Design Tool : The objective of this one year Congressional add is to develop a CAD Thermal Fluid Design Tool for Army applications. No additional funding is required to complete this project.

Project HA3
- FY02 Funding = $1000 Virtual Parts Engineering Research Center : The objective of this one year Congressional add is to support development of a Virtual Parts Engineering Research Center. No additional funding is required to complete this project.

Project HA5
- FY02 Funding = $1500 Center For Optics Manufacturing : The objective of this one year Congressional add is to support a Center For Optics Manufacturing. No additional funding is required to complete this project.

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9384	7875	8107	8280	8465	9314	10107

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 Objective Force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The barriers include designing communications systems for Survivable Wireless Mobile Networks, providing Signal Processing for Communications-on-the-Move, Secure Jam-Resistant Communications, Automated Information Protection and Detection, Survivable Information Infrastructures, and Information Assurance Situational Awareness for Mobile Tactical Information Systems. The results of this work will significantly affect Objective Force communications/networking development efforts. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 9384 - Validated energy-efficient techniques for secure, jam-resistant, multi-user communications effective in noisy and hostile environment including wideband low-probability of intercept signal design, adaptive spectrum reuse, interference rejection, and jammer detection and mitigation. This research/technology was transitioned to CECOM's Networked Sensors for the Objective Force ATD.

  - Completed energy-efficient tactical information protection technologies including computationally-efficient intrusion detection, automated intrusion detection and vulnerability assessment, and highly efficient security infrastructures. This research/technology was transitioned to CECOM's Networked Sensors for the Objective Force ATD.

  - Established/awarded a cooperative agreement for the Collaborative Technology Alliance in Communications and Networks focusing on basic research into technologies to enable highly dynamic mobile tactical and sensor networks in noisy/hostile wireless environments and under severe bandwidth and energy constraints.

  - Defined space-time compression of FLIR (Forward Looking Infrared) video images with compression ratios of 256-to-1 while preserving motion features.

FY 2001 Accomplishments: (Continued)

- Completed and demonstrated self-configuring wireless networking technologies that provide auto-configuration, auto-addressing, and mobile ad hoc routing functionality. This research/technology was transitioned to CECOM's MOSAIC ATD.

- Completed refinement and validation of the Dynamic Registration and Configuration Protocol (DRCP) and Dynamic Registration and Configuration Protocol (DCDP) which provides functionality for wireless, multi-hop networks and that permits configuration in milliseconds and enables the auto-configuration of mobile routers. This research/technology was transitioned to CECOM's MOSAIC ATD.

Total 9384

FY 2002 Planned Program

• 7875

- Investigate and simulate dynamically self-configuring wireless network technologies including ad hoc wireless routing, medium-access-control algorithms, auto-addressing, and adaptive network configuration.

- Investigate and simulate signal processing techniques to enable communications among highly mobile users in adverse channel conditions including channel propagation modeling, spread-spectrum and space-time coding, compression, and collision resolution algorithms.

- Investigate and simulate secure, jam-resistant, multi-user communications effective in noisy and hostile environment including wideband low-probability of intercept signal design, adaptive spectrum reuse, interference rejection, and jammer detection and mitigation.

- Investigate and simulate tactical information protection technologies including computationally-efficient intrusion detection, automated intrusion detection and vulnerability assessment, and highly efficient security infrastructures.

Total 7875

FY 2003 Planned Program

• 8107

- Investigate and show energy-efficient techniques for dynamically self-configuring wireless network technologies including ad hoc wireless routing, medium-access-control algorithms, auto-addressing, and adaptive network configuration.

- Investigate and show energy-efficient signal processing techniques to enable communications among highly mobile users in adverse channel conditions including channel propagation modeling, spread-spectrum and space-time coding, compression, and collision resolution algorithms.

Total 8107

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H53	ADV DIS INTR SIM RSCH	2638	2569	2594	2587	2579	2778	2826

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 problem is that to date no large scale heterogeneous collaborative architectures have been modeled. Implementation and integration of future command and control system Commander/User requirements with architectures which utilize enterprise javabean 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. Research efforts to overcome the technical barriers are listed in the FY01-03 planned program bullets below. This project also supports Army critical research at the Army High Performance Computer Research Center focused on the Objective Force, including: neutralizing the effects of airborne and groundborne contaminant transport, structural response of armored vehicles to perforating and nonperforating projectiles, investigating more efficient gun projectile and missile propulsion systems, and evaluating materials suitable for armor/anti-armor applications. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 500 - Created a Distributed Collaborative Battlefield Visualization System (DCBVS) to record and store video, images, text and voice of command planning sessions for later playback and review by the staff. DCBVS was incorporated into the Advance Battlefield Processing STO.
- 2138 - Validated models for heated regions in the design of seekerheads for future contaminated soils interceptor systems for AMCOM.

  - Improved computational models for the remediation of explosives of the bioavailability and biodegradability of nitroaromatic explosives within soil granulates.

  - Applied data mining algorithms to analyze scientific data sets for clustering and pattern discovery in fluid mechanics and structural mechanics for enhanced simulation and design of Future Combat Systems (FCS).

  - Established the framework for computational multi-disciplinary signature modeling that will enable the FCS developers to design systems with minimal signatures to increase survivability.

Total 2638

FY 2002 Planned Program

•	771	- Devise mobile agent technology for a distributed combat information systems to enhance collaboration between the Commander and his staff.
		- Design a prototype battlefield data exchange and retrieval system to automate the transfer and exchange of information between a Commander and his staff.
•	1798	- Apply intelligent processing techniques in composite manufacturing to the Objective Force.
		- Improve portability of partitioning algorithms for use in the design of Army combat platforms.
		- Analyze and apply principles of simulation based design to reduce cost and time to fielding the Objective Force.
		- Extend scalable algorithms to next generation High Performance Computing platforms.
Total	2569	

FY 2003 Planned Program

•	785	- Design and perform laboratory experiments on the battlefield data exchange and retrieval systems to define hypotheses on collaboration and information transfer.
		- Perform usability studies on the data manager and distributed combat information system, including heuristic walk-throughs with experts and users; as well as usability experiments with users to validate and verify the hypotheses.
•	1809	- Apply data mining tools and techniques to test data and extract patterns useful for design of Objective Force components.
		- Apply predictive groundwater contaminant transport techniques for demilitarization of Army hazardous explosive and biocontaminated sites.
		- Apply scalable, dynamic partitioning methods in the design of lightweight structures for the Objective Force.
Total	2594	

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9574	6084	6306	6488	6680	7548	8361

A. Mission Description and Budget Item Justification: This project supports long term collaboration between the Army Research Laboratory (ARL) and the competitively selected industry/university consortium for the purpose of leveraging world class research relevant to the needs of the Objective Force and Army Transformation needs. The technical areas addressed under this project include overcoming technical barriers associated with: multidomain smart sensors (includes multispectral infrared focal plane arrays); sensor modeling and algorithms for automatic target recognition (ATR) involving multiple sensors; radar sensors and sensing phenomenology; and signal processing. Emphasis is being placed on capitalizing on commercially available hardware, microsensors which integrate microelectromechanical systems (MEMS), acoustic, seismic, and RF technologies for application to the Objective Force materiel requirements. This Collaborative Technology Alliance (CTA) links a broad range of government technology agencies and industry/academia partners with ARL. The CTA will conduct innovative research focusing on three main technical areas: microsensors, electro-optic smart sensors, and advanced frequency concepts to support the Objective Force's requirement for advanced sensing technologies. In FY2001, this project establishes a new Power and Energy CTA. Starting in FY2002, the Power and Energy CTA will be funded in 61104/J09. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 6574 - Integrated single-band target detection and chipping algorithm into microsensor computing architecture for improved battlefield situational awareness.

  - Completed moving target indicator algorithm and transitioned to Program Manager-Night Vision/Reconnaissance, Surveillance and Target Acquisition for application to the Long Range Advanced Scout Surveillance System.
  - Incorporated cooperative signal processing into a network of distributed microsensors; yield improved battlefield situational awareness.

  - Established capability to create dual-band Focal Plane Arrays in HgCdTe using Molecular Beam Epitaxy.
  - Completed millimeter wave clutter database.

FY 2001 Accomplishments: (Continued)

- 2000 - Established new Sensors CTA with three main technical areas: Microsensors, Electro-Optic Smart Sensors, and Advanced Radar Frequency Concepts.

- 1000 - Established a new Power and Energy CTA with three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric Propulsion and Power. (Starting in FY02, the Power and Energy CTA Planned Program is funded in 61104/J09.)

Total 9574

FY 2002 Planned Program

- 6084 - Execute first full year of new CTA with three main technical areas: microsensors, electro-optic smart sensors and advanced radar frequency concepts.
  - Investigate target and background phenomenology and modeling.
  - Investigate advanced materials and devices.
  - Investigate novel architectures and sensor fusion.
  - Investigate signal and image processing techniques and architectures.
  - Investigate automatic target recognition.

Total 6084

FY 2003 Planned Program

- 6306 - Execute CTA with three main technical areas: microsensors, electro-optic smart sensors and advanced radar frequency concepts.
  - Devise and adapt specific milestones/deliverables for the Cooperative Agreement after the competitive award is made.

Total 6306

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	5724	6020	6168	6274	6382	6901	7382

A. Mission Description and Budget Item Justification: This project supports a new consortium, a competitively awarded Collaborative Technology Alliance (CTA) which begins in FY2002. This CTA, which links a broad range of government technology agencies and industry/academia partners with ARL, conducts innovative research to support the Objective Force's requirement for 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. This CTA continues the information control and data visualization efforts begun under the prior Federated Laboratory university/industry consortium formed to provide solutions for the many requirements for information assimilation on the battlefield. The Federated Laboratory contract ended in FY2001. 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 approach to overcoming the technical barriers is outlined in a planned program beginning in FY2002. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 5724 - Finalized the Integrated Support Laboratory (ISL) architecture and transitioned package to CECOM and Battle Labs at Ft. Leavenworth and Ft. Huachuca.

  - Provided algorithms using wavelets and fractals for embedded coding of image/video to the Agile Commander ATD LAN.
  - Incorporated talking and gesturing avatars into collaborative planning and execution scenarios to the Agile Commander ATD LAN.
  - Extended the FOX-RAVEN-OWL-CORAVEN-ACAD-CADET paradigm to include collaborative planning within the intelligence arena.
  - Provided a commander/staff model capable of conducting cognitive engineering of Army command and control interfaces; created a model of opposing force commanders to direct other State operator and results (SOAR)-controlled unit entities.
  - Began investigating technologies to enable commanders to tailor C2 systems to support their individual cognitive processes. Work will be completed in 1Q FY2002.
  - Researched intelligent systems that provide an enabled understanding of information needs for situation and tasks and integrated into CORAVEN.

FY 2001 Accomplishments: (Continued)

- Established a new cooperative agreement with Collaborative Technology Alliance in Advanced Decision Architectures. Contract was awarded in May 2001.

Total 5724

FY 2002 Planned Program

- 6020 - Identify key decision parameters that predominate in field settings, develop cognitive architectures to extend the methods and techniques of computational models, prepare decision centered design principles based on cognitive systems engineering and naturalistic decision making.

- Create models of expert decision making from cognitive task analysis of distributed tactical operations.

- Create tools to facilitate multi-modal communication and user adaptable interfaces.

- Prepare prototype architectures to accommodate adaptive interface agents, mediating representations for context-sensitive information presentation, data fusion and information integration to combine uncertainty for intermediate abstractions.

Total 6020

FY 2003 Planned Program

- 6168 - Complete prototype integration of cognitive computational models as decision aids to support command decision-making.

- Identify level and scope of user-state model fidelity to predict different aspects of user state.

- Complete concept evaluation on measuring situation awareness to determine readiness for operations and analytical tools for collaborative evaluation and planning.

- Identify auto-adaptive architectures that provide high situation awareness, low workload, mode awareness and user trust for inclusion in the decision integration testbed.

Total 6168

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H59	UNIV CENTERS OF EXCEL	2166	19229	11977	11954	11937	7042	7077

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 high priority areas. The Army Centers have significant collaborative participation by Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) and all future Army Centers will be formed in partnerships with an HBCU/MI. Army Centers supported within this project are currently active in the field of rotary wing technology.. Beginning in FY2002, this project will focus on Army Rotorcraft Centers of Excellence, nanoscience, image science, and science, mathematics and engineering (SME) education. This project supports the Objective Force and Joint Vision 2020 by providing research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles and the Objective Force Warrior. Industry is encouraged to actively support Army Centers of Excellence and the University Affiliated Research Center in nanoscience to leverage and synergize the investment in these collaborative efforts. In FY02, this project establishes the Institute for Soldier Nanotechnologies. A single university will host this institute, which will emphasize revolutionary materials research toward advanced soldier protection and survivability capabilities. This program will transition to 61104/J12 starting in FY03. The project also supports the Objective Force through the sponsorship of a nation-wide education competition that encourages the nation's youth to pursue advanced education and careers in SME thereby providing a pool of technologically trained soldiers and civilians for the Army workforce of tomorrow. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 2166
  - Investigated rotor aerodynamics and acoustics during maneuvering flights.
  - Investigated passive and active noise reduction concepts for blade-vortex interactions.
  - Investigated adaptive driveshafts/struts for noise and vibration reduction, and damage mitigation.
  - Established alleviation concepts of aeromechanical stability and whirl flutter through blade-embedded elastomeric tuned dampers for lag damping and Shape Memory Alloy (SMA)-based passive wing damping.
  - Investigated high flexibility rotorcraft driveshafts using flexible matrix composites and active bearing controls.
  - Established simulation and controls of helicopter shipboard launch and recovery operations.

FY 2001 Accomplishments: (Continued)

- Investigated theory and analysis of the behavior of deformable airfoils in rotor control applications.
- Conducted damage tolerance analysis of stiffened composites and rotor hubs.
- Established neural network based adaptive flight control concepts.

Total 2166

FY 2002 Planned Program

- 1968
  - Investigate vibration mechanisms and establish reduction concepts in level and maneuvering flight.
  - Investigate transmission design for robust diagnostics and prognostics.
  - Establish carefree maneuvering control laws for rotorcraft.
  - Investigate deformable wake dynamics for maneuvering flight simulation.
  - Investigate warping actuation of rotor blades by using active materials.
  - Investigate data fusion and biomimetic materials for rotorcraft health monitoring systems.
  - Establish advanced analysis, design and experimental testing capabilities of hybrid active-passive rotor systems for vibration reduction and performance enhancement.
- 9825
  - Establish University Affiliated Research Center focusing on application of nanoscience to enhance Objective Force Warrior survivability through nanotechnology-based materials and devices.
- 2479
  - Accelerate image science research to develop algorithms for cluttered, highly dynamic scenes to improve real-time robotic perception.
  - Investigate artificial intelligence based algorithms to enable adaptive tactical behaviors in diverse, complex environments.
- 4957
  - Complete concept for Army Competition in Education and develop education testing package.
  - Conduct regional beta test of the web-based game challenge and launch Army Competition in Education Program.

Total 19229

FY 2003 Planned Program

- 3389 - Establish semi-active damping control concepts of rotor systems.
  - Investigate adaptive control concepts of helicopter vibrations with self-contained active-passive hybrid actuators optimally distributed in the airframe.
  - Investigate passive and semi-active reduction technologies of gearbox vibration and noise.
  - Conduct studies of advanced flight control systems.
  - Investigate elastically tailored smart composite rotor blade concepts.
- 8588 - Establish an Army center for research in biotechnology to harness the enormous new opportunities that exist between the biological and non-biological sciences. Scientific investigations have been identified initially in the following areas: - Novel biocomputation approaches to information processing, using information content of macromolecules and their interactions. - Self-assembly processes for molecular manufacture of ultra-high density EMO materials. - Photodynamic protein-based molecular memory for rapid and accurate information processing and storage. - Biologically derived and biologically inspired synthesis and processing for enhanced performance materials properties.

Total 11977

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H62	ELECTROMECH/HYPER PHYS	9434	7911	7948	7923	7942	8347	8680

A. Mission Description and Budget Item Justification: This project funds electromechanics and hypervelocity physics Army basic research relating to electromechanical components (electromagnetic launchers and power supplies) for applications to electromagnetic (EM) guns. Additionally, this project provides for research, testing 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 to achieve extended rail life, and on establishing the utility of hypervelocity projectiles. 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 Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 7434
  - Evaluated thermal management technology for EM pulsed power, switching, and railgun needs. Identified most promising candidates.
  - Designed and implemented laboratory launcher for technology evaluation and investigations of transition in the armature. Upgraded the pulsed forming network to be capable of 2 MJ muzzle energy compared to previous 1 MJ level.
  - Evaluated alternate EM pulsed power options. Developed a model of the EM pulsed power system and used to describe performance of pulsed alternators.
  - Evaluated material and structural components of launchers and launch packages for future field applications. Developed models of the sequence of events leading to armature transition and applied to compute launch package dynamic behavior.
  - Exploited robust EM gun penetrators.
  - Conducted research on advanced switch technology, specifically examining the magnetohydrodnamic processes in advanced vacuum gap switch concepts.
- 2000
  - Advanced state-of-the-art research in pulsed power, to achieve extended rail life and to establish the utility of hypervelocity projectiles for electromagnetic guns.

Total 9434

FY 2002 Planned Program

- 7911 - Devise solutions for armature transition using the C-armature.
  - Evaluate laboratory launcher and launch packages for technology evaluation.
  - Conduct component trials for alternate EM pulsed power options.
  - Prove advanced material and structural components of launchers and launch packages for future field applications.
  - Prove robust EM gun penetrator lethality against advanced targets.
  - Investigate the utility for optical triggering for advanced EM switch technology.

Total 7911

FY 2003 Planned Program

- 7948 - Investigate next generation armature transition solutions including magnetic armatures.
  - Prove advanced integrated launch packages.
  - Prove alternate EM pulsed power options.
  - Prove muzzle shunt operation over the full range of velocities and projectiles.
  - Prove robust EM gun penetrator lethality against advanced targets using the lowest energy solution.
  - Validate advanced switch technology, including Silicon Carbide (SiC) and optical triggering, for EM.

Total 7948

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

February 2002

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

COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H64 MATERIALS CENTER	2462	2155	2267	2379	2491	2615	2774

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 Army Research Laboratory (ARL), Aberdeen Proving Ground, MD, scientists and university researchers. The MCRAs provide for mutual exchange of personnel and sharing of research facilities with U. Delaware, Johns Hopkins U., U. Maryland-College Park, U. Minnesota, U. Pennsylvania, Tuskegee U. and Howard U. 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 Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 1962 - Devised analytical and computational models of structural response of composite armor during ballistic impact.
  - Devised models relating microstructural deformation and damage in polymer composites during dynamic loading.
  - Characterized high-strain-rate mechanical properties and damage accumulation mechanisms of metal/intermetallic microlaminates.
  - Optimized joining processes of high performance ceramics in metal encapsulations.
  - Devised electromagnetic manipulation strategies for controlling orientation in electrospinning of nanofibers, and assessed the effects of orientation on microstructure.
- 500 - Enhanced Materials Center of Excellence research ongoing at the University of Delaware (FY2001 Congressional add).

Total 2462

FY 2002 Planned Program

•	2155	- Devise techniques and models for controlling functionally-graded properties in thick-section composites.
		- Devise models of energy dissipation mechanisms in the composite backing plate of lightweight armors during ballistic impact.
		- Produce and characterize controlled macrostructure ceramic armor materials.
		- Devise computer techniques to model and optimize the use of graded metal matrix composites in dynamic failure environments.
		- Synthesize novel organic/inorganic hybrid materials for ultra-light weight personnel extremities protection systems.
Total	2155	

FY 2003 Planned Program

•	2267	- Devise models of deformation behavior and energy dissipation in porous materials during ballistic impact.
		- Improve lightweight structural armor models relating ballistic impact and penetration to dynamic structural responses.
		- Devise computer simulations to predict the performance of ceramics under high-strain-rate impact loading.
		- Devise integrated two and three dimensional computer codes to simulate dynamic failure in bulk amorphous metals and nanostructured metals.
		- Evaluate high strain rate response of novel organic/inorganic hybrid materials and provide parameters to be used in the modeling of their performance in a ballistic environment.
Total	2267	

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

February 2002

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

COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
H73 NAT AUTO CENTER	6646	2944	3042	3080	3133	3231	3295

A. Mission Description and Budget Item Justification: The Center of Excellence for Automotive Research, established in 1994, is a key element of the basic research module of the National Automotive Center (NAC), located at the U.S. Army Tank-Automotive Research, Development, and Engineering Center (TARDEC). The Center of Excellence for Automotive Research is an innovative university/industry/government consortium leveraging commercial dual-use technology for the Army through on-going and new programs in automotive research, resulting in significant cost savings while maximizing technological achievement. The goal of this PE is to significantly enhance the Objective Force's application of advanced vehicle technologies. This transformation will be accomplished through leap ahead technologies resulting in phased improvements over the next decade. To achieve the Army vision, the Army must also be more strategically deployable and agile, with a smaller logistical footprint. In addition, lighter ground vehicle systems must be pursued that are more lethal, survivable, and tactically mobile. The 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 21st Century Truck Initiative will research alternate fuels, advanced propulsion, advanced materials, reduced parasitic losses, vehicle intelligence, and safety. The work in this program element is consistent with the Army Science and Technology Master Plan, the Army Modernization Plan, and Project Reliance. In FY 2001, Congress added $2 million for NAC university research. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 2797
  - Explored concepts for simulating and advancing technology in vehicle intelligence and wireless systems for future Department of Defense (DOD) and Army applications.
  - Evaluated methods for validating unique simulation environments.
- 1849
  - Performed simulation based modeling and analysis in support of all areas of technology under investigation.
  - Optimized powertrains for the Army's next generation of vehicles.
  - Performed state-of-the-art trade-off analyses on concept vehicles and components.
  - Researched the current state-of-the-art in advanced sensing systems for vehicle intelligence systems.

FY 2001 Accomplishments: (Continued)

- 2000 - Congressional add was used for the modeling of ground vehicles with simulation based acquisition in support of enhancement of simulation based acquisition tools.

Total 6646

FY 2002 Planned Program

- 2944 - Formulate and mature advanced modeling and simulation strategies for the Army's Future Combat Systems (FCS) efforts.
  - Optimize the dual-need overall simulation network.
  - Model and experimentally validate advance propulsion/mobility simulation models for the Army's future fleet of vehicles.
  - Explore concepts for advancing technology of wireless vehicle intelligence systems for future DOD and Army applications.
  - Experimentally validate fully functional system model using advanced prototypes.

Total 2944

FY 2003 Planned Program

- 3042 - Advance state-of-the-art simulation and modeling for future Army automotive technologies, including FCS.
  - Complete final validation and implementation of future FCS mobility and propulsion predictive algorithms.
  - Evaluate and analyze systems for intelligent remote monitoring, guidance and control to be used for autonomous and semi-autonomous vehicles.
  - Evaluate and analyze models suitable for design decisions for collision avoidance warning systems, rollover warning, active yaw control, lane departure, and intelligent airbag systems.

Total 3042

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	8182	6806	9463	4589	4707	4982	5225

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 in August 1999 by DDR&E as a University Affiliated Research Center (UARC) 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 will actively engage 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 will also work 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. In return, industry will leverage DoD-sponsored research being done by the Modeling and Simulation UARC. Creating a true synthesis of the creativity, technology and capabilities of the industry and the R&D community will revolutionize 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. It will also allow the United States to maintain dominance in simulation and training technologies. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- 8182 - Examined entertainment industry methods and data for their applicability to networked, realistic simulation tools for combat training.

  - Published IEEE Jan 01 Article informing the community on experiential learning.

  - Conducted research to understand the levels of reality/fidelity required to suspend disbelief and generate verisimilitude in virtual environments in support of the new Army Vision/Transformation.

  - Continued research with the Mission Rehearsal Exercise for Virtual Human representation, speech recognition, and interactive stories.

  - Investigated the use of avatars to depict locals, friendly and hostile forces and mission team members for mission rehearsal environments.

FY 2001 Accomplishments: (Continued)

- Showcased the Virtual Human aspect of the Mission Rehearsal Exercise at the American Association for Artificial Intelligence Fall conference.

- Created advanced immersive environment utilizing sound, visual cues, motion and other sensory elements.

-Studied concepts for creating projected spaces for immersion to include emotion.

Total 8182

FY 2002 Planned Program

- 4327 - Conduct basic research in the three essential elements of immersive environments - graphics visualization, immersive 3D audio environments and algorithms, and virtual humans including non-verbal communication (e.g. gesture, gaze, emotion, facial expression).

  - Conduct research to exploit advances in computer science to explore techniques, algorithms, methods, and multi-sensory stimuli to enhance training across operational military functions.

- 2479 - Accelerate research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness.

Total 6806

FY 2003 Planned Program

- 4475 - Conduct research to advance virtual environments through selected multisensory techniques.

  - Investigate the balance between selective fidelity and computing environments to determine scalability and affordability of promising advances in computational geometry, signed processing for audio, and artificial intelligence approaches to interactive reasoning.

- 4988 - Advance basic research for the promising development of the Experience Learning System (ELS), a widely scaleable systems of virtual reality systems that is cross platform, networked, and completely immersive.

  - Investigate advanced visual techniques for photo realism and environmental effects like shadows for synthetic representations.

  - Research the enabling technologies in modeling, simulation, and training for the development of new paradigms in training the Transformation Force.

Total 9463

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

February 2002

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

	COST (In Thousands)	FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	5978	6021	6007	5996	5991	5978

A. Mission Description and Budget Item Justification: This project supports a Collaborative Technology Alliance (CTA) in Power and Energy Technologies. The 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 vehicles and robotic platforms. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming of logistics fuels to generate reformate fuel for fuel cells, and reducing the size and weight of electric power components and systems. This project was competitively awarded in FY2001. In FY2001 this program is funded in 61104/H54. The CTA focuses on three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric Propulsion and Power. These technologies are fundamental elements required to realize the Army Transformation and support the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

- None. FY2001 program is funded in 61104/H54.

FY 2002 Planned Program

- 5978
  - Operate the electrostatic microturbine generator at high speed.
  - Operate the micro gas turbine hydrogen demo engine at high speed.
  - Develop PROX catalysts for RT PEM fuel cells.
  - Conduct initial system modeling of a 1W planar Direct Methanol Fuel Cell system.

FY 2002 Planned Program (Continued)

- Perform modeling of Si IGBT AC module.
- Investigate etch processes for SiC diodes and thyristors.

Total 5978

FY 2003 Planned Program

• 6021
- Design and model the magnetic micro air turbine generator.
- Design and model a hydrocarbon fueled micro gas turbine.
- Fabricate a 1W multi-layer ceramic Direct Methanol Fuel Cell substrate.
- Design a carbon monoxide removal reactor.
- Perform sulfidation screening tests of sorbents and H2S absorption kinetics for logistics fuel desulfurization.
- Investigate high temperature turbomachinary candidate materials.
- Investigate 3-in-1 AC power modules of 1200V, 25A-100A.

Total 6021

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

February 2002

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

COST (In Thousands)		FY 2001 Actual	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate
J12	NANOTECHNOLOGY	0	0	9976	9945	9921	9904	10705

A. Mission Description and Budget Item Justification: Funding for this program was begun in FY02 in Project H59. This is a new Project initiated by the Office of the Assistant Secretary of the Army (Acquisition, Logistics and Technology) to support nanotechnology research at an as yet to be determined Institute for Soldier Nanotechnologies. A single university will host this institute, which will emphasize revolutionary materials research toward advanced soldier protection and survivability capabilities. This institute will work in close collaboration with industry, the Army's Natick Soldier Center (NSC), the Army Research Laboratory (ARL) and other Army Research Development and Engineering Centers (RDECs) in pursuit of its goals. The institute will be designated as a University Affiliated Research Center (UARC) to support the Army Objective Force Warfighter through research to develop nanometer-scale science and technology solutions for the soldier. This research will emphasize revolutionary materials research toward an advanced uniform concept. The 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 developed 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 soilage. These technologies are fundamental elements required to realize the Army Transformation and support the Objective Force. The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Army Materiel Command. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2001 Accomplishments:

NONE

FY 2002 Planned Program

This program starts in 2002 under Project H59 by establishing the Institute for Soldier Nanotechnologies.

FY 2003 Planned Program

•	9976	- Advance materials research with the objective of developing a revolutionary soldier uniform concept - Advance research in new computational models that predict and monitor the soldier's performance

Total 9976