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

June 2001

BUDGET ACTIVITY
1 - BASIC RESEARCH

PE NUMBER AND TITLE
0601104A - University & Industry Rsch Ctrs

	COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	64854	59318	69147	0	0	0	0	0	0	0
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9206	9671	7943	0	0	0	0	0	0	0
H53	ADV DIS INTR SIM RSCH	1467	1183	2592	0	0	0	0	0	0	0
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9397	9868	6136	0	0	0	0	0	0	0
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	6520	5901	6072	0	0	0	0	0	0	0
H59	UNIV CENTERS OF EXCEL	9334	1970	19395	0	0	0	0	0	0	0
H62	ELECTROMECH/HYPER PHYS	8578	9860	7980	0	0	0	0	0	0	0
H64	MATERIALS CENTER	1579	2929	2174	0	0	0	0	0	0	0
H65	MICROELECTRONICS CTR	1670	1975	991	0	0	0	0	0	0	0
H73	NAT AUTO CENTER	5647	6844	2969	0	0	0	0	0	0	0
H7A	SCIENCE-BASED REGULATORY COMPLIANCE STUDY	0	993	0	0	0	0	0	0	0	0
J07	COUNTER-TERRORISM PROGRAM	11456	0	0	0	0	0	0	0	0	0
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	0	8124	6865	0	0	0	0	0	0	0
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	0	6030	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification:

PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.

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. Federated Laboratories are an innovative and forward thinking approach to focusing the talents of industry and academia on critical technology needs of the Army.

They involve partnerships between the Army Research Laboratory (ARL) and industry/university consortia with recognized competencies in specific technology areas where the centers of expertise are outside of the government (i.e. telecommunications). Under the Federated Laboratory approach, ARL formed associations with consortia consisting of at least one each of an industrial company, a major university, and a Historically Black College or University/Minority Institution (HBCU/MI). Long-term cooperative agreements (5 years) were established in three key areas with consortia that have become "virtual labs" within ARL and function as any other ARL division. Research is jointly planned and executed and Army scientists and engineers are intermingled with consortia researchers through long-term rotational assignments. The Federated Laboratories will complete their contracts and will be replaced by Collaborative Technology Alliances (CTAs) in late FY 2001. 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 the DOD Basic Research Plan. The program element contains no duplication with any effort within the Military Departments.

B. Program Change Summary	FY 2000	FY 2001	FY 2002	FY 2003
Previous President's Budget (FY2001 PB)	64370	54365	49026	0
Appropriated Value	65066	59865	0	
Adjustments to Appropriated Value	0	0	0	
a. Congressional General Reductions	0	0	0	
b. SBIR / STTR	-1730	0	0	
c. Omnibus or Other Above Threshold Reductions	-265	0	0	
d. Below Threshold Reprogramming	2222	0	0	
e. Rescissions	-429	-549	0	
Adjustments to Budget Years Since FY2001 PB	0	0	20121	
Current Budget Submit (FY 2002/2003 PB)	64864	59316	69147	0

Change Summary Explanation: Funding - FY 2001: Congressional adds were made for a Science-Based Regulatory Compliance Study (+1000); Electromechanics and Hypervelocity Physics, Project H62 (+2000); Army (Materials) Center of Excellence, Project H64 ($500); and the National Automotive Center (+2000).

- (+1000) Science Based Regulatory Compliance Study: The objective of this one year Congressional add is to conduct a study of and a risk assessment for chemical demilitarization activities. No additional funding is required to complete this project.

Project without a R-2A:

Project H65
- (FY 2002 Funding = $991) Microelectronics Center of Excellence: 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.

Additional funding in FY 2002 (+20000) added for the following: (1) to initiate University Affiliated Research Center focused on application of nanoscience to enhance Objective Force Warrior survivability through nanotechnology-based materials and devices (10000); (2) to create an innovative national math, science, and engineering competition for students (5000); (3) to support basic research in unmanned ground vehicle perception and intelligent control methodologies (2500); and (4) to develop fundamental principles for advanced training concepts through research under a unique Army, academia, and entertainment industry partnership (2500).

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H50**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H50	COMMS & NETWORKS COLLAB TECH ALLIANCE (CTA)	9206	9671	7943	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium (Federated Laboratory) that was formed to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. This Federated Laboratory completes its contract in FY2001. The project also supports a new consortium which will be competitively awarded in late FY2001, a Collaborative Technology Alliance (CTA), which links a broad range of government technology agencies and industry/academia partners with ARL. 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 9206 - Established data distribution schemes based on adaptive triggers and intelligent agents to support a fault tolerant architecture.
  - Provided a network management system based on a next-generation, software-based, fault-tolerant distributed object computing platform and a multi-tier network architecture to manage tactical communication networks.
  - Established compression techniques for multimedia delivery to tactical networks.
  - Simulated large-scale highly mobile untethered battlefield networks.
  - Investigated laser communications using adaptive optics technology.

Total 9206

FY 2001 Planned Program

•	9384	- Design alternative signaling protocols for call-off, origination, delivery, and internet protocol mobility in a highly mobile battlefield environment.
		- Provide a network management system based on a next-generation software-base.
		- Show tactical data exchange across multiple platforms using adaptive flow control and routing, meta data queries, and user-controllable threshold criteria to enhance seamless information transfer on the battlefield.
		- Establish packetization and error recovery methods for multimedia communications over wireless battlefield channels.
		- Provide intermedia and interparticipant multimedia synchronization using submillisecond time synchronization to provide multimedia applications over the tactical network.
		- Establish Collaborative Technology Alliance in Communications and Networks cooperative agreement 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.
		- Research efforts in the areas of survivable wireless mobile networks, signal processing for communications-on-the-move, secure jam-resistant communications, and tactical information protection.
•	287	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	9671	

FY 2002 Planned Program

•	7943	- 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	7943	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H53**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H53	ADV DIS INTR SIM RSCH	1467	1183	2592	0	0	0	0	0	0	0

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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 536 - Established scenarios for experimentation and usage of a distributed information system for automating the Military Decision Making Process (MDMP).

  - Investigated the integration of intelligent whiteboard technology with a legacy (distributed combat information) system for more interactive/effective displays and interfaces.
  - Designed a data manager architecture for distributed combat information system.
  - Explored/experimented with advanced concepts for information transfer systems.

- 931 - Used computational fluid dynamics (CFD) codes and boundary layer transition prediction tools to validate and analyze recent experimental measurements to examine the aerothermal characteristics of advanced interceptor seekerheads.

  - Designed partitioning algorithms of highly unstructured and irregular graphs for efficient design of Army combat platforms for applications on both serial and parallel computers.
  - Visualized composite material manufacturing process for complex geometric structures.

FY 2000 Accomplishments (Continued)

- Provided efficient technologies that expedite the remediation of explosive contaminants in soils and aquifers.

Total 1467

FY 2001 Planned Program

• 582
- Establish a prototype data manager and distributed combat information system to capture command knowledge and experience for lessons learned repositories and after action analyses.
- Identify, design and prototype components for C2 intelligent priority management and multimedia data management.
- Investigate a battlefield data exchange and retrieval model based on eXtensible Mark-up Language (XML) and mobile agent technologies to enhance and speed up the MDMP.

• 566
- Apply designs of lightweight, battlefield survivable composite structures to agile platforms of the Objective Force.
- Improve the bioavailability and biodegradability of nitroaromatic explosives within the soil granulates.
- Examine and validate models for heated regions in the design of seekerheads for future interceptor systems.
- Design and use different data mining algorithms to analyze scientific data sets for clustering and pattern discovery.

• 35
- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1183

FY 2002 Planned Program

• 778
- 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.

• 1814
- 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 2592

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H54**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H54	ADVANCED SENSORS COLLAB TECH ALLIANCE (CTA)	9397	9868	6136	0	0	0	0	0	0	0

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 current ARL Federated Laboratory explores advanced sensors and processing tools to convert raw sensor data into meaningful information for transmission over tactical networks. 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 Federated Laboratory comes to an end in FY2001. This project also supports a new consortium, a Collaborative Technology Alliance (CTA), which is a follow on to the Federated Laboratory, benefiting from the lessons learned from the program. The CTA will be competitively awarded in late FY2001. This CTA will link 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 9397 - Improved atmospheric normalization of hyperspectral sensor data for remote materiel identification for enhanced target recognition and situational awareness on the battlefield.
  - Reduced false alarm rate for detection of mines and buried unexploded ordnance using multi-sensor signatures.
  - Evaluated networked microsensor signal processing techniques that minimize communication power for increased life of microsensors placed on the battlefield for situational awareness.
  - Evaluated hybrid digital signal processing / reconfigurable computing architecture processing of acoustic data from an array of microphones.

FY 2000 Accomplishments (Continued)

- Designed and laboratory tested a 94 GHz radar with an 8 element single polarization electronic scanning antenna in a continuing effort to reduce the proliferation of antenna systems on the battlefield.

Total 9397

FY 2001 Planned Program

- 6574 - Integrate dual-band target detection algorithm into microsensor computing architecture for improved battlefield situational awareness.

  - Complete moving target indicator algorithm and transition to Program Manager-Night Vision/Reconnaissance, Surveillance and Target Acquisition for application to the Long Range Advanced Scout Surveillance System.
  - Evaluate network of distributed microsensors that is capable of cooperative signal processing for improved battlefield situational awareness.

  - Establish capability to create dual-band Focal Plane Arrays in HgCdTe using Molecular Beam Epitaxy
  - Complete 2-band Focal Plane Array for handoff to the Night Vision and Electronic Sensors Directorate of the Communications Electronics Command.

  - Complete millimeter wave clutter database.
- 2000 - Establish new Sensors CTA with three main technical areas: Microsensors, Electro-Optic Smart Sensors, and Advanced Radar Frequency Concepts.
- 1000 - Establish 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.)
- 294 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 9868

FY 2002 Planned Program

•	6136	- 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	6136	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H56**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H56	ADV DECISION ARCH COLLAB TECH ALLIANCE (CTA)	6520	5901	6072	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project supports a competitively selected university/industry consortium (Federated Laboratory) that was formed to provide solutions for the many requirements for information assimilation on the battlefield. The focus of the consortium is to investigate more powerful and more user friendly computer displays and information control concepts. The problem is how to provide access to all information of practical use and provide data visualization in an efficient manner without overwhelming the user. 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 oulined in planned program tasks for FY01-FY03. This Federated Laboratory completes its contract in FY2001. The project also supports a new consortium, a Collaborative Technology Alliance (CTA) which will be competitively awarded in late FY2001. This CTA, which will link a broad range of government technology agencies and industry/academia partners with ARL, will conduct 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 program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 5346
  - Transitioned refined integrated course of action investigation and analysis tools for use in collaborative technology Science and Technology Objective (STO) and Advanced Technology Demonstrations(ATDs).
  - Published guidelines, methods and procedures for investigation of more effective visual-auditory displays and guidance on use of eye-tracking in interacting with displays.
  - Provided Beta algorithms for vision-based gesture analysis, speech/gesture integration, and bimodal speech recognition as well as selected foreign language translation (DRAGON).
  - Transitioned Automation Speech Recognition (ASR) server to collaborative technologies STO and ATDs.
  - Provided Cognitive Engineering Applications model(s) to collaborative technology STO, CECOM and Battle Labs (support output of Cognitive Engineering STO).

FY 2000 Accomplishments (Continued)

•	1174	- Implemented and assessed registration system and technique for overlaying 3D information onto video or see-through helmet mounted display.
		- Designed single and dual access electronic stabilization algorithms for mobile displays.
Total	6520	

FY 2001 Planned Program

•	5725	- Finalize refinement of the Integrated Support Laboratory (ISL) architecture and transition package to CECOM and Battle Labs.
		- Provide algorithms using wavelets and fractals for embedded coding of image/video.
		- Incorporate talking and gesturing avatars into collaborative planning and execution scenarios.
		- Extend the FOX-RAVEN-CADET paradigm to include collaborative planning within the intelligence arena.
		- Use Army State Operator And Results-Modular Semi-Automated Forces (Soar-Mod SAF) architecture: provide a commander/staff model capable of conducting cognitive engineering of Army command and control interfaces; create model-opposing force commanders to direct other Soar-controlled unit entities.
		- Investigate technologies to enable commanders to tailor C2 systems to support their individual cognitive processes.
		- Research intelligent systems that provide an enabled understanding of information needs for situation and tasks.
		- Establish new cooperative agreement with Collaborative Technology Alliance in Advanced Decision Architectures.
•	176	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	5901	

FY 2002 Planned Program

•	6072	- Research and identify variables in user's overall state (physical, cognitive, emotional) critical to effective and efficient use of command and control systems. Include variables that measure commander's level of trust in decision aids.
		- Investigate methods to analyze, assess certainty of, merge, and display information from diffuse sources relevant to battlefield decision-making, addressing terrain, weather, time, forces, and other factors.
		- Refine and test single and dual access electronic stabilization algorithms for mobile displays in military vehicles.

FY 2002 Planned Program (Continued)

- Research cognitively valid interactive display methods that exploit different output modalities for visualizing and otherwise conveying battlespace information, uncertainty, and synchronization of spatially and temporally disparate data.

Total 6072

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H59**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H59	UNIV CENTERS OF EXCEL	9334	1970	19395	0	0	0	0	0	0	0

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 rotorcraft scientists and engineers. 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 are currently active in the fields of rotary wing technology; fuel cell technology; the foundations of image science; and science, mathematics, and engineering (SME) training. Beginning in FY2001, this project will focus on Army Rotorcraft Centers of Excellence and other technical efforts will be assigned to new projects. 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. Industry will be encouraged to actively support Army Centers of Excellence to leverage and synergize the investment in these collaborative efforts. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 2978 - Investigated and validated a first principle-based approach to model the sound wave propagation through a non-uniform, unsteady flow field.
  - Investigated wake instability, turbulence modeling, and vortex core axial velocity, using an advanced Mie-scattering technique.
  - Completed advanced design concept, such as multi-element airfoils, to reduce dynamic stall effects on maneuvering flight.
  - Established and validated analytical models for predicting response of damaged asymmetric composites under influence of hygrothermal stresses.
  - Conducted piloted simulation of transient response limit avoidance system.
  - Established an accurate elastomeric material model, including the effects on rotorcraft loads, response and stability.
- 3354 - Generated computer models of targets and synthetic image generation to guide theoretical work and verify existing image recognition theories at the Johns Hopkins University center.
  - Supported science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and attract underrepresented minority students to careers in these fields.

FY 2000 Accomplishments (Continued)

- Concluded multidisciplinary research program in landmine detection and identification and transfer the results to applied research.

• 3002 - Linked entertainment industry and defense through the development of a center, the Institute for Creative Technologies, to research networked, realistic simulation tools focused on incorporating entertainment industry methods and data into combat training devices (moved to PE 0601104, Project J08 in FY2001).

- Explored emerging entertainment technologies that may be applicable to meet future Army training needs (moved to Project J08 in FY01).

- Researched applicability of entertainment database tools and methods for use in Army modeling and simulation (moved to Project J08 in FY2001).

Total 9334

FY 2001 Planned Program

• 1912 - Investigate rotor aerodynamics and acoustics during maneuvering flights.

- Investigate passive and active noise reduction concepts for blade-vortex interactions.

- Investigate adaptive driveshafts/struts for noise and vibration reduction, and damage mitigation.

- Establish 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.

- Investigate high flexibility rotorcraft driveshafts using flexible matrix composites and active bearing controls.

- Establish simulation and controls of helicopter shipboard launch and recovery operations.

- Investigate theory and analysis of the behavior of deformable airfoils in rotor control applications.

- Conduct damage tolerance analysis of stiffened composites and rotor hubs.

- Establish neural network based adaptive flight control concepts.

• 58 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1970

FY 2002 Planned Program

•	1985	- 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.
•	9910	- Establish University Affiliated Research Center focusing on application of nanoscience to enhance Objective Force Warrior survivability through nanotechnology-based materials and devices.
•	2500	- 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.
•	5000	- 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	19395	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H62**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H62	ELECTROMECH/HYPER PHYS	8578	9860	7980	0	0	0	0	0	0	0

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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 8578 - Investigated pulsed power technology with emphasis on the disk topology approach.
  - Investigated alternative EM pulsed power applications.
  - Examined high current, fast transient switching for EM pulsed power.
  - Examined launcher and launch package technologies for future field applications.
  - Conducted experiments on the robust defeat capabilities of EM gun penetrators.
  - Examined electric power generation, storage and distribution for mobility.

Total 8578

FY 2001 Planned Program

•	7566	- Evolve thermal management technology for EM pulsed power, switching, and railgun needs.
		- Design and implement laboratory launcher for technology evaluation and investigations of transition in the armature.
		- Evaluate alternate EM pulsed power options.
		- Evaluate material and structural components of launchers and launch packages for future field applications.
		- Exploit robust EM gun penetrators.
		- Conduct research on advanced switch technology.
•	2000	- FY2001 Congressional add to advance state-of-the-art research in pulsed power, to achieve extended rail life and to establish the utility of hypervelocity projectiles for electromagnetic guns.
•	294	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	9860	

FY 2002 Planned Program

•	7980	- 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	7980	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H64**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H64 MATERIALS CENTER	1579	2929	2174	0	0	0	0	0	0	0

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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 1579 - Completed models of induction-based processing of specialty composites for munitions and transitioned technology to Army tank ammunition manufacturing development program.
  - Devised algorithms for computational optimization of composite processes through integration of genetic algorithms and gradient-sensitivity methods.
  - Invented series of Zr-Ti-X-Ni-Al bulk amorphous metals that exhibit a dramatic increase in strain-to-failure from 1-3% to 7%.
  - Determined high-strain-rate behavior of metal matrix composites with varying volume fraction of ceramic incorporations.
  - Completed processing and characterization studies of elastomer/nylon microlayered composites.

Total 1579

FY 2001 Planned Program

•	2342	- Devise analytical and computational models of structural response of composite armor during ballistic impact.
		- Devise models relating microstructural deformation and damage in polymer composites during dynamic loading.
		- Characterize high-strain-rate mechanical properties and damage accumulation mechanisms of metal/intermetallic microlaminates.
		- Optimize joining of high performance ceramics in metal encapsulations.
		- Devise electromagnetic manipulation strategies for controlling orientation in electrospinning of nanofibers, and assess the effects of orientation on microstructure.
•	500	- Enhance Materials Center of Excellence research ongoing at the University of Delaware (FY2001 Congressional add).
•	87	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	2929	

FY 2002 Planned Program

•	2174	- 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	2174	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H65**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H65 MICROELECTRONICS CTR	1670	1975	991	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification:: This program supports a long-term collaboration between Army Research Laboratory scientists and universities. It allows the Army to leverage the extensive scientific manpower and expertise of the universities. The universities work in a collaborative manner with Army scientists to address critical technologies for the Army's Future Combat System (FCS) and Objective Force related to power and energy: batteries, fuel cells, high temperature power electronics, and novel non-electrochemical compact power generation techniques. The goals of this effort are to conduct innovative research and exploit new concepts in solid state physics, electrochemistry, electrical engineering, microelectromechanical systems (MEMS), and chemical/electrochemical engineering to support specific Army needs. The program provides for a mutual exchange of personnel and for a sharing of research capabilities.

FY 2000 Accomplishments

- 1670 - Showed that deposited aluminum nitride films have promise for passivation of high temperature electronics.
  - Investigated new catalysts to improve methanol fuel cell efficiency.
  - Optimized the fabrication process for MEMS RF filters.

Total 1670

FY 2001 Planned Program

- 1917 - Investigate the use of deposited aluminum nitride films for high temperature voltage controlled switched for hybrid electric drive vehicles (FCS).
  - Complete SiC deep etch process to fabricate MEMS structures for compact power sources.
  - Explore a method to inhibit methanol oxidation of the cathode to extend the lifetime of fuel cells.
- 58 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 1975

FY 2002 Planned Program

•	991	- Formulate a device model for voltage controlled high power high temperature switched using new alternative dielectrics (not SiO2).
		- Fabricate MEMS structures for use in compact power energy sources.
		- Investigate new additives to the methanol fuel cell to extend the life and increase the electrode voltage.
Total	991	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**H73**

COST (In Thousands)	FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
H73 NAT AUTO CENTER	5647	6844	2969	0	0	0	0	0	0	0

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, allowing significant cost savings while maximizing technological productivity. 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. In FY 2001, Congress added $2 million for NAC university research. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- 2877 - Completed the mathematical formulation of the next generation of high fidelity military vehicle simulation models.
  - Completed a thorough evaluation of new simulation capabilities using enhanced, unique experimental procedures.
- 2770 - Completed the formation of high-resolution computer databases that represent real-world terrains for use in interactive vehicle simulations.
  - Completed a vehicle system modeling approach that is suitable for real-time simulation of on-road vehicles such as passenger cars, light trucks, and heavy trucks.

Total 5647

FY 2001 Planned Program

•	2796	- Explore concepts for simulating and advancing technology in vehicle intelligence and wireless systems for future Department of Defense (DOD) and Army applications.
		- Evaluate methods for validating unique simulation environments.
•	1849	- Perform simulation based modeling and analysis in support of all areas of technology under investigation.
		- Optimize powertrains for the Army's next generation of vehicles.
		- Perform state-of-the-art trade-off analyses on concept vehicles and components.
		- Research the current state-of-the-art in advanced sensing systems for vehicle intelligence systems.
•	2000	- Congressional add will be used for the modeling of ground vehicles with simulation based acquisition in support of enhancement of simulation based acquisition tools.
•	199	- Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.
Total	6844	

FY 2002 Planned Program

•	2969	- Optimize the dual-need overall simulation network.
		- Continue exploring concepts for advancing technology of wireless vehicle intelligence systems for future DOD and Army applications.
		- Experimentally validate fully functional system model using advanced hardware prototypes.
Total	2969	

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**J07**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J07	COUNTER-TERRORISM PROGRAM	11456	0	0	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project established a one year Congressionally-directed program to be conducted by the Army Engineer Research and Development Center and a competitively selected industry/university consortium for the purpose of leveraging world class research relevant to mitigating the efforts of terrorist acts. This basic research program explored technologies that deter, resolve, and mitigate terrorist acts, including physical structure and effects research. The research investigated revolutionary approaches in science and technologies that will provide next generation solutions for force protection and terrorist threats. These technologies include new and/or improved structural strengthening methods and materials to building collapse, improved window, roof, wall systems to reduce injuries from flying glass and debris, new blast shielding systems, and vulnerability assessment modeling. The work was managed by the Structures Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.

FY 2000 Accomplishments

- 11456 - Completed the conceptual design of the blast load simulator to investigate debris hazard mitigation technology; awarded a contract to complete the design and to fabricate the blast load simulator.

  - Awarded contracts to: Pennsylvania State University to investigate explosive load definition, precision impact tests, material behavior, structures and structural components performance and safety; Mississippi State University to investigate constitutive modeling, computational methods, simulations and code validation; and Jackson State University to investigate computational simulations, code validation, structural behavior, performance and safety, assessments, technology transfer and training.

Total 11456

FY 2001 Planned Program

Not funded in FY 2001.

FY 2002 Planned Program

Not funded in FY 2002.

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**J08**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J08	INSTITUTE FOR CREATIVE TECHNOLOGY	0	8124	6865	0	0	0	0	0	0	0

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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- FY 2000 project work was supported by Project H59.

FY 2001 Planned Program

• 7882 - Examine entertainment industry methods and data for their applicability to networked, realistic simulation tools for combat training.

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

FY 2001 Planned Program (Continued)

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

• 242 - Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 8124

FY 2002 Planned Program

• 4365 - 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.

• 2500 - Accelerate research on intelligent avatars for virtual environments to enhance realism of interactions with trainee(s) and increase training effectiveness.

Total 6865

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

June 2001

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
1 - BASIC RESEARCH	**0601104A - University & Industry Rsch Ctrs**	**J09**

COST (In Thousands)		FY 2000 Actual	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	Cost to Complete	Total Cost
J09	POWER & ENERGY COLLABORATIVE TECH ALLIANCE (CTA)	0	0	6030	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This project establishes a Collaborative Technology Alliance (CTA) in Power and Energy Technologies. The CTA will form 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 fuel efficient vehicles and robotic platforms will be conducted. Technical barriers include overcoming energy density limitations of traditional electrochemical portable power sources, reforming of logistics fuels to generate hydrogen, and reducing the size and weight of hybrid electric propulsion components and systems. This project is being competitively bid in FY2000/FY2001 with an award in FY2001. In FY2001 this program is funded in 61104/H54. The CTA will focus 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. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

FY 2000 Accomplishments

- None.

FY 2001 Planned Program

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

FY 2002 Planned Program

•	6030	- Execute first full fiscal year of new CTA with three main technical areas: Portable Compact Power Sources (non-electrochemical), Fuel Cells and Fuel Reforming, and Hybrid Electric Propulsion and Power. (Specific milestones/deliverables will be determined after program is competitively awarded in FY01).
		- Establish and adapt specific milestones/deliverables for the Cooperative Agreement after the competitive award is made.
Total	6030	