

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)	DATE February 2000
---	------------------------------

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

<i>COST (In Thousands)</i>	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
Total Program Element (PE) Cost	42343	64370	54365	49026	49804	50603	51462	Continuing	Continuing
BH50 Telecommunications Research	8634	9595	9760	9908	10099	10293	10493	Continuing	Continuing
BH53 Advanced Distributed Interactive Simulation Research	1864	1177	1195	1214	1236	1260	1284	Continuing	Continuing
BH54 Advanced Sensors Research	8809	9791	9960	10111	10305	10503	10707	Continuing	Continuing
BH56 Advanced Displays Research	4204	6833	5955	6045	6160	6279	6400	Continuing	Continuing
BH59 University Centers of Excellence	3716	6214	1988	1986	1985	1983	1982	Continuing	Continuing
BH62 Electromechanics and Hypervelocity Physics	8206	8815	7951	7944	7937	7931	7965	Continuing	Continuing
BH64 Materials Center of Excellence	2112	2416	2457	2494	2540	2590	2640	Continuing	Continuing
BH65 Microelectronics Center of Excellence	2204	1958	1992	2023	2062	2101	2142	Continuing	Continuing
BH73 National Automotive Center of Excellence	2594	5800	4908	2956	3012	3070	3128	Continuing	Continuing
J07 Counter Terrorism Program	0	11771	0	0	0	0	0	11771	11771
J08 Institute for Creative Technologies	0	0	8199	4345	4468	4593	4721	Continuing	Continuing

A. Mission Description and Budget Item Justification: This program element leverages research in the private sector through Federated Laboratories, Centers of Excellence, and the University Affiliated Research Center. Federated laboratories are an innovative and forward thinking approach focusing the talents of industry and academia on critical technology needs of the Army. Federated laboratories are partnerships between the Army Research Laboratory (ARL) and industry/university consortia with recognized competencies in specific technology areas where the centers of expertise are definitely 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

UNCLASSIFIED

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	
<p>consortia researchers through long term rotational assignments. The federated laboratory approach for ARL is in accordance with the 1991 Base Realignment and Closure, and the Department of Defense mandate to exploit private sector research and reduce infrastructure. This program element also includes the Army's Centers of Excellence, which are the centerpiece of academic linkage to Army R&D organizations. Centers of Excellence continue to be an integral part of the Army's research investment strategy, along with single investigator programs and Army laboratory research. Centers have proven to be highly effective in many applications-oriented projects, in areas such as rotary wing technology and electronics. Centers couple state-of-the-art research programs with broad-based graduate education programs to increase the supply of scientists and engineers in areas of Army importance. 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 immersion, networked simulation, standards for interoperability, and tools for creating simulated environments. Work in this program element is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and DoD Project Reliance</p>		
B. Program Change Summary		
	<u>FY 1999</u>	<u>FY 2000</u>
Previous President's Budget (FY 2000/2001 PB)	44839	47066
Appropriated Value	45138	65066
Adjustments to Appropriated Value		
a. Congressional General Reductions	-299	
b. SBIR / STTR	-1185	
c. Omnibus or Other Above Threshold Reductions		-265
d. Below Threshold Reprogramming	-1131	
e. Rescissions	-180	-431
Adjustments to Budget Years Since (FY 2000/2001 PB)		+6341
Current Budget Submit (FY 2001 PB)	42343	64370
<p>Change Summary Explanation: Funding – FY 2001: Project J08 increased (+4000) to support research on more effective immersive environments; Project BH73 increased (+2000) to support research on 21st Century Truck.</p>		

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601104A University and Industry Research Centers				PROJECT BH50		
COST (In Thousands)		FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH50 Telecommunications Research		8634	9595	9760	9908	10099	10293	10493	Continuing	Continuing
<p>Mission Description and Justification: This project provides long term collaboration between the Army Research Laboratory and competitively selected industry/university consortium headed by Lockheed Sanders, Nashua, NH, for the purpose of leveraging world class research relevant to Army needs. Battlefield telecommunications involve the reliable, timely, and secure electronic transport of multi-media information over heterogeneous, digital networks exhibiting dynamic topologies. The technical areas addressed under this project are: wireless battlefield digital communications; tactical/strategic interoperability; information distribution; multi-media concepts.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 8634 - Determined signaling protocols for call hand-off, origination, delivery, and internet protocol mobility in a highly mobile battlefield environment. - Established network management techniques based on a next-generation, software-based, fault-tolerant distributed object computing platform and a multi-tier network architecture to manage tactical communication networks - Completed 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 and demonstrated at the Federated Laboratory Symposium. - Generated packetization and error recovery methods for multimedia communications over wireless battlefield channels. - Researched and provided inter-media and inter-participant multimedia synchronization using sub-millisecond time synchronization to provide multimedia applications to the tactical network. <p>Total 8634</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 9336 - Establish data distribution schemes based on adaptive triggers and intelligent agents to support a fault tolerant architecture. - Provide 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. -Establish compression techniques for multimedia delivery to tactical networks. - Simulate large-scale highly mobile untethered battlefield networks. - Investigate laser communications using adaptive optics technology. • 259 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 9595</p>										
Project BH50		Page 3 of 21 Pages				Exhibit R-2A (PE 0601104A)				

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	February 2000
FY 2001 Planned Program:		
•	9760 - Determine information hiding techniques to enhance information assurance over wireless battlefield channels. - Describe simulation of large-scale highly mobile untethered battlefield networks. - Show the feasibility of 3D-network management system integrated into advanced visualization techniques for tactical command and control. - Improve communications using a laser system with adaptive optics. - Investigate mobile wireless communications at frequencies above 5 gigabytes. - Investigate global information distribution over satellites or surrogate satellites with intelligent, adaptive multicast techniques.	
Total	9760	
Project BH50	Page 4 of 21 Pages	Exhibit R-2A (PE 0601104A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000			
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601104A University and Industry Research Centers				PROJECT BH53		
COST (In Thousands)		FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH53 Advanced Distributed Interactive Simulation Research		1864	1177	1195	1214	1236	1260	1284	Continuing	Continuing
<p>Mission Description and Justification: This project establishes long term collaboration between the Army Research Laboratory and a competitively selected Army Center of Excellence in Information Sciences (ACEIS). The Clark Atlanta University, a HBCU, will perform research in information science. The research focuses on the mid- to far-term needs of Army Command and Control Systems. It performs research in information science with emphasis in the following areas: interactive and intelligent systems; database and information systems; and distributed and parallel processing systems. This project also supports research critical to the Army at the Army High Performance Computer Research Center beginning in FY99. The research includes characterizing the effect of trailing vortices on paratrooper deployment, structural response of armored vehicles to perforating and nonperforating impact, developing more efficient gun and missile propulsion systems, and developing materials suitable for armor/anti-armor applications.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 583 - Identified the visual clues that detect a "Sense of Presence" on a virtual battlefield that include the detection, identification, and location of visual stimuli, conveyed to the human via parallel paths. <ul style="list-style-type: none"> - Investigated techniques to optimize each stimulus in order to develop effective visualization applications. - Explored how battle command knowledge and experience can be utilized to provide visual problem solving for a knowledge base using the internet. - Established an experimental environment to formulate advanced concepts for information transfer systems. - Provided a capability to identify signatures of anomalous activities in large data systems. - Identified issues associated with transfer of learning in virtual environments. • 1281 - Extended techniques for simulation of parachute inflation fluid-structure interactions and applied them to parachute fluid structure interactions for full 3D parachute models. <ul style="list-style-type: none"> - Described methods to model the effect of the vortex-wake system behind a large transport aircraft on paratrooper separation from aircraft. - Described methods to model aircraft wake vortices and vortice shedding as it relates noise generation and suppression from helicopter blades. - Described adaptive girding, mesh moving, and multi-body modeling techniques and apply these techniques to modeling paratrooper exit from large transport aircraft. - Established mesh-free methods for large deformation analysis of solids and structures; capability to model crack and shear band growth is essential to first principles modeling of the physics of weapons effects. - Provided, as required for new research applications, fast and efficient parallel mesh generation/regeneration algorithms for use in fluid-object (mesh moving) applications or solution adaptive computations. - Advanced highly parallel solvers for sparse linear systems for applications to solve problems in fluid flow, structural mechanics, electromagnetics and heat transfer. 										
Project BH53			Page 5 of 21 Pages				Exhibit R-2A (PE 0601104A)			

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH53
<p>FY 1999 Accomplishments: (continued)</p> <ul style="list-style-type: none"> - Extended virtual environment using neural nets and fuzzy logic. Incorporated advanced data mining techniques into intelligent data base capabilities. - Investigated technologies for information distribution in a wireless mobile environment. <p>Total 1864</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 557 - Describe different scenarios for "Sense of Presence" and performance in battlefield virtual environments. <ul style="list-style-type: none"> - Explore knowledge acquisition, knowledge dissemination, concept analysis, and decision tools to enable users to engage in visual problem solving technologies when working with large knowledge bases. - Capture signatures of anomalous activities in large data systems using cluster analysis, Fourier Transforms, and Neural Networks. - Study the transferability of soldiers' knowledge and experience gained during training in a virtual environment to the real world.. • 588 - Extend techniques for simulation of parachute inflation fluid-structure interactions and apply them to parachute fluid structure interactions for full 3D parachute models. In conjunction with Natick, verify model against empirical data. <ul style="list-style-type: none"> - Establish methods to model the effect of the vortex-wake systems behind multiple large transport aircraft flying in formation on paratrooper deployment (i.e., extend model to multiple aircraft and multiple paratroopers). - Investigate highly parallel algorithms for repartitioning of dynamic and adaptive meshes. - Validate computational algorithms for transient/dynamic analysis and scientific computations. • 32 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 1177</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 585 - Evaluate prototype "Sense of Presence" in a battlefield virtual environment. <ul style="list-style-type: none"> - Explore techniques identifying signatures to handle data analysis in real time on an active system. • 610 - Deliver production quality software which can be used by Army personnel at the Natick RDEC for simulation of parachute inflation fluid-structure interactions and apply parachute fluid structure interactions for full 3D parachute models. <ul style="list-style-type: none"> - Verify computational models for simulating the vortex-wake systems behind multiple large transport aircraft flying in formation on paratrooper deployment . - Analyze lightweight, battlefield survivable structures for agile combat platforms. - Establish simulation based design of composite materials for application to Future Combat Vehicle and Rotorcraft. - Model ballistic impact on composite materials in application to combat systems. <p>Total 1195</p>		
Project BH53	Page 6 of 21 Pages	Exhibit R-2A (PE 0601104A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000					
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601104A University and Industry Research Centers				PROJECT BH54				
COST (In Thousands)				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH54 Advanced Sensors Research				8809	9791	9960	10111	10305	10503	10707	Continuing	Continuing
<p>Mission Description and Justification: This project provides long term collaboration between the Army Research Laboratory and a competitively selected industry/university consortium for the purpose of leveraging world class research relevant to Army needs. Advanced sensors are the elements of systems that view the environment and convert the basic raw sensor data into meaningful information suitable for transmission over tactical networks. The technical areas addressed under this project are: multidomain smart sensors, to include multispectral infrared focal plane arrays; multisensor fusion automatic target recognition algorithms, to include synthesis of sensor modeling; radar sensors, to include atmospheric and terrain effects on propagation; and signal processing, capitalizing on commercially available hardware, microsensors which integrate microelectromechanical systems (MEMS), acoustic, seismic, and RF technologies. These technologies are fundamental elements required to realize vision of a medium weight force to detect, target, and engage the enemy.</p> <p>FY 1999 Accomplishments</p> <ul style="list-style-type: none"> • 1842 - Established a comprehensive millimeter wave (MMW) radar backscatter database for low grazing angle backscatter and a scattering model for improved target tracking and detection algorithms. • 1389 - Established the application of low-power signal processing techniques to a medical monitoring problem. <ul style="list-style-type: none"> - Evaluated a network situation of distributed signal processing. - Designed reconfigurable processor performing fusion of 2 color infrared (IR) imagery. • 2308 - Imaged utilizing dual color 256x256 quantum well infrared photodetector (QWIP) and 240x320 HgCdTe (MCT) IR Focal Plane Arrays (IRFPAs); improved quantum efficiency by 50% for QWIP detector array and 60% for MCT. • 1390 - Evaluated distributed microsensor testbed at Spesutie Island, Aberdeen Proving Ground, MD. • 1880 - Improved automatic target recognition (ATR) performance for forward looking infrared (FLIR) by rapid updating from reconnaissance imagery, improved detection of camouflaged targets using hyperspectral sensing and established coregistered multisensor dataset for detection of mines and buried unexploded ordnance. <p>Total 8809</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 1932 - Design a 94 GHz radar with a 64-element electronically scanned antenna at an Aberdeen test site. The antenna will be capable of receiving a transmitting in two orthogonal polarizations and will employ high level of integration necessary for low cost production • 2341 - Investigate multi-domain smart sensor (MDSS) with dual color IRFPAs and eye safe LADAR; design spatial noise mitigation and low power optical IRFPA read-out techniques. 												
Project BH54				Page 7 of 21 Pages				Exhibit R-2A (PE 0601104A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH54
<p>FY 2000 Planned Program: (continued)</p> <ul style="list-style-type: none"> • 2033 - Evaluate computing architectures for the application of adaptive computing techniques to low-power signal processing for networks of distributed microsensors. • 1117 - Evaluate combination of fixed and mobile unattended ground sensors. • 2104 - Develop multi-fusion algorithms in support of third generation imaging sensors. • 264 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 9791</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 9960 - Investigate innovative adaptive signal processing techniques to enable fusion of self-organizing multidomain networks. - Investigate adaptive multisensor fusion algorithm that requires minimal training for detection and recognition of battlefield targets. - Explore innovative hardware/software architecture for on-sensor processing of advanced multi and hyperspectral sensors, and multimode radio frequency (RF) sensors. <p>Total 9960</p>		
Project BH54	Page 8 of 21 Pages	Exhibit R-2A (PE 0601104A)

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000				
BUDGET ACTIVITY 1 - Basic Research			PE NUMBER AND TITLE 0601104A University and Industry Research Centers					PROJECT BH56			
COST (In Thousands)			FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH56 Advanced Displays Research			4204	6833	5955	6045	6160	6279	6400	Continuing	Continuing
<p>Mission Description and Justification: This project supports a competitively selected university/industry consortium that was formed to provide solutions for the many requirements for information assimilation on the battlefield. The focus of the consortium is to develop more powerful and more user friendly computer displays and information control constructs to provide access to all information of practical use and provide data visualization in an efficient manner without overwhelming the user. Work in this project differs from the Defense Advanced Research Projects Agency's (DARPA's) program, which aims to establish a domestic capability for display hardware. The technical areas being addressed under this project are: human-computer interface in an information rich environment; display configuration, real time visualization, architecture, information presentation, and control coupling.</p> <p>FY 1999 Accomplishments</p> <ul style="list-style-type: none"> • 4204 - Studied scaling problems with spatial reasoning in a large, multi-dimensional battlefield databases. <ul style="list-style-type: none"> - Integrated FOX Course of Action (COA) tool to Decision-Analytic Wargaming tool, OWL, and analyzed the efficacy of COAs, and demonstrated at the Annual Federated Laboratory Symposium. - Integrated and tested speech and gaze inputs into battlefield visualization and simulation environments. - Investigated application software and displayed simulated information from widely distributed Microsensor network on commander's workstation. - Established cross-consortium (Displays, Sensors and Telecommunications) research products using the architecture developed in the Integration Support Laboratory (ISL). - Established audio icons for joint modality displays. - Completed integration of FOX & OWL with CADET and transitioned to CECOM. - Conducted experiments on Cognitive Engineering Applications in the collaborative planning and maneuvering area. <p>Total 4204</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 5659 - Transition refined integrated course of action development and analysis tools for use in collaborative technology STO and ATDs. <ul style="list-style-type: none"> - Publish guidelines, methods and procedures for development of more effective visual-auditory displays and guidance on use of eye-tracking in interacting with displays. - Provide Beta algorithms for vision-based gesture analysis, for speech/gesture integration, and for bimodal speech recognition as well as selected foreign language translation (DRAGON). - Transition Automation Speech Recognition (ASR) server to collaborative technologies STO and ATDs. 											
Project BH56			Page 9 of 21 Pages				Exhibit R-2A (PE 0601104A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH56
FY 2000 Planned Program: (continued)		
- Provide cognitive Engineering Applications model(s) to collaborative technology STO, CECOM and Battle Labs (support output of Cognitive Engineering STO).		
• 991	- Implement and assess registration system and technique for overlaying 3D information onto video or see-through helmet mounted display.	
	- Develop single and dual access electronic stabilization algorithms for mobile displays.	
• 183	- Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs.	
Total	6833	
FY 2001 Planned Program:		
• 5955	- Finalize and finish refinement of 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.	
	- Using Army Soar-MODSAF 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.	
Total	5955	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 2000
--	------------------------------

BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH59
---	--	-------------------------------

COST (In Thousands)	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH59 University Centers of Excellence	3716	6214	1988	1986	1985	1983	1982	Continuing	Continuing

Mission Description and Justification Army Centers of Excellence are active in the fields of rotary wing technology, fuel cell technology, the foundations of image science, and science, mathematics, and engineering (SME) training. The Army's 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. In addition, industry will be encouraged to buy into future Army Centers of Excellence to leverage and synergize the investment in these collaborative efforts.

FY 1999 Accomplishments:

- 1885 - Completed model for noise/vibrations reduction; tested magneto-rheological (MR) dampers to alleviate rotor aeromechanical instabilities; reformulated motion equation for reconfigurable flight control systems; developed intelligent algorithms for transmission fault detection/classification; implemented joint probabilistic decision making process for multi-attribute, multi-objective, multi-constraint design problems; implemented adaptive neural net controller, with fuzzy logic controls, on the R-50 helicopter test bed.
- 1831 - Concluded research at the Illinois Institute of Technology center on advanced fuel cell and advanced battery research and transferred the results to advanced research and advanced technology development.
 - Advanced target imaging research by fusing data from laser radar systems and forward-looking infrared sensors using pose estimation of ground-based targets rather than algorithms to determine the position and orientation of targets at the Johns Hopkins University Center on image analysis.
 - Supported science, mathematics and engineering (SME) education at Contra Costa College to strengthen academic programs in SME and encouraged underrepresented minority students to pursue advanced degrees and careers in science and engineering.

Total 3716

FY 2000 Planned Program:

- 1929 - Investigate and validate a first principle-based approach to model the sound wave propagation through a non-uniform, unsteady flow field.
 - Investigate wake instability, turbulence modeling, and vortex core axial velocity, using an advanced Mie-scattering technique.
 - Complete advanced design concept development, such as multi-element airfoils, to reduce dynamic stall effects on maneuvering flight.
 - Develop and validate analytical models for predicting response of damaged asymmetric composites under influence of hygrothermal stresses.
 - Conduct piloted simulation of transient response limit avoidance system.
 - Develop an accurate elastomeric material model, including effects on rotorcraft loads, response and stability.
- 2173 - Generate computer models of targets and synthetic image generation to guide theoretical work and verify existing image recognition theories at the Johns Hopkins University center.

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH59
FY 2000 Planned Program: (continued)		
<ul style="list-style-type: none"> - Support 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. - Conclude multidisciplinary research program in landmine detection and identification and transfer the results to advanced research and advanced technology development. 		
•	<ul style="list-style-type: none"> 1945 - Link 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 Project J08 in FY01). - Explore emerging entertainment technologies that may be applicable to meet future Army training needs (moved to Project J08 in FY01). - Research applicability of entertainment database tools and methods for use in Army modeling and simulation (moved to Project J08 in FY01). 	
•	<ul style="list-style-type: none"> 167 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. 	
Total	6214	
FY 2001 Planned Program:		
•	<ul style="list-style-type: none"> 1988 - Conduct interdisciplinary investigations at Penn State University, the University of Maryland and Georgia Institute of Technology on topics of specific relevance to rotorcraft science and technology base in conjunction with the National Rotorcraft Technology Center. 	
Total	1988	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000				
BUDGET ACTIVITY 1 - Basic Research			PE NUMBER AND TITLE 0601104A University and Industry Research Centers					PROJECT BH62			
COST (In Thousands)			FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH62 Electromechanics and Hypervelocity Physics			8206	8815	7951	7944	7937	7931	7965	Continuing	Continuing
<p>Mission Description and 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 Future Combat Systems (FCS).</p> <p>FY 1999 Accomplishments</p> <ul style="list-style-type: none"> • 8206 - Showed efficient hypervelocity gun launch of lethal launch packages (40-mm, 2.5km/s, 50% mass in the projectile) with sufficient gun rail life and projectile accuracy to compete with conventional gun technology. <ul style="list-style-type: none"> - Proved defeat of advanced armors with novel penetrators at both ordnance velocity and hypervelocity. - Established the system utility of the EM gun concept. - Supported compulsator exploitation efforts and explored disk topology technology. <p>Total 8206</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 8578 - Investigate pulsed power technology; with emphasis on the disk topology approach. <ul style="list-style-type: none"> - Investigate alternative EM pulsed power applications. - Conduct research on high current, fast transient switching for EM pulsed power. - Examine launcher and launch package technologies for future field applications. - Prove the robust defeat capabilities of EM gun penetrators. - Examine electric power generation, storage and distribution for mobility. • 237 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 8815</p>											
Project BH62			Page 13 of 21 Pages					Exhibit R-2A (PE 0601104A)			

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	February 2000
FY 2001 Planned Program:		
•	7951 - Evolve thermal management technology for EM pulsed power, switching, and railgun needs. - Design and fabricate laboratory launcher for technology evaluation. - 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 for mobility.	
Total	7951	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000					
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601104A University and Industry Research Centers				PROJECT BH64				
COST (In Thousands)				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH64 Materials Center of Excellence				2112	2416	2457	2494	2540	2590	2640	Continuing	Continuing
<p>Mission Description and Justification: This project promotes long-term collaboration between the Army Research Laboratory (ARL), Aberdeen Proving Ground, MD and University/Industry Research Centers for the purpose of conducting world class research and exploiting breakthroughs in materials science relevant to Army needs. Basic research in materials science and engineering is focused on armor, armaments, personnel protection, ground vehicles, tactical missiles, chemical/biological materials defense, and related Defense Science Research Areas, with application to the Future Combat Systems (FCS). The project emphasizes advanced materials characterization; integrated, multifunctional composites; dendritic/hyperbranched polymers and nanostructured materials research. Current collaborative research agreements are with U. Delaware, Johns Hopkins U., and Michigan Molecular Institute. U. Michigan, U. Minnesota, U. California-San Diego, U. Maryland-College Park, U. Pennsylvania, Cornell U., Princeton U., Howard U. and Boston College are also integrated into the Program. This work is closely coordinated with the ARL in-house materials research project funded through PE 0601102A, Project AH42.</p> <p>FY 1999 Accomplishments</p> <ul style="list-style-type: none"> • 2112 - Characterized Silicon Carbide (SiC) surfaces and thermal cycling effects on electrical, structural and metallurgical properties of SiC contacts and interfaces. <ul style="list-style-type: none"> - Devised new model and improved Ion Beam Assisted Deposition processing technology that involves photon stimulated dissociation of absorbed hydrogen to explain and control the formation of diamond-like coatings on surfaces of advanced materials. - Established micromechanical models that incorporate polymer-fiber interphase phenomena to predict processing and moisture effects on residual stress and other critical composite material properties.. - Completed a design and optimization procedure for vacuum assisted resin transfer molding using analytical model and simulation genetic algorithm. - Provided basic research on novel dendritic and hyperbranched polymer-fiber surface treatments that enhance the environmental durability and shear/impact resistance of composite materials. - Designed and tested dendritic polymer substrate and bioconjugate materials for use in biotoxin detection and immobilization. <p>Total 2112</p>												
Project BH64				Page 15 of 21 Pages				Exhibit R-2A (PE 0601104A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	PROJECT BH64
FY 2000 Planned Program:		
<ul style="list-style-type: none"> • 2351 	<ul style="list-style-type: none"> - Establish in-situ ultrasonic velocity technique for characterization and process monitoring of lithium aluminosilicate glass for transparent armor. - Determine trapping rates and energies for hydrogen traps present in high strength steels. - Improve fracture toughness and poor interfacial adhesion of E-beam curable resins. - Devise novel experimental technique to investigate high-strain rate behavior in sub-micron region next to fiber surfaces in composite materials. - Design and synthesize dendritic/hyperbranched polymer nanoreactors for chemical decontamination application. - Prove that antibody-dendritic polymer-metal conjugates are able to improve biosenor signal amplification by at least an order of magnitude. 	
<ul style="list-style-type: none"> • 65 	<ul style="list-style-type: none"> - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. 	
Total	2416	
FY 2001 Planned Program:		
<ul style="list-style-type: none"> • 2457 	<ul style="list-style-type: none"> - Extend basic theory, processing technology, and testing methodology for tailoring and characterizing fiber surfaces, fiber-matrix interphase, matrix composition, and 3-D architecture of fiber-reinforced composite materials. - Establish guiding principles for data documentation, testing and design of multi-functional, integrated composite materials. - Devise transport models and extend basic knowledge to describe and understand penetrant-penetrant and penetrant-polymer interactions in multiphase polymer systems and for selective/controlled transport of penetrants in tailored "smart" polymer membranes and coatings. - Establish underpinning theory and processing technology for rapid repair and joining of dissimilar metals/ceramics by self-propagating reactions in multi-layer foils. 	
Total	2457	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000				
BUDGET ACTIVITY 1 - Basic Research			PE NUMBER AND TITLE 0601104A University and Industry Research Centers					PROJECT BH65			
COST (In Thousands)			FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH65 Microelectronics Center of Excellence			2204	1958	1992	2023	2062	2101	2142	Continuing	Continuing
<p><u>Mission Description and Justification:</u> The Microelectronic Research Agreement (MICRA) supports a long-term collaboration between Army Research Laboratory scientists and the universities. This program allows the Army to leverage extensive scientific manpower and know how of the universities to work in a collaborative manner with Army scientists to address critical Army microelectronics issues related to night vision, RF and optical sensors, bio sensors, batteries/fuel cells and high temperature power electronics for future electric vehicles. The goals of this effort are to conduct innovative research and exploit new concepts in solid state physics, electrical engineering, photonics, microelectromechanics (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.</p> <p>FY 1999 Accomplishments</p> <ul style="list-style-type: none"> • 2204 - Designed a silicon carbide (SiC) switch for high temperature and high current electronic applications such as all-electric vehicle. <ul style="list-style-type: none"> - Expanded understanding of physics of millimeter wave (MMW) devices for applications such as passive MMW imaging and high resolution radar. - Investigated electroless plating oxidized vertical cavity surface emitting lasers (VCSELS) and specialized complementary metal oxide semiconductor (CMOS) circuits for sensor processing. - Improved catalysts for methanol-air fuel cell for man- and vehicle-portable power supplies. - Designed high brightness light emitting diodes (LEDs) for fiber gyro rotational rate sensor for missile navigation applications and transitioned to MRDEC. <p>Total 2204</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 1905 - Use newly created aluminum nitride (AlN) insulating films to fabricate high power switches that can operate at high temperatures in future electric combat vehicles. <ul style="list-style-type: none"> - Investigate new catalysts to improve methanol fuel cell efficiency. - Integrate vertical cavity surface emitting lasers (VCSELS) with silicon driver chips for very high speed optical data processing. - Optimize the fabrication process for microelectromechanical RF filters. • 53 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 1958</p>											
Project BH65			Page 17 of 21 Pages				Exhibit R-2A (PE 0601104A)				

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)		DATE
BUDGET ACTIVITY 1 - Basic Research	PE NUMBER AND TITLE 0601104A University and Industry Research Centers	February 2000
FY 2001 Planned Program:		
	<ul style="list-style-type: none">• 1992 - Apply low resistivity high temperature metallization to the fabrication of SiC high power switches.- Fabricate cavityless vertical amplifiers and incorporate into smart pixel based optical signal processors.- Validate performance of low loss perovskite films in RF phase shifters for electronically scanned antennas.- Integrate ferroelectric thin films with optimized phyroelectric response with silicon to fabricate uncooled IR sensor elements.	
Total	1992	

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000				
BUDGET ACTIVITY 1 - Basic Research			PE NUMBER AND TITLE 0601104A University and Industry Research Centers					PROJECT BH73			
COST (In Thousands)			FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
BH73 National Automotive Center of Excellence			2594	5800	4908	2956	3012	3070	3128	Continuing	Continuing
<p>Mission Description and 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 Iowa, 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.</p> <p>FY 1999 Accomplishments:</p> <ul style="list-style-type: none"> • 2594 - Completed optimization of overall simulation network by linking optimal subsystem simulations into a seamless distributed design network for military vehicle, powertrain and structural design. - Completed experimental validation of fully functional system model using advanced hardware prototypes. - Finalized mechanism for fostering effective government, industry and academic partnering which facilitates cooperative dual-use technology development, reduces research costs and duplication of efforts. <p>Total 2594</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 5647 - Research derivation of next generation, high fidelity, military vehicle simulation models. - Develop and implement target cascading methodology for integrated optimization. - Assess accuracy of new simulation capability using enhanced, unique experimental procedures. • 153 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 5800</p> <p>FY 2001 Planned Program:</p> <ul style="list-style-type: none"> • 4908 - Incorporate new generation building blocks for enhanced military vehicle simulation models. - Assess new simulation model accuracy over a wide range of military vehicles and conditions. <p>Total 4908</p>											
Project BH73			Page 19 of 21 Pages						Exhibit R-2A (PE 0601104A)		

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)							DATE February 2000					
BUDGET ACTIVITY 1 - Basic Research				PE NUMBER AND TITLE 0601104A University and Industry Research Centers				PROJECT J07				
<i>COST (In Thousands)</i>				FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
J07 Counter Terrorism Program				0	11771	0	0	0	0	0	11771	11771
<p><u>Mission Description and Justification:</u> This project establishes 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 will explore technologies that deter, resolve, and mitigate terrorist acts, including physical structure and effects research. The research will investigate 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 is managed by the Structures Laboratory, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi.</p> <p>FY 1999 Accomplishments: Project not funded in FY 1999.</p> <p>FY 2000 Planned Program:</p> <ul style="list-style-type: none"> • 11454 - Design, fabricate and complete a laboratory high-pressure simulator to investigate debris hazard mitigation technology. <ul style="list-style-type: none"> - Investigate high-performance materials for structural strengthening. - Examine debris hazard modeling techniques. - Investigate next-generation window systems. • 317 - Small Business Innovative Research / Small Business Technology Transfer (SBIR/STTR) Programs. <p>Total 11771</p> <p>FY 2001 Planned Program: Not funded in FY 2001.</p>												
Project J07				<i>Page 20 of 21 Pages</i>				Exhibit R-2A (PE 0601104A)				

UNCLASSIFIED

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)	DATE February 2000
--	------------------------------

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

<i>COST (In Thousands)</i>	FY1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY2004 Estimate	FY2005 Estimate	Cost to Complete	Total Cost
J08 Institute for Creative Technologies	0	0	8199	4345	4468	4593	4721	Continuing	Continuing

Mission Description and 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. ICT was designated 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 such as mission rehearsal, leadership development, and distance learning. ICT will actively engage industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology. ICT will serve as a means for the military to learn about, and benefit from entertainment technologies, and enable their transfer into military systems. ICT will also work with creative talent from industry in order to adapt their concepts of story and character to increasing the degree of immersion experienced by participants in synthetic experiences, and to improving the utility of the outcomes of these experiences. In return, industry will leverage the DoD sponsored research being done by the Modeling and Simulation UARC. Creating a true synthesis of creativity and technology and of the capabilities of 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.

FY 1999 Accomplishments: Project not funded in FY 1999.

FY 2000 Planned Program: FY 2000 project work is supported by Project BH59.

- FY 2001 Planned Program:**
- 8199 - Support research center on networked, realistic simulation tools focused on incorporating entertainment industry methods and data into combat training devices.
 - 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.
 - Create advanced immersive environment utilizing sound, visual cues, motion and other sensory elements.
- Total 8199