Exhibit R-2, PB 2010 Army RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
Total Program Element	109.520	130.291	96.144						Continuing	Continuing
F17: NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE	.000	.000	4.980						Continuing	Continuing
H04: HBCU/MI CENTERS - TRADOC BATTLELABS	2.570	2.723	2.746						Continuing	Continuing
H05: INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6.925	11.033	8.588						Continuing	Continuing
H09: ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2.962	4.365	4.543						Continuing	Continuing
H50: Network Sciences CTA	6.794	7.175	3.187						Continuing	Continuing
H53: Army High Performance Computing Research Center	1.919	3.485	3.444						Continuing	Continuing
H54: Micro-Autonomous Systems Technology (MAST) CTA	5.793	7.635	8.056						Continuing	Continuing
H56: Adv Decision Arch Collab Tech Alliance (CTA)	5.362	5.938	.000						Continuing	Continuing
H59: UNIV CENTERS OF EXCEL	3.879	5.202	5.535						Continuing	Continuing
	5.814	6.134	6.437						Continuing	Continuing

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APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					
H62: Institude for Advanced Technology (IAT)										
H64: MATERIALS CENTER	2.653	2.813	2.838						Continuing	Continuing
H73: Automotive Research Center (ARC)	2.798	2.940	2.941						Continuing	Continuing
J08: INSTITUTE FOR CREATIVE TECHNOLOGY	7.230	7.673	7.791						Continuing	Continuing
J12: Institute for Soldier Nanotechnology (ISN)	9.562	10.063	10.265						Continuing	Continuing
J13: UNIVERSITY AND INDUSTRY INITIATIVES (CA)	25.339	30.001	.000						Continuing	Continuing
J14: ECYBERMISSION	4.706	5.228	5.273						Continuing	Continuing
J15: NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	6.941	7.889	8.146						Continuing	Continuing
J16: NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE	2.876	2.985	.000						Continuing	Continuing
J17: VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE	1.918	2.026	2.044						Continuing	Continuing
J19: Automotive Research Center (ARC) Initiatives (CA)	3.479	.000	.000						Continuing	Continuing

Exhibit R-2, PB 2010 Army RDT&E Budget Item Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research					R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					
J22: NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER	.000	4.983	9.330						Continuing	Continuing

A. Mission Description and Budget Item Justification

This program element (PE) supports future force capabilities by providing research that supports enabling technologies for future force capabilities. Broadly, the work in this project falls into three categories: Collaborative Technology Alliances (CTAs), University Centers of Excellence (COE), and paradigm-shifting centers - University-Affiliated Research Centers (UARCs). The Army formed CTAs to leverage large investments by the commercial sector in basic research areas that are of great interest to the Army. CTAs involve partnerships between industry, academia, and the Army Research Laboratory (ARL) to incorporate the practicality of industry, the expansion of the boundaries of knowledge from universities, and Army scientist to shape, mature, and transition technology. CTAs have been competitively established in the areas of Advanced Sensors, Advanced Decision Architecture, Communications and Networks, Power and Energy, and Robotics. Work done under the Advanced Sensors CTA and the Power and Energy CTA was redirected into the Micro Autonomous Systems Technology (MAST) CTA in FY08. This PE includes the Army's COE, which focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs, such as rotorcraft, automotive, microelectronics, materials, and information sciences. COEs couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in information sciences, materials science, electronics, automotive, and rotary wing technology. Also included is eCYBERMISSION, the Army's national web-based competition to stimulate interest in science, math, and technology among middle and high school students. This PE also includes the four Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. The Institute of Advanced Technology funds basic research in electromagnetic and hypervelocity physics. The Institute for Soldier Nanotechnologies focuses on Soldier protection by emphasizing revolutionary materials research for advanced Soldier protection and survivability. The Institute for Collaborative Biotechnologies, focusing on enabling network centric-technologies, will broaden the Army's use of biotechnology for the development of bio-inspired materials, sensors, and information processing. The Institute for Creative Technologies is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and simulation. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence address critical research areas for Army Transformation.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this PE is managed by: the Army Research Lab (ARL) in Adelphi, MD; the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) in Warren, MI; the Simulation and Training Technology Center (STTC) in Orlando, FL; and the US Army Research Institute for the Behavioral and Social Sciences (ARI) in Arlington, VA.

Exhibit R-2, PB 2010 Army RDT&E Budget Item Justification	DATE: May 2009
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B. Program Change Summary ($ in Millions)

	FY 2008	FY 2009	FY 2010	FY 2011
Previous President's Budget	110.100	105.622	101.814	
Current BES/President's Budget	109.520	130.291	96.144	
Total Adjustments	-.580	24.669	-5.670	
Congressional Program Reductions	.000	-5.431		
Congressional Rescissions	.000	.000		
Total Congressional Increases	.000	30.100		
Total Reprogrammings	2.496	.000		
SBIR/STTR Transfer	-3.076	.000		

Change Summary Explanation

FY09 funding increase is due to congressional adds.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER F17	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
F17: NEUROERGONOMICS COLLABORATIVE TECHNOLOGY ALLIANCE	.000	.000	4.980						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Neuroergonomics Collaborative Technology Alliance (CTA), a competitively selected industry and university consortium, to leverage world-class research in support of future force and Army transformation needs. Escalating levels of complexity and uncertainty on the current and future battlefield present conditions which have never existed before now. Solution strategies and approaches must be developed or tailored. The emerging field of neuroergonomics, which seeks to understand the brain at work and to leverage that understanding to optimize system design, offers tremendous potential for providing the solutions needed to meet the needs of Army forces in the future. This CTA addresses the solution strategies and approaches needed to design systems to fully exploit investments in revolutionary technological advances in areas such as robotics, microelectronics, and computer and network information systems. These technologies present significant opportunities to enhance Army mission capabilities, but impose significant burdens on the human brain, which will ultimately limit Soldier-system effectiveness, sustainability, and survivability. The technical barriers associated with this project include: immature knowledge base to guide the neuroergonomic approach to human-system integration; inadequate capabilities to sense and extract information about brain activity in dynamic, operational environments; lack of valid measures to robustly and uniquely characterize operationally-relevant cognitive performance; lack of techniques for integrating advanced understandings of brain activity into systems designs, including real-time use of measures of cognitive behavior as system inputs and the capability to account for individual differences in maximizing Soldier-system performance. This CTA conducts an intensive and accelerated program to formulate, validate, and transition basic research findings through multi-dimensional approaches (e.g., genetics, computational modeling, neuroimaging, and performance) focused in three areas: maximal effectiveness of information transfer between the system and Soldier; identification of mental states, traits, and experiences that impact commander-level decisions; individualized, real-time measurements and analysis of cognitive processing under operationally-relevant stressors. This Neuroergonomics Collaborative Technology Alliance will begin in FY10.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

Funding was restructured from the Advanced Decision Architecture Collaborative Technology Alliance in PE 0601104A, project H56.

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Maximize effectiveness of information transfer between system and Soldier. In FY10, will investigate perceptual-motor interactions, including those between sensory-perceptual channels and motor systems; will explore the complex effects of information quality and quantity on physical and cognitive performance.	.000	.000	1.429	
Identify mental states, traits, and experiences that impact commander-level decisions. In FY10, will explore the neural representations of command-level decision making through identification of information representation; will examine factors leading to successful or faulty decisions, including biases, heuristics, implicit versus explicit knowledge, context and stressor.	.000	.000	1.446	
Individualize real-time measurement and analysis of cognitive processing under operationally-relevant stressors. In FY10, will identify key individual differences and stressors and investigate their impact on neural processing and cognitive performance; will explore the appropriate neuro-sensing approaches for assessment in operational environments.	.000	.000	2.105	
Total	.000	.000	4.980	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H04	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H04: HBCU/MI CENTERS - TRADOC BATTLELABS	2.570	2.723	2.746						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project transitions advances resulting from basic research to technology demonstration as rapidly as possible. Centers of Excellence have proven effective in harnessing a critical mass of university research expertise and focusing their intellectual capabilities on Army unique science and technology problems. This project takes that approach one step further by partnering the university researchers at Historically Black Colleges and Universities/Minority Institutions (HBCU/MI) with Army Training and Doctrine Command (TRADOC) Battle Labs to gain first hand perspective of the end-user's needs. Through these centers, the Army user begins the collaboration with university researchers from the outset of the research. These Centers of Excellence will join with Army and industrial partners to accelerate the transition from research phase to actual technology demonstration. In addition, these Centers of Excellence will recruit, educate, and train outstanding students and post doctoral researchers in science and technology areas relevant to Army Transformation. This project was previously funded in PE 0601104A, project H59 (University Centers of Excellence) and is being transferred into a distinct project for visibility and management.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work on this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
HBCU/MI Centers of Excellence for Battlefield Capability Enhancements: The centers are: Tuskegee University (Flexible Extremities Protection); NCA&T State University (Environmentally-stable Flexible Displays), and (Human-centric Command and Control Decision Making: predictive modeling of group situational awareness); Tennessee State University (Sensor Fusion); and Prairie View A&M University (Beyond-Line-of-Sight Lethality). In FY08, refined fabric designs with new testing strategies; validated sense-making models with test command groups; characterized semiconductor materials on flexible substrates for optical properties; showed use of multi-modal sensor network in urban terrain; refined wireless network protocols using simulation test bed. Additional significant accomplishments for FY08 included: synthesis of shear-thickening fluids; novel low-temperature growth of wide-band-gap GaAlAsN layers; development of Sensemaking Support Software; application of a novel cross-layer mobility support	2.570	2.646	2.746	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
resulting in 58% reduction in packet delay; and application of KV Transform Coding for a multi-path environment. FY09 culminates the Increment I program. In FY09, emphasize transitioning technologies to advanced/applied research. Collaborations with TRADOC Battle Labs will help accelerate technology transitions to the battlefield. Also in FY09, devise enhanced protection capability of final fabric designs; deliver deployable decision support programs for test command groups; design and fabricate hybrid semiconductor devices on flexible substrates and evaluate environmental stability; show full data-fusion for large-scale sensor networks; and show protocols for wireless sensor network. FY09 will also include initiation of the BCE Increment II program via topic selection and execution solicitation. In FY10, the HBCU/MI program is being re-competed. FY10 and FY11 plans will be defined post solicitation.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.077	.000	
Total	2.570	2.723	2.746	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H05	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H05: INSTITUTE FOR COLLABORATIVE BIOTECHNOLOGIES	6.925	11.033	8.588						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Army's Institute for Collaborative Biotechnologies (ICB), a University Affiliated Research Center led by the University of California-Santa Barbara, and two major supporting partners, the California Institute of Technology and the Massachusetts Institute of Technology. The ICB is the Army's primary conduit for leveraging biotechnology for: 1) advanced sensors; 2) new electronic, magnetic, and optical materials; and 3) information processing and bioinspired network analysis. The objective is to perform sustained multidisciplinary basic research supporting technology to provide the Army with biomolecular sensor platforms with unprecedented sensitivity, reliability, and durability; higher-order arrays of functional electronic and optoelectronic components capable of self-assembly and with multi-functions; and new biological means to process, integrate, and network information. These sensor platforms will incorporate proteomics (large scale study of proteins) technology, DNA sequence identification and detection tools, and the capability for recognition of viral pathogens. A second ICB objective is to educate and train outstanding students and post doctoral researchers in revolutionary areas of science to support Army Transformation. The ICB has many industrial partners, such as IBM and SAIC, and has strong collaborations with Argonne, Lawrence Berkley, Lawrence Livermore, Los Alamos, Oak Ridge, and Sandia National Laboratories, the Army's Institute for Soldier Nanotechnologies, the Institute for Creative Technologies, and Army Medical Research and Materiel Command (MRMC) laboratories.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Neuroscience: In FY09, research the emerging area of cognitive neuroscience, examining functional magnetic resonance imaging (fMRI) techniques coupled with electroencephalogram (EEG) results to increase understanding of fast decision making processes, memory retrieval, categorization, aptitudes for specific tasks and other brain functions. Investigate the use of other potential brain imaging techniques such as positron emission tomography (PET) and magnetoencephalography (MEG) to enhance understanding of brain function. Study and characterize individual differences in brain strategy. Research methods within neuroscience to provide optimal control for human/machine interfaces.	.000	3.003	1.230	

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APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H05

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will extend brain mapping to evaluate Army personnel with field experience for decision making, executive function and memory performance. Will partner with the Institute for Creative Technologies (ICT) to design, develop and implement standard virtual human-agent interaction contexts and scenarios in order to create standard test-bed scenarios for determining the human interactional efficacy of virtual human agents.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.308	.000	
Institute for Collaborative Biotechnologies: In FY08, established biologically based development path toward flexible high-efficiency batteries and new high-efficiency solar energy materials; provided a means to greatly enhance sensitivity in detection of viral pathogens; enabled electronic detection of DNA. In FY09, define a biocatalytically derived route to low-cost fuel and fuel-cell feedstock using microbes to produce fuels directly from biomass including novel cellulose enzymes to break down biomass; characterize and further develop microfluidic chip-based bioseparation technology; research new bio-inspired nanoparticles to yield optimal signal enhancement in microfluidic channel biomolecular sensors; investigate bio-templated ultra-lightweight batteries for micro-unmanned air vehicles. In FY10, will translate discoveries of the mechanisms by which lightweight biological composites dissipate energy and resist fracture into new approaches for blast-resistant materials and structures; will develop a blood-based assay for specific markers of 9 traumatic brain injuries (TBI); will develop decentralized bio-inspired algorithms for information processing and control by networks of autonomous agents in the presence of unexpected and unfriendly environments.	6.925	7.722	7.358	
Total	6.925	11.033	8.588	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

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APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H09	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H09: ROBOTICS COLLABORATIVE TECH ALLIANCE (CTA)	2.962	4.365	4.543						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a collaborative effort between the competitively selected industry and university consortium, the Robotics Collaborative Technology Alliance (CTA), and the Army Research Laboratory (ARL) for the purpose of leveraging world-class research in support of the future force and Army transformation needs. This project conducts basic research in areas that will expand the capabilities of intelligent mobile robotic systems for military applications with a focus on enhanced, innate intelligence, ultimately approaching that of a dog or other intelligent animal, to permit unmanned systems to function as productive members of a military team. Research is conducted in machine perception, including the exploration of sensor phenomenology, and the investigation of basic machine vision algorithms enabling future unmanned systems to more fully understand their local environment for enhanced mobility and tactical performance; intelligent control, including the advancement of artificial intelligence techniques for robot behaviors permitting future systems to autonomously adapt, and alter their behavior to dynamic tactical situations; and understanding the interaction of humans with machines focusing upon intuitive control by Soldiers that minimizes cognitive burden. The program will conduct both analytic and validation studies. Research products will be transitioned to the companion applied technology program, PE 0602618A, project H03, for integration and evaluation in test bed platforms and will form the scientific basis for new technology that will migrate into Army and Joint advanced and system development programs to provide highly capable unmanned systems for the future force.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Autonomous systems: Explore opportunities enabling revolutionary, autonomous, highly mobile systems for the future force. Research focuses on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations. In FY08, explored methodologies to permit unmanned systems to perform as co-combatants; examined real-time evaluation of possible adversarial responses, each possessing differing levels of likelihood based upon considerations such as terrain and tactical environment that includes friendly and non-combatant forces; expanded the range of perception algorithms for classification of structures found in the urban environment and explored methods to fuse detection from individual sensor modalities and/or algorithmic approaches.	2.962	4.242	4.543	

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B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY09, focus on techniques for fusion of the key perception algorithms to enable an unmanned vehicle to maneuver with a high degree of autonomy in urban environments; examine perception based navigation, especially for indoor and GPS denied environments; explore approaches for autonomous activity recognition; evaluate the performance of both perception and behavior algorithms in varied tactical environments. Conduct research to explore human robot interaction, dynamic scene understanding and contextual situational awareness. In FY10, will expand research to include a more complete understanding of control and interaction between humans and robots through non-verbal cues and natural language; autonomous understanding and retention of salient features and activities to promote learning and adaptation to dynamic, unknown environments; and novel structural and control techniques to enable more dexterous manipulation.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.123	.000	
Total	2.962	4.365	4.543	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H50	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H50: Network Sciences CTA	6.794	7.175	3.187						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a competitively selected university and industry consortium, the Communication and Networks Collaborative Technology Alliance (CTA) that was formed to leverage commercial research investments to provide solutions for the Army's requirements for robust, survivable, and highly mobile wireless communications networks. The future force has a requirement for state-of-the-art wireless mobile communications networks for command-on-the-move. The objectives include designing communications systems for survivable wireless mobile networks; providing signal processing for communications-on-the-move; secure jam-resistant communications; and tactical information protection. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, as well as the use of state-of-the-art facilities and equipment at the participating organizations. This CTA accelerates the transition of communications and networks technology to PE 0602783A (Computer and Software Technology). The results of this work will significantly affect future force communications and networking formulation efforts. A portion of this program will be shifted to in-house efforts funded from 61102 H48 beginning in FY10. The remainder of the program will be re-focused in FY10 on the Network Sciences CTA to more strongly emphasize Information Assurance and Network Science as defined by the December 2005 National Research Council Board on Army Science and Technology study. Since the International Technology Alliance on Network and Information Sciences (PE 0601104A/project J15) was established in 2006, joint planning of the research programs prevents redundancies and leverages accomplishments from both programs.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Survivable Wireless Mobile Networks: This work performs research in dynamically self-configuring wireless network technologies that enables secure, scaleable, energy-efficient, and reliable communications for command on-the-move. Devise techniques to model, design, analyze, predict, and control the performance of mobile ad hoc networks. In FY08, devised formal models, abstractions, metrics, and validation techniques for understanding the behavior of large scale military mobile ad hoc networks. Designed techniques that combine social networking and network structure control functions in real-time to dramatically increase the level of resource utilization in keeping with the stated intentions (outcomes) of a particular military objective.	2.633	2.717	.000	

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APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers			PROJECT NUMBER H50	
B. Accomplishments/Planned Program ($ in Millions)		**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
In FY09, design networking techniques for sensing the networking operating environment, identifying the best networking functional components, and dynamically composing protocols for superior performance.					
Small Business Innovative Research/Small Business Technology Transfer Programs		.000	.200	.000	
Signal Processing for Communication-on-the-Move: This effort performs research in signal processing techniques to enable reliable low-power multimedia communications among highly mobile users under adverse wireless conditions. In FY08, designed and validated multi-input, multi-output, multi-carrier waveforms that exploit non-contiguous spectrum during mobile operations. In FY09, design optimal channel-adaptive distributed multiple access techniques to provide high capacity, interference-robust, multiple access networks for communications-on-the-move.		1.524	1.600	.000	
Secure Jam-Resistant Communication: This effort performs research on secure, jam-resistant, multi-user communications effective in noisy and cluttered and hostile wireless environments enabling low probability of detection/intercept. In FY08, devised low power adaptive medium access control algorithms that are energy-efficient and support duty-cycling to extend the life of sensor networks. In FY09, design signal separation techniques to mitigate packet collisions and improve signal detection for improved network performance.		1.085	1.021	.000	
Tactical Information Protection: This work performs research in scalable, efficient, adaptive, and secure information protection for very resource-constrained and highly mobile ad hoc networks. In FY08, designed and evaluated formal methods-based protocol specification intrusion detection techniques on mobile adhoc networking protocols. In FY09, design resilient clustering algorithms to provide a dynamic detection hierarchy to support detection and localization of attackers under mobile conditions.		1.552	1.637	.000	
Network Sciences Collaborative Technology Alliance (NS CTA): Beginning in FY10, this new CTA will focus on two new research areas: Information Networks and Social/Cognitive Networks; and will build upon successes of the Communications & Networks CTA for Communications Networks and Integration. The vision for the NS CTA is to develop a fundamental understanding of the ways that information, social/cognitive, and communications networks can		.000	.000	3.187	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H50

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
be designed, composed, and controlled to dramatically increase mission effectiveness and ultimately enable humans to effectively exploit information for timely decision-making. Information Networks research will develop the fundamental understanding of autonomous network activities and its linkage to the physical & human domains as related to human decision making within the networked command & control (C2) structure. Social/Cognitive Networks research will develop the fundamental understanding of the interplay of the various aspects of the social & cognitive networks with information & communications. Communications Networks research will develop the foundational techniques to model, analyze, predict, and control the behavior of secure tactical communication networks as an enabler for information and C2 networks. Integration will focus on achieving an integrated Information Networks, Social/Cognitive Networks, Communications Networks research program that significantly enhances the fundamental understanding of the underlying science of networks. In FY10, will establish the Network Sciences CTA in support of the Network Science & Technology Research Center. Research will include modeling to understand network centric organizations & will develop mobile ad hoc network simulation & emulation technologies to evaluate networks in organizations.				
Total	6.794	7.175	3.187	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H53	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H53: Army High Performance Computing Research Center	1.919	3.485	3.444						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports critical research at the Army High Performance Computing Research Center (AHPCRC). Research at the AHPCRC is focused on the Lightweight Combat Systems Survivability, computational nano- and bio-sciences, computational battlefield network and information sciences including evaluating materials suitable for armor/anti-armor and sensor applications, defense from chemical and biological agents, and associated enabling technologies requiring computationally intensive algorithms in the areas of combat systems survivability, battlefield network sciences, chemical and biological defense, nanoscience and nanomechanics, and computational information sciences, scientific visualization enabling technologies that support the future force transition path. This project also supports the Robotics Collaborative Technology Alliance which explores new opportunities to enable revolutionary autonomous mobility of unmanned systems for the Future Force. This research is an integral part of the larger Army Robotics Program and feeds technology into PE 0602618A, project H03 (Robotics Technology). The project will also address research focusing on unmanned systems operating as a team with human supervisors and displaying a high degree of adaptability to dynamic environmental and tactical situations.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Basic Research Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.098	.000	
AHPCRC: In FY08, explored new interdisciplinary methods to evaluate lightweight fabric structure systems, developed the Flexible Architecture Research Machine to accelerate architecture and algorithmic research on novel parallel models and facilitated evaluations on heterogeneous systems that combine central processing units (CPU), graphical processing units (GPU), and field programmable gate arrays (FPGA); investigated and planned new computational approaches to analyze very large-scale networks for battlefield applications.	1.919	3.387	3.444	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H53

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY09, implement interdisciplinary methods to evaluate lightweight fabric structure systems; investigate computational approaches to analyze very large-scale networks for mobile network applications; explore advanced simulations to develop new materials for military vehicles and equipment, improve wireless battlefield communication, advance detection of chem/bio attacks and stimulate innovations in supercomputing; design a common infrastructure model for a wide class of interdisciplinary applications; explore new scalable programming models for emerging multi-core computing architectures. In FY10, will enhance lightweight fabric structure systems; enhance innovative scalable algorithms to analyze very large-scale complex mobile network simulation applications; develop new scalable multi-scale computational approaches for micro-systems design, implement computational bio- and nano-science scalable algorithms.				
Total	1.919	3.485	3.444	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H54	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H54: Micro-Autonomous Systems Technology (MAST) CTA	5.793	7.635	8.056						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports the Micro Autonomous Systems and Technology (MAST) Collaborative Technology Alliance (CTA), a competitively selected industry-university consortium which leverages world-class research necessary to address future force and Army Transformation needs. The CTA links a broad range of government technology agencies, as well as industrial and academic partners with the Army Research Laboratory (ARL). The MAST CTA focuses on innovative research in four main technical areas related to the coherent and collaborative operation of multiple micro autonomous platforms: microsystem mechanics, processing for autonomous operation, microelectronics, and platform integration. Payoff to the warfighter will be advanced technologies to support future force requirements in situational awareness. The CTA facilitates the exchange of people among the collaborating organizations to provide cross-organizational perspectives on basic research challenges, and to make available to the Alliance state-of-the-art facilities and equipment at the participating organizations.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.214	.000	
MAST: In FY08, performers were involved in and supported the Micro Air Vehicles 08 Demonstration in Agra, India. Performers developed plans for collaborative capabilities evaluations to investigate autonomous operation of air and ground microplatforms. In FY09, performers investigate key technologies and techniques for autonomous navigation of microplatforms, low power and low bandwidth communication for collaborative behavior, low power sensing, low power processing, low Reynolds numbers aeromechanics, and ambulation of micro-ground platforms. Perform a capabilities analysis of microsystems and of a system of microsystems as an aid in microsystem design. Develop tools for microsystem design.	5.793	7.421	8.056	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H54

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will define information flow architecture for a candidate robotic platform, implement small group collaborative tactical behaviors, investigate tradeoffs in distributed processing and communications for perception and navigation, and incorporate sensing and processing into energy efficient architectures. Will investigate novel concepts and develop initial models and prototypes in microelectronics for navigation, communication, information processing, and energy harvesting and sensing for micro-autonomous systems.				
Total	5.793	7.635	8.056	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H56	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H56: Adv Decision Arch Collab Tech Alliance (CTA)	5.362	5.938	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a collaborative effort between the competitively selected industry and university consortium, the Advanced Decision Architecture (ADA) Collaborative Technology Alliance (CTA), and the Army Research Laboratory (ARL). These technologies will provide for real-time situational awareness (SA), distributed commander-staff-subordinate collaboration and planning, and execution monitoring in high-tempo, high-stress battlefield environments at speeds that permit operating inside the enemy's decision cycle. This project will conduct an intensive and accelerated program to formulate, validate, and transition basic research to provide solutions for the many requirements for understanding SA, expert decision making, team collaboration, the ability to display information in a way that facilitates knowledge assimilation on the battlefield, and visualization and decision support architectures. Research is conducted in four areas: cognitive process modeling and measurement, analytical tools for collaborative planning and execution, user adaptable interfaces, and auto-adaptive information presentation. The technical barriers associated with this project are: human-computer interface in an information rich environment; display configuration; real time visualization; information presentation; and control coupling This CTA accelerates the transition of advanced decision architecture technology to PE 0602716A (Human Factors Engineering Technology) and PE 0602783A (Computer and Software Technology). The ADA CTA ends in FY09 and this program will be re-focused to emphasize individual Soldier, squad, and platoon level tools and information and knowledge fusion. Research partnerships will be established with the Institute for Creative Technology (PE 0601104A, project J08) and the Flexible Display Center (PE 0602705A, project H17).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

Beginning in FY10 funding will be transferred from the Advanced Decision Architecture Collaborative Technology Alliance to PE 0601104A, project F17, for the Neuroergonomics CTA.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Modeling and measurements of cognitive processes of Army commanders and staffs (decision makers): In FY08, extended and improved the system for the automatic generation of Cognitive Models of Situation Awareness (CMSA). In FY09, validate software agent architecture for enhancing the performance of human teams using advanced artificial intelligence techniques including context-sensitive information sharing, automated development of shared situation	1.320	1.357	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H56

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
awareness and recognition-primed decision support, a naturalistic decision making (NDM) technique used by experienced decision makers to quickly scan an array of displays or information and "instantly" know the best course of action to pursue.				
Auto-adaptive information presentation: Investigate how to make autonomous machines team players with their human partners or supervisors in warfighting operations. In FY08, tested an agile computing infrastructure integrated with agent-based policy and domain services to enable efficient use of scarce computing and network resources and coordination of human-robot teams in realistic Army future combat system scenarios. In FY09, devise a distributed system for real-time target tracking of multiple entities in an area under surveillance exploiting a reasoning-based approach to include diagrammatic reasoning, domain knowledge, and algorithmic solutions.	1.214	1.271	.000	
User-adaptive interfaces: Explore ideas, frameworks, and technologies that assist the Soldier in understanding, problem solving, planning, and decision-making. In FY08, investigated interface technologies to fuse and visualize sensed information (persistent surveillance) as relevant tactical events to improve Commander's real time situational awareness. In FY09, validate functional model of the capabilities of new sensor/network technologies as they could contribute to perceptual awareness including concepts such as trust.	1.620	1.843	.000	
Analytical tools for collaborative planning and execution: Create tools that effectively support teams in coordinating and collaborating to achieve mission success across the spectrum of operations. In FY08, provided tools and techniques to foster better adaptive learning, expert decision-making, and teamwork. In FY09, devise theoretical foundations and empirical findings on the design of collaborative systems to make Soldiers more effective as sensors in the Brigade and Below Battlefield Awareness Network environment and to enhance Soldier-automation collaboration.	1.208	1.301	.000	
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.166	.000	
Total	5.362	5.938	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H56

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H59	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H59: UNIV CENTERS OF EXCEL	3.879	5.202	5.535						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the International Technology Centers (ITCs), the Foreign Technology (and Science) Assessment Support (FTAS) program, and a Basic Research Center for Network Science located at the United States Military Academy. The nine ITCs located in Australia, the United Kingdom, Canada, France, Germany, Japan, Chile, Argentina, and Singapore support the Army's goals of providing the best technology in the world to our Warfighters by leveraging the Science and Technology (S&T) investments of our international partners. The ITCs perform identification and evaluation of international technology programs to assess their potential impact on the Army's S&T investment strategy. ITC "technology finds" are submitted as technology information papers (TIPs) to various Army S&T customers including the Army Research Laboratory (ARL), the Research Development and Engineering Centers (RDECs) of the Research Development and Engineering Command (RDECOM), RDECOM technology Integrated Process Teams, the Rapid Equipping Force (REF), and others for evaluation and consideration for further research and development. The ITC TIPs also serve as input into the international section of the Army S&T Master Plan. The FTAS program builds upon the TIPs submitted by the ITCs. In some cases the TIP is truly unique and may well meet an Army requirement or potentially support ongoing Army S&T investments. In such cases, the FTAS program can provide initial resources (seed money) to fund basic research in these technology areas identified by the TIPs as having potential relevance to the Army's S&T plan. The research will provide information useful in making an early assessment of the technology's potential contributions to the Army's S&T strategy.

In FY09, this project funds a Basic Research Center in Network Science at the United States Military Academy (USMA) to further the theoretical understanding and develop the engineering design principles leading to the development of a science about networks and how they operate. Work in this project is coordinated with and complementary to the work at the Network Science and Technology Research Center funded under PE 0601104A/project J22.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by RDECOM HQ and the Army Research Laboratory (ARL)in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.124	.000	
International Technology Centers (ITC)/Foreign Technology (and Science) Assessment Support (FTAS): Prior to FY08, the ITC and FTAS efforts were funded in PE 0601102A, project H57.	3.879	4.077	4.547	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H59

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY09, the ITCs will improve upon execution of their international technology search process to focus on critical technology capability gaps based upon direct face-to-face feedback with the RDECOM Commanding General and RDECOM center and lab directors. In FY10, the ITCs will work to make progress in several main areas of foreign technology identification and support to international collaboration including: unmanned systems, Counter-Improvised Explosive Devices, active protection, and power and energy. FTAS Program: During FY08, all seven FY06 FTAS projects were completed and have shown to have successfully advanced technology programs for ARL, CERDEC and MRMC. We will continue to solicit projects and build on the success of the FTAS Program. In FY09, four FY07 FTAS projects will be ongoing for ARL and CERDEC. In FY10, eight FY08 FTAS projects will be completed.				
Basic Research Center in Network Science at the United States Military Academy (USMA): In FY09, to further the theoretical understanding and develop the engineering design principles leading to the development of a science about networks. The Center is prepared to make progress in several main areas of study including: dynamics, spatial location, and information propagation in networks, through better understanding of the relationship between the architecture of a network and its function. Will leverage science to develop the backbone of the Army's future fighting force. Develop fundamental knowledge to support the Army's Basic Research Program in Network Science and enhance the education of the Corps of Cadets in these matters. Perform modeling and analysis of very large networks using tools, abstractions, and approximations that allow reasoning about large-scale networks, as well as techniques for modeling networks characterized by noisy and incomplete data. In FY10, will contribute to and facilitate the Army transformation to network-centric operations (NCO), and promote the professional development of the United States Military Academy (USMA) faculty in the physical, mathematical, engineering, biological, behavioral, and social sciences relevant to network science. The goal will be the creation of tools that allow the design and synthesis of networks to obtain desired properties, and, to increase the level of rigor and mathematical structure in network science.	.000	1.001	.988	
Total	3.879	5.202	5.535	

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H59

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H62	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H62: Institude for Advanced Technology (IAT)	5.814	6.134	6.437						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds a University Affiliated Research Center, the Institute for Advanced Technology (IAT) at the University of Texas, to conduct basic research in electromechanics and hypervelocity physics in support of electromagnetic (EM) guns. Of particular interest are EM power, EM launchers, EM integrated launch packages, and hypervelocity terminal ballistics. Advanced computational models are devised and/or applied to solve complex problems in each of these areas. In keeping with the Army EM Armaments Program strategy, highest emphasis has been placed on advancing the state-of-the-art in pulsed power. The sponsored research provides the scientific underpinning for EM gun pulsed power including switching; addresses technical barriers associated with EM gun launcher life; and researches advanced technologies for hypervelocity target defeat. The sum of these focused efforts serves as a catalyst for technological innovation and provides crucial support to the Army technology base for advanced weapon systems development with applications for anti-armor, artillery, air defense, and the future force.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is monitored and guided by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Pulsed Power: In FY08, modeled and evaluated validated potential alternate pulsed power systems. In FY09, provide technology for large-scale solid state converters. In FY10, will analyze methods to increase energy density of pulsed alternators. Will evaluate the design options for moderate-sized advanced pulsed power system tests of new concepts, especially including battery-inductor arrangements, for Army EM gun applications to define their operating system characteristics.	2.496	2.568	3.050	
Launch: In FY08, examined advanced materials for launcher components. In FY09, examine thermal management of EM launchers.	1.518	1.647	1.673	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H62

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will investigate techniques to increase rail life and show higher muzzle energy railgun operation with integrated launch packages that contain realistic flight bodies. Will update theories for elevated temperature railgun operation based on experiments and simulations.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.171	.000	
Electromagnetic Lethality: In FY08, measured material properties under short duration electrodynamic and structural loads; examined the target interaction physics of reactive material during hypervelocity impact. In FY09, complete and validate numerical model of armature physics including gouging and transition; will examine coupled high density/reactive materials during target interaction at hypervelocity. In FY10, will study target effects of novel penetrator concepts for precision fires and other high velocity impact conditions.	1.800	1.748	1.714	
Total	5.814	6.134	6.437	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H64	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H64: MATERIALS CENTER	2.653	2.813	2.838						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project concentrates scientific resources on materials research for lightweight vehicle protection and is executed through Cooperative Research Agreements (CRAs). The effort funds collaborative research in three Materials Science and Engineering Research Areas (MSERAs): (1) Composite Materials Research; (2) Advanced Metals and Ceramics Research; and (3) Polymer Materials Research. Each MSERA pursues thematic research thrusts that address topics pertinent to lightweight vehicle protection and that are aligned with the Army's strategic materials research vision enabling long-term synergistic collaboration between the Army Research Laboratory (ARL) scientists and university researchers. The Materials Cooperative Research Agreements provide for mutual exchange of personnel and sharing of research facilities with the University of Delaware, Johns Hopkins University, Rutgers University, Drexel University, and Virginia Polytechnic Institute and State University. Lightweight, multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymer, and hybrid systems are emphasized. This project is closely coordinated with ARL in-house materials research projects (PE 0601102A, project H42) to promote effective and efficient transfer of fundamental scientific research addressing lightweight protective material requirements for the future force. The center accelerates the transition of technology to PE 0602105A (Materials Technology).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Materials Research for vehicle protection: In FY08, validated models for multifunctional composite attributes and showed multifunctional capabilities in single composite material; devised schemes for synthesis of protective polymers with enhanced energy absorption; identified key materials parameters for the improved performance of metal matrix nanocomposite materials. In FY09, utilize multifunctional composites to validate potential composite weight reductions; characterize and quantify performance of newly synthesized energy absorbing polymers; and validate effects of armor ceramic processing and materials selection on mechanical properties. In FY10, will examine high rate deformation mechanisms for ceramics and other advanced materials; examine the role of defects; characterize materials using advanced microscopy methods; and develop microstructure-processing relationships for severely plastically deformed materials.	2.653	2.734	2.838	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H64

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research	.000	.079	.000	
Total	2.653	2.813	2.838	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER H73	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
H73: Automotive Research Center (ARC)	2.798	2.940	2.941						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project significantly enhances the Army's transformation to the future force by the application of novel, high payoff technologies that can be integrated into Army ground platforms. The Center of Excellence for Automotive Research is part of the basic research component of the National Automotive Center (NAC), a business group within the US 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 technology for potential application in Army vehicle systems through ongoing and new programs in automotive research, resulting in significant cost savings and performance enhancing technological opportunities. The research performed in this project contributes to formulating and establishing the basic scientific and engineering principles for these technologies.

Efforts are fully coordinated and complementary to those performed by the NAC and TARDEC under PE 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, University of Wisconsin, Wayne State University, University of Alaska, University of Tennessee, and Clemson University. Key industry partners include all major US automotive manufacturers and suppliers. The Automotive Research Center (ARC) formulates and evaluates advanced automotive technologies and advances state-of-the-art modeling and simulation for the Army's future ground vehicle platforms.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed by TARDEC, Warren, MI.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Automotive Research Center (ARC): In FY08, performed unique advanced evaluation validation of optimized ground vehicle models to assure proper predictions relative to actual real-world conditions. In FY09, extend the applicability of the advanced automotive models to future Army ground vehicle requirements to address elevated temperatures, increased terrain severity, ultra-reliability and general new global embedded constraints. Perform new extended model validations of these broadened areas of Army ground vehicle automotive models, using advanced instrumentation and efficient state-of-the-art data analysis procedures.	2.798	2.862	2.941	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER H73

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will explore and develop mobility and propulsion models for unmanned ground vehicles; will develop more detailed vehicle thermal management models for hybrid electric tactical ground vehicles; and will study the feasibility of advanced materials for reducing Army ground vehicle weight while meeting survivability needs with a focus on improved fragmentation protection models.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.078	.000	
Total	2.798	2.940	2.941	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J08	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J08: INSTITUTE FOR CREATIVE TECHNOLOGY	7.230	7.673	7.791						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports simulation and training technology research at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California. The ICT was established to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, and distance learning. The ICT actively engages industry (multimedia, location-based simulation, interactive gaming) to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable entertainment technologies into military systems. The ICT also works with creative talent from the entertainment industry to adapt concepts of story and character to increase the degree of participant immersion in synthetic environments and to improve the realism and usefulness of these experiences. Creating a true synthesis of the creativity, technology, and capability of the industry and the research and development community is revolutionizing military training and mission rehearsal by making it more effective in terms of cost, time, range of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by performing basic research in modeling and simulation in accordance with the core competencies for the ICT University Affiliated Research Center (UARC).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Graphics and Sound: Research will improve computational techniques in graphics for achieving real-time photo-realistic rendering of physical and synthetic environments for training and simulations. Research into auditory aspects of immersion will provide the sound stimulus for increasing the realism for military training and simulation devices. In FY08, implemented hybrid three-dimensional audio system to create perception of auditory depth in mixed reality environments. Developed facial and body animation techniques that can capture a person and then re-light and re-animate him or her in new environments. In FY09, explore concepts for facial and body animation controlled by avatars in real time and investigate methods for development of virtual speakers in immersive environments. In FY10, will investigate technologies for near-photo real, life-like characters.	1.618	1.668	1.743	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J08

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Immersive Environments: Conduct basic research in immersive environments, to include virtual humans, three dimensional (3D) sound and visual media, to achieve more efficient and affordable training, modeling, and simulation solutions. Research includes investigation of techniques and methods to address the rapid development of synthetic environments that can be used for mission rehearsal and training of military operations. In FY08, created custom, multi-view, holograph-like display solutions. In FY09, investigate use of emerging technologies, such as wide-field head mounted displays and interactive soundscapes to create immersive environments. In FY10, will develop semi-automatic environment setup and alignment system that will allow rapid setup and configuration of immersive environments.	2.785	2.874	3.001	
Techniques and Human-virtual Human Interaction: In FY08, investigated techniques for appropriate modeling and social schema for avatar-based crowd behaviors. In FY09, assess adequacy of virtual human models against models of human behavior and use feedback to guide further research. Develop tools and techniques to speed creation and adaptation of virtual humans. In FY10, will investigate technologies allowing virtual humans to sense a person's gestures or facial expressions. Develop new virtual human cognitive architecture.	2.827	2.916	3.047	
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.215	.000	
Total	7.230	7.673	7.791	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J12	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J12: Institute for Soldier Nanotechnology (ISN)	9.562	10.063	10.265						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports sustained multidisciplinary nanotechnology research for the Soldier at the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN emphasizes revolutionary materials research for advanced Soldier protection and survivability. The ISN works in close collaboration with the Army Research Laboratory (ARL), the Army's Natick Soldier Center (NSC), and other Army Research Development and Engineering Command (RDECOM), as well as several major industrial partners including Raytheon and DuPont, in pursuit of its goals. The institute is designated as a University Affiliated Research Center (UARC) to support research to devise nanotechnology-based solutions for the Soldier. This research emphasizes revolutionary materials research toward an advanced uniform concept. The future uniform will integrate a wide range of functionality, including ballistic protection, responsive passive cooling and insulating, screening of chemical and biological agents, biomedical monitoring, performance enhancement, and extremities protection. The objective is to lighten the Soldier's load through system integration and multifunctional devices while increasing survivability. The new technologies will be compatible with other Soldier requirements, including Soldier performance, limited power generation, integrated sensors, communication and display technologies, weapons systems, and expected extremes of temperature, humidity, storage lifetimes, damage, and spoilage.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Lab (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Soldier Protection: Conduct research on Soldier Survivability and Protection and Nanosystems Integration. In FY08, investigated nanoengineered electronic devices for sensing. In FY09, explore chemical sensing based upon nanoelectronic building blocks; to improve the function of cell-based biosensors, switchable surfaces will be created to facilitate the patterned adhesion of various cell types allowing control of the spatial location of multiple cell types relative to each other; derivatization of hyperbranched poly-electrolytes designed for virucidal applications and the incorporation of these coatings onto surfaces using layer-by-layer techniques. In FY10, will develop strategy for electrical contacts for optoelectronic fibers; testing of virucidal coatings for activity and toxicity and elucidation of mechanism of virucidal action; demonstrate amplifying fluorescent chemical sensing devices with plasmon-mediated electrical transduction to produce resistivity-based chemical sensing.	2.316	2.485	2.618	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J12

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Nanomaterials: Conduct research in light-weight, multifunctional nanostructured fibers and materials. In FY08, devised a theory of a new type of "lasing" based on stimulated emission of hypersound in dual band gap (sound and light) composite polymeric structures; identified optimized structures for photon (light) flow control, and measured sound propagation in select materials. In FY09, use Monte Carlo simulation methods to optimize 2-D and 3-D structural configurations for simultaneous control of light and sound propagation and reflection; fabricate desired structures by interference lithography and test the resulting materials for the directional dependence of energy flow. Devise mechanically robust initiated chemical vapor deposition coatings fully compatible with electro-spun mats that provide high surface area and a diversity of substrate materials. In FY10, will prepare nanostructures with unique, controlled sizes and shapes for sensing light; continue development of microfluidic reactor for the synthesis of complex, engineered nanostructured quantum dots; engineering and functionalization of carbon nanotubes (CNTs) to enhance ability of CNTs to generate photocurrents following absorption in the infrared and visible spectra;, continue development of an acoustic fiber having acoustic wave detection and modulation capabilities.	2.378	2.485	2.598	
Blast Effects on Soldier: Conduct research in Battle Suit Medicine and Blast and Ballistic Protection. In FY08, conducted low rate mechanical testing of mechanical energy absorption for promising polymers. In FY09, explore relation of molecular structural features to resultant toughness, including high strain rate testing; development of polymeric nanostructures by synthesis of high molecular weight conducting polymers resulting in superior molecular actuation; determine critical biosensory signatures of inflammatory reaction for integration into multiplexed microfluidic sensing system; develop methodologies to quantitatively assess the mechanical properties of hard nanostructured biocomposites and to measure local property gradients and heterogeneity. In FY10, will develop models predicting transdermal transport in skin and investigate various transport pathways and mechanisms; design of nanosized micellar structures formed as a block copolymer thin film on surfaces and interfaces for non-invasive drug delivery; tethering of amplified fluorescent polymers for pre-symptomatic biosensing system via polymeric nanocoatings deposited by chemical vapor deposition; portable electro-microfluidic devices for real-time medical monitoring, modeling and simulation of the next-generation of "induced charge electro-osmosis" nanoscale fluid flow regimes; flexible armor based on grapheme chainmail structures.	4.868	4.811	5.049	
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.282	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J12

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Total	9.562	10.063	10.265	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J13	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J13: UNIVERSITY AND INDUSTRY INITIATIVES (CA)	25.339	30.001	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for University and Industry Initiatives.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Nanotubes Optimized for Lightweight Exceptional Strength Composite Materials	2.704	2.325	.000	
Electron Microprobe Research	1.449	.000	.000	
Visualization for Training and Simulation in Urban Terrains	1.082	1.162	.000	
Center for Information Assurance	.773	.775	.000	
National Network Security Test Bed	1.545	.000	.000	
Infotonics Research	2.318	.000	.000	
Florida Collaborative Development of Advanced Materials for Strategic Applications	.918	1.162	.000	
Integrated Systems in Sensing, Imaging and Communications	.773	.000	.000	
Nanosensor Stagegate Accelerator	1.600	1.163	.000	
Transparent Nanocomposite Armor	.290	.000	.000	
Center of Excellence In Industrial Metrology & 3D Imaging Research	1.546	.000	.000	
Development of Enabling Chemical Technologies for Power from Green Sources	1.546	1.162	.000	
Manufacturing and Industrial Technology Center	.967	.775	.000	
Nanoscale Biosensor Research	2.416	2.422	.000	
Research Support for Nanoscale Sciences and Technologies	.967	.000	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J13

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Detecting and Eradicating Corrosian in Army Vehicles	1.159	.000	.000	
MEMS Antenna for Wireless Comms/UAVs	2.319	2.325	.000	
Center for Education in Nanoscience and Nanotechnology	.000	.620	.000	
Modeling and Analysis of the Response of Structures	.967	.000	.000	
Novel Methods for Detecting and Inhibiting Corrosian	.000	1.318	.000	
Center for Nanoscale Bio-Sensors as a Defense Against Biological Threats to America	.000	.775	.000	
Academic Support and Research Compliance for Knowledge Gathering	.000	1.938	.000	
Large Area Monitoring Network (LAMNET)	.000	5.814	.000	
Western Hemisphere Security Analysis Center (WHSAC) (pending transfer to 643779)	.000	1.550	.000	
Ink-Based Desktop Electronic Material Technology (pending transfer to 622624)	.000	1.550	.000	
Norfolk State University Center for Modeling and Simulation	.000	2.325	.000	
SBIR/STTR	.000	.840	.000	
Total	25.339	30.001	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J14	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J14: ECYBERMISSION	4.706	5.228	5.273						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports eCYBERMISSION, a nation-wide, web-based, science, technology, engineering and mathematics (STEM) competition designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide. The project supports Army Transformation by providing a pool of technologically literate citizenry that potentially grow to become future Soldiers and civilians for the Army workforce of tomorrow.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, the Army Science and Technology Master Plan, the Department of Defense Basic Research Plan, and the President's initiative for education.

Work in this project is executed by the U. S. Army Research, Development and Engineering Command (RDECOM).

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
FY08: Completed a full-scale competition to all middle school (grades 6-8) and high school (9th grade) students across the country and Department of Defense Educational Activity (DoDEA) schools. Increased student and teacher participation. FY09: Sustain eCYBERMISSION and implement enhancements as necessary based on lessons learned from previous years. Seek to increase team participation. FY10: Will continue to seek increased participation from existing levels and to increase geographic diversity and will sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years.	4.706	5.081	5.273	
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.147	.000	
Total	4.706	5.228	5.273	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J14

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J15	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J15: NETWEORK SCIENCES INTERNATIONAL TECHNOLOGY ALLIANC	6.941	7.889	8.146						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project supports a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science research in the areas of network theory, system-of-systems security, sensor processing and delivery, and distributed coalition planning and decision making. The focus is on enhancing distributed, secure, and flexible decision-making to improve coalition operations, and developing the scientific foundations for complex and dynamic networked systems-of-systems to support the complex human, social, and technical interactions anticipated in future coalition operations. The US Army Research Laboratory (ARL) and the UK Ministry of Defense (MOD) established a jointly funded and managed US and UK consortium, to be known as an International Technology Alliance (ITA) on Network and Information Sciences in FY06. The goal is fundamental science breakthroughs to enable superior coalition operations. Emphasis is on integration of multiple technical disciplines in an international arena. This program supports the future force transition path of the Transformation Campaign Plan (TCP).

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) at Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	**FY 2008**	**FY 2009**	**FY 2010**	**FY 2011**
Network and information science basic research for US/UK coalition operations. In FY08, investigated mathematical frameworks to model the structure/behavior of wireless networks to establish theoretical limits on capacity, scalability, reliability, and energy-efficiency to understand the performance of command-and-control, sensor, and communication coalition networks. Designed protocols for automated policy negotiations and tools for refining high-level user-specified goals into low-level setting of components in coalition environments. Devised and validated analytical networked fusion architectures based on semantic information. In FY09, investigate models, theory, and algorithms for creating self-organizing wireless networks inspired by highly adaptive biological systems. Investigate cognitive and socio-cultural factors on coalition command processes and coalition networks to enhance situational awareness and decision-making. Establish and validate analytic frameworks, leading to tradeoffs between sensing, computing, communications, and actuation, for classes of wireless sensor networks.	6.941	7.668	8.146	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J15

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
In FY10, will devise efficient robust resource usage algorithms for operations without centralized control, and with inaccurate knowledge of operating conditions for enhanced network capabilities. Investigate trust models to ensure distributed sensor data fusion under uncertainty. Devise agent reasoning models and agent interaction models & algorithms to allow for effective agent support for human ad hoc teams in time stressed environments.				
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.221	.000	
Total	6.941	7.889	8.146	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J16	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J16: NANOTECHNOLOGY AND MICROELECTRONICS INSTITUTE	2.876	2.985	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project conducts basic research in nano and micro technologies to improve the performance and effectiveness of portable electronic equipment for the warfighter. This will be accomplished by reducing power and weight while increasing real-time interactivity of vital information content between the warfighters and their environment. The Center for Nanotechnology and Microelectronics (CNAM) is a university research effort focusing on the development and application of nanotechnology that can be integrated with microelectronic systems while not duplicating existing nanoelectronics research programs. The objective is to accelerate the deployment of nanotechnology for military applications by focusing on applications where nanotechnology complements rather then replaces microelectronics. The research program will concentrate on four technology areas focused on resolving key issues associated with military applications of microelectronics and power electronics. Research thrusts include: 1) Thermal Management - the removal of heat from electronics and power electronics is the primary limit on the performance of small devices. Nanotechnology may improve the performance of thermal management systems by enhancing the cooling properties of materials, interfaces, and fluids for microelectronics; 2) Hybrid nano/micro structures and devices - bottom-up self-assembly of nanoscale components onto/into microelectronic platforms can lead to electronic components that integrate nanoscale optical interconnects, produce significantly less waste heat, and integrate on-board sensing; 3) Nanotechnology-enhanced transparent electronic materials - transparent materials can be used for microelectronics, increasing the designers flexibility in integrating microelectronics into other systems; 4) Active Cooling - nanotechnology-based active cooling technology such as high efficiency thermoelectric coolers and nano-enhanced adsorption/ desorption cooling can, in theory, cool microelectronics to temperatures below ambient or even to cryogenic temperatures, thus improving performance.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Army Research Laboratory (ARL) in Adelphi, MD.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.084	.000	
Research thrusts include thermal management, hybrid nano/microstructures and devices, nanotechnology-enhanced transparent electronic materials, and active cooling for improved portable warfighter electronic equipment. In FY08, researched specialized thermal management techniques to provide improved cooling of Army systems through the	2.876	2.901	.000	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J16

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
fabrication of materials with superior thermal conductivity and functionalized thermal interfaces to enhance heat transfer; researched novel nano-technology based sensors and electronics devices, including potentially lower power systems; studied nanotechnology-enhanced transparent electronic materials that may improve portable and flexible display technology; investigated advanced nanotechnology-enhanced cooling techniques including thermoelectric and adsorption/desorption cooling. In FY09, will implement thermal management techniques that provide improved thermal conductivity and will study methods to functionalize the thermal interfaces to improve heat transfer; will fabricate novel nano-electronics for low power sensors and systems; will study nanotechnology-enhanced electronic materials that provide superior electrical capabilities; will research advanced nanotechnology-enhanced cooling techniques including thermoelectric and adsorption/desorption				
Total	2.876	2.985	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J17	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J17: VERTICAL LIFT RESEARCH CENTER OF EXCELLENCE	1.918	2.026	2.044						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project is for Vertical Lift Research Center of Excellence to couple state-of-the-art research programs with broad-based graduate education programs at academic institutions with the goal of increasing the supply of scientists and engineers who can contribute to Army Transformation. Work will provide research into technologies that can improve tactical mobility, reduce the logistics footprint, and increase survivability for rotary wing vehicles.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project is performed extramurally by the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) in Huntsville, AL.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Small Business Innovative Research/Small Business Technology Transfer Programs	.000	.056	.000	
Vertical Lift Research Center of Excellence: In FY08, investigated interactional aerodynamics for noise prediction of heavy lift rotorcraft configurations, investigated anti-icing and erosion protection systems for rotor blades, investigated high-lift airfoil concepts for delaying dynamic stall onset and reducing adverse pitching moments; and developed data fusion and biomimetic materials for rotorcraft health monitoring systems. In FY09, develop light-weight high-flexibility rotorcraft shafts using flexible matrix composites and active bearing controls; and develop efficient and affordable joining concepts for high-stiffness, light-weight composites. In FY10, will design and fabricate robust wind tunnel testing system for rotating icing environment tests; will build and test active trailing edge flaps rotor configurations for reducing rotor vibrations, power, and noise; will investigate the performance improvements in the tip/casing region of ducted fan systems; and will demonstrate health monitoring capability of hybrid carbon-fiber/carbon-nanotube epoxy composites.	1.918	1.970	2.044	
Total	1.918	2.026	2.044	

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J17

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification			DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers		PROJECT NUMBER J19

COST ($ in Millions)	FY 2008 Actual	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	FY 2014 Estimate	FY 2015 Estimate	Cost To Complete	Total Cost
J19: Automotive Research Center (ARC) Initiatives (CA)	3.479	.000	.000						Continuing	Continuing

A. Mission Description and Budget Item Justification

Congressional Interest Item funding provided for Automotive Research Center (ARC) initiatives.

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
University-based Automotive Research	1.933	.000	.000	
NAC University Automotive Research Coalitions	1.546	.000	.000	
Total	3.479	.000	.000	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification								DATE: May 2009		
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research				R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers					PROJECT NUMBER J22	
COST ($ in Millions)	**FY 2008 Actual**	**FY 2009 Estimate**	**FY 2010 Estimate**	**FY 2011 Estimate**	**FY 2012 Estimate**	**FY 2013 Estimate**	**FY 2014 Estimate**	**FY 2015 Estimate**	**Cost To Complete**	**Total Cost**
J22: NETWORK SCIENCE AND TECHNOLOGY RESEARCH CENTER	.000	4.983	9.330						Continuing	Continuing

A. Mission Description and Budget Item Justification

This project funds the establishment of the Network Science and Technology Research Center (NSTRC). The NSTRC will be competitively awarded and managed by the Army Research Laboratory (ARL). ARL researchers, with partners at other sites, will collaborate in a virtual center environment. There will be an effort undertaken to include additional partners such as universities, industry, and other government agencies. Network Science is the study of network representations of physical, biological, and social phenomena leading to predictive models of these phenomena. As such, network science may be seen as the cornerstone for future military operations and the conduct of network-centric warfare. The mission of this center will be to strengthen the theoretical underpinnings of network science; conduct basic research on how and why biological and social (non-physical) networks function and determine their applications to military networks; to manage the activities in network science research, technology development, and network experimentation for the Army; to focus science and technology investments to enable network-centric operations and warfare; to focus applied science and technology to enable social networks important to Army operations; and to enable the development of network science applications and facilitate their transition to Army and Joint operations. Network science, technology, and evaluations encompasses all information and information exchange, visualization, collaboration, manipulation, protection, restoration, transport, services, data storage, and application layers, including the knowledge that human use of networks is a critical component. Establishment of the center will require a phased approach cable of supporting development of fundamental network theory and network technologies, and carry out the assessment of impacts upon human performance; the integration of new technologies and social networks into capabilities; and experimentation as a means to test and confirm fundamental theories and predictive models and/or characterize new technologies and operational concepts while also being capable of promoting training of personnel when applicable. Unlike the Training and Doctrine Commands on-going efforts within their centers, schools, and battle-labs, the focus of the NSTRC will be to develop the framework to perform research important to the Army in the areas of modeling, simulation and testing of very large networks, command and control of joint/combined networked forces, impact of network structure on organizational behavior, security and information assurance of networks, swarming behavior, and managing network complexity. It will also have a significant focus on and investment in the discovery and foundational aspects of the science of networks both human engineered and biologically evolved.

Work is this project is coordinated with and complementary to the work at the United States Military Academy (USMA) Basic Research Network Science Center funded under PE 0601104/project H59.

The cited work is consistent with the Director, Defense Research and Engineering Strategic Plan, the Army Modernization Strategy, and the Army Science and Technology Master Plan.

Work in this project will be performed primarily extramurally with a small intramural effort by the Army Research Laboratory (ARL) in Adelphi, MD.

Exhibit R-2a, PB 2010 Army RDT&E Project Justification		DATE: May 2009
APPROPRIATION/BUDGET ACTIVITY 2040 - Research, Development, Test & Evaluation, Army/BA 1 - Basic Research	R-1 ITEM NOMENCLATURE PE 0601104A University and Industry Research Centers	PROJECT NUMBER J22

B. Accomplishments/Planned Program ($ in Millions)	FY 2008	FY 2009	FY 2010	FY 2011
Network Science and Technology Research Center (NSTRC): Research in the broad area of network sciences technology is performed at various government agencies, industries and universities across the country. The future Army will have to take advantage of a multitude of new technologies to network the force and create a decisive warfighting advantage. The challenges will be to select, on the basis of their technical merit and applicability, those technologies best able to resolve identified technology shortfalls. In FY09, establish the NSTRC capability through a multitude of geographically diverse, interdisciplinary researchers working collaboratively on military network research issues, using shared or existing resources, and exploiting advances in computing, communications, collaboration, and other information technologies to make research and technology development efficient and seamless. In FY10, will develop diagnostic models and methods to advance the science of social/cognitive networks. Establish a synergistic framework for physics-based and human-based information fusion. Will develop models of mobile ad hoc networking to define interactions and behavior among information networks.	.000	4.843	9.330	
Small Business Innovative Research/Small Business Technology Transfer Program	.000	.140	.000	
Total	.000	4.983	9.330	

C. Other Program Funding Summary ($ in Millions)

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance metrics used in the preparation of this justification material may be found in the FY 2010 Army Performance Budget Justification Book, dated May 2010.