Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
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)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
Total Program Element	-	102.084	123.045	113.662	-	113.662	118.502	120.840	123.136	125.736	Continuing	Continuing
EA6: *Cyber Collaborative Research Alliance*	-	0.000	0.000	3.010	-	3.010	2.966	2.972	2.982	2.993	Continuing	Continuing
F17: *Neuroergonomics Collaborative Technology Alliance*	-	4.995	5.251	5.381	-	5.381	5.462	5.659	5.595	5.696	Continuing	Continuing
H04: *HBCU/MI Programs*	-	2.215	18.507	2.960	-	2.960	3.010	3.061	3.112	3.168	Continuing	Continuing
H05: *Institute For Collaborative Biotechnologies*	-	11.823	12.326	12.458	-	12.458	12.877	12.976	13.234	13.437	Continuing	Continuing
H09: *Robotics CTA*	-	5.115	5.550	6.649	-	6.649	5.945	5.842	5.940	6.047	Continuing	Continuing
H50: *Network Sciences CTA*	-	12.494	12.968	14.201	-	14.201	14.879	14.844	14.894	15.033	Continuing	Continuing
H53: *Army High Performance Computing Research Center*	-	4.215	4.516	4.902	-	4.902	6.193	6.991	7.109	7.237	Continuing	Continuing
H54: *Micro-Autonomous Systems Technology (MAST) CTA*	-	7.689	8.127	8.096	-	8.096	8.348	8.381	8.419	8.630	Continuing	Continuing
H59: *International Tech Centers*	-	6.175	7.503	7.609	-	7.609	7.708	7.832	7.964	8.107	Continuing	Continuing
H62: *Institude for Advanced Technology (IAT)*	-	1.378	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
H64: *MATERIALS CENTER*	-	2.826	0.758	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
H73: *Automotive Research Center (ARC)*	-	3.870	4.092	4.195	-	4.195	4.197	4.251	4.321	4.399	Continuing	Continuing
J08: *Institute For Creative Technologies (ICT)*	-	7.764	8.003	8.104	-	8.104	8.751	9.355	9.623	9.805	Continuing	Continuing
J12: *Institute For Soldier Nanotechnology (ISN)*	-	10.441	10.706	10.558	-	10.558	10.646	10.689	10.884	11.096	Continuing	Continuing
J14: *Army Educational Outreach Program*	-	6.029	9.593	9.738	-	9.738	9.864	9.935	10.038	10.219	Continuing	Continuing

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army											DATE: April 2013	
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*					R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*							
J15: *Network Sciences ITA*	-	7.453	4.048	4.125	-	4.125	4.192	4.221	4.301	4.384	Continuing	Continuing
J17: *Vertical Lift Research Center Of Excellence*	-	2.569	2.771	3.062	-	3.062	3.026	3.189	3.243	3.301	Continuing	Continuing
VS2: *Multi-Scale Materials Modeling Centers*	-	5.033	8.326	8.614	-	8.614	9.263	9.462	9.990	10.441	Continuing	Continuing
VS3: *Center For Quantum Science Research*	-	0.000	0.000	0.000	-	0.000	1.175	1.180	1.487	1.743	Continuing	Continuing

[#] FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

[##] The FY 2014 OCO Request will be submitted at a later date

Note

FY12 reprogramming to move Historically Black Colleges and Universities program to RDTE,DW.
Fy14 decrease to support other higher priority efforts.

A. Mission Description and Budget Item Justification

This program element (PE) fosters university and industry based research to provide a scientific foundation for enabling technologies for future force capabilities. Broadly, the work in this project falls into three categories: Collaborative Technology Alliances / Collaborative Research Alliances (CTAs/CRAs), University Centers of Excellence (COE), and 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 are industry-led 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 scientists to shape, mature, and transition technology relevant to the Army mission. CTAs have been competitively established in the areas of Micro Autonomous Systems Technology (MAST), Network Sciences, Robotics, Cognition and Neuroergonomics, and Multi-Scale Materials Modeling. COEs focus on expanding the frontiers of knowledge in research areas where the Army has enduring needs and 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 automotive and rotary wing technology. Also included are Army Educational Outreach Program (AEOP) and activities to stimulate interest in science, math, and technology among middle and high school students. This PE includes support for basic research at three Army UARCs, which have been created to exploit opportunities to advance new capabilities through a sustained long-term multidisciplinary effort. 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 focuses on enabling network centric-technologies, and broadening 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. This PE also includes the Historically Black Colleges and Universities and Minority Institution (HBCU/MI) Centers of Excellence that address critical research areas for Army Transformation.

Exhibit R-2, RDT&E Budget Item Justification: PB 2014 Army	DATE: April 2013
APPROPRIATION/BUDGET ACTIVITY 2040: *Research, Development, Test & Evaluation, Army* BA 1: *Basic Research*	R-1 ITEM NOMENCLATURE PE 0601104A: *University and Industry Research Centers*

The cited work is consistent with the Assistant Secretary of Defense, Research and Engineering science and technology focus areas and the Army Modernization Strategy.

Work in this PE is performed by: the Army Research Lab (ARL) in Adelphi, MD; the US Army Tank-Automotive Research, Development, and Engineering Center (TARDEC) in Warren, MI; Aviation and Missile Research, Development and Engineering Center (AMRDEC), in Huntsville, AL, and Research, Development and Engineering Command (RDECOM), in Aberdeen, MD.

B. Program Change Summary ($ in Millions)	FY 2012	FY 2013	FY 2014 Base	FY 2014 OCO	FY 2014 Total
Previous President's Budget	140.715	123.045	128.947	-	128.947
Current President's Budget	102.084	123.045	113.662	-	113.662
Total Adjustments	-38.631	0.000	-15.285	-	-15.285
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-34.967	-			
• SBIR/STTR Transfer	-3.664	-			
• Adjustments to Budget Years	-	-	-15.285	-	-15.285

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 EA6: *Cyber Collaborative Research Alliance*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
EA6: *Cyber Collaborative Research Alliance*	-	0.000	0.000	3.010	-	3.010	2.966	2.972	2.982	2.993	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

The Cyber Security Collaborative Research Alliance (CRA), a competitively selected consortium, is formed to advance the theoretical foundations of cyber science in the context of Army networks. This CRA consists of academia, industry and government researchers working jointly with the objective of developing a fundamental understanding of cyber phenomena so that fundamental laws, theories, and theoretically grounded and empirically validated models can be applied to a broad range of Army domains, applications, and environments. This research will focus on three interrelated aspects of cyber security and will be conducted using a trans-disciplinary approach that takes into account the human element of the network. The three aspects of cyber that are considered are: 1)vulnerabilities and risks of cyber networks to malicious activities, 2)anticipating, detecting and analyzing malicious activities, and 3) agile cyber maneuver to thwart and defeat malicious activities. Overarching goals of cyber security are to significantly decrease the adversary's return on investment when considering cyber attack on Army networks, and minimizing the impact on (Army) network performance related to implementing cyber security. The CRA research creates a framework that effectively integrates the knowledge of cyber assets and potential adversary capabilities and approaches, and provides defense mechanisms that dynamically adjust to changes related to mission, assets, vulnerability state, and defense mechanisms.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Cyber Security Collaborative Research Alliance	0.000	0.000	3.010
Description: The Cyber Security CRA focuses on three Research Areas (Risk, Detection, Agility), and on Cross Cutting Research Issue (CCRI) (Psychosocial Effects). Research in Risk will develop theories and models that relate fundamental properties and features of dynamic risk assessment algorithms to the fundamental properties of dynamic cyber threats, Army's networks, and defensive mechanisms. Research in Detection will develop theories and models that relate properties and capabilities of cyber threat detection and recognition processes/mechanisms to properties of a malicious activity, and of properties of Army networks. Research in Agility will develop theories and models to support planning and controls of cyber maneuver (i.e., "maneuver" in the space of network characteristics and topologies) that would describe how control and end-state of the maneuver are influenced by fundamental properties of threats, such as might be rapidly inferred from limited observations of a new, recently observed threat.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 EA6: *Cyber Collaborative Research Alliance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
The Psychosocial Effects CCRI is studied in each of the three Research Areas and will develop theories and models related to user, operator and adversary behavior in risk assessment, detection, and cyber maneuver. Research Areas will develop theories and models related to user, operator and adversary behavior in risk assessment, detection, and cyber maneuver. ***FY 2014 Plans:*** Will competitively select a consortium consisting of academia, industry and government researchers to advance the theoretical foundations of cyber science in the context of Army networks. Will investigate new holistic conceptualizations and definitions of risk, resiliency and robustness under an adversarial setting. Will study and create theory and techniques for effective non-signature based detection of advanced persistent threats. Will develop mathematical theories and models leading to algorithms to affect a desired maneuver end-state in dynamic environments and deliberate obfuscation attempts by the adversary. Will explore theoretical models of the cyber defender leading to improved defender effectiveness.			
Accomplishments/Planned Programs Subtotals	0.000	0.000	3.010

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 F17: *Neuroergonomics Collaborative Technology Alliance*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
F17: *Neuroergonomics Collaborative Technology Alliance*	-	4.995	5.251	5.381	-	5.381	5.462	5.659	5.595	5.696	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project fosters research through the Cognition and 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 focused in three areas: understanding fundamental principles underlying Soldier neurocognitive performance in operational environments, advancing computational approaches for the analysis and interpretation of neural functioning, fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 F17: *Neuroergonomics Collaborative Technology Alliance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Neurocognitive performance in operational environments ***Description:*** This effort is intended to understand fundamental principles underlying Soldier neurocognitive performance in operational environments. ***FY 2012 Accomplishments:*** Transitioned lessons learned to the design and creation of simulation experiments to capture neurocognitive performance while embedded in military-relevant operational contexts; utilized simulation environments to evaluate predictions made from formal models; elaborated and refined models of neurocognitive function developed based on results generated during simulation experiments. ***FY 2013 Plans:*** Complete execution of large scale simulation evaluations to generate data for addressing issues of individual differences in neurocognitive performance; transition lessons learned from evaluation of formal models in simulation assessments to inform the development of a second phase of evaluation with increased military relevance/realism. ***FY 2014 Plans:*** Will develop and transition lessons learned on individual differences in neurocognitive performance from large scale simulation evaluations to second phase of evaluation with increased military relevance/realism; will develop simulation evaluations with increased military relevance/realism to evaluate formal models of neurocognitive performance issues of individuals in neurocognitive performance.	1.862	1.965	2.047
Title: Computational neural analysis ***Description:*** This effort advances computational approaches for the analysis and interpretation of neural functioning. ***FY 2012 Accomplishments:*** Analyzed data sets generated during large-scale simulation experiments; used simulation data sets for further expansion and elaboration of models and methods for assessing predictive features involving inter- and intra-subject variability; and refined models according to assessments of the adequacy of overlap and agreement between data and observations. ***FY 2013 Plans:*** Complete the analysis of large-scale simulations including further elaboration of models and computational methods for assessing neurocognitive performance and identifying predictive features of inter- and intra-subject variability; and design extensions of databases to enable further analysis and modeling of individual differences in neurocognitive function. ***FY 2014 Plans:***	1.510	1.586	1.609

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 F17: *Neuroergonomics Collaborative Technology Alliance*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Will conduct data mining explorations of large-scale simulation evaluations using novel computational methods for identification and clustering of predictive features of inter- and intra-subject variability; and will implement extensible database designs for enabling data exploration and modeling of individual differences in neurocognitive function.			
Title: Neurotechnologies ***Description:*** This effort provides a fundamental advancement in neurotechnologies that enhance Soldier-system interactions and performance. ***FY 2012 Accomplishments:*** Refined online signal processing methods as well as expanded methods for analysis of electroencephalogram (EEG) data; identified key biomechanical measures based on the inertial fatigue-monitoring sensors and investigated remote monitoring of Soldier fatigue; designed algorithms for a neuro-computer vision system for automated environmental appraisal; and developed methods for integration of user feedback into a system for alerting the Soldier to important environmental events involving saliency and attention modeling, object detection, object tracking and crowd modeling. ***FY 2013 Plans:*** Mature and assess online signal processing methods for analysis of EEG data; validate methods and sensor performance for remote monitoring of Soldier fatigue; implement and evaluate algorithms for a neuro-computer vision system for automated environmental appraisal; implement and assess user feedback / alerting system relating to saliency and attention modeling, object detection, object tracking for automation and Soldier training technology design. ***FY 2014 Plans:*** Will refine methods, sensor performance, and system designs for on-line monitoring and assessment of Soldier fatigue and neurocognitive state; will validate performance of algorithms for a neuro-computer vision for automated environment appraisal; will evaluate and validate methods for Soldier monitoring and assessment in human-computer interaction technologies for Soldier intentional and target detection performance and adaptive automation systems.	1.623	1.700	1.725
Accomplishments/Planned Programs Subtotals	4.995	5.251	5.381

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 F17: *Neuroergonomics Collaborative Technology Alliance*

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H04: *HBCU/MI Programs*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H04: *HBCU/MI Programs*	-	2.215	18.507	2.960	-	2.960	3.010	3.061	3.112	3.168	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

FY 14 OSD funding for Historically Black Colleges and Univerisites and Minority Institutions was realigned from the RDT&E,Army appropriation to RDT&E, Defense-wide appropriation. Army specific efforts continue to be funded in this project.

A. Mission Description and Budget Item Justification

This project supports basic research through the Partnership in Research Transition (PIRT) program, the Army's research initiative focused on partnerships with Historically Black Colleges and Universities and Minority Institutions (HBCU/MI), and provides support to Department of Defense Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) program providing support for research and collaboration with DoD facilities and personnel for research and collaboration with DoD facilities and personnel. The focus of this effort is to enhance programs and capabilities of a select number of high-interest scientific and engineering disciplines through innovative research at Centers of Excellence established at Historically Black Colleges and Universities. These COEs work with Army, industrial, and other academic partners to accelerate the transition from the research phase to technology demonstration. In addition, these Centers of Excellence recruit, educate, and train outstanding students and post-doctoral researchers in science and technology areas relevant to the Army.

Work in this project if fully coordinated with the Office of Secretary of Defense program manager for HBCU/MI programs.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Centers of Excellence for Battlefield Capability Enhancements (BCE)	2.215	2.908	2.960
Description: Five new Partnership in Research Transition (PIRT) Centers of Excellence were established in 2011 at: Hampton Univ. (Lower Atmospheric Research Using Lidar Remote Sensing); NCA&T State Univ. (Nano to Continuum Multi-Scale Modeling Techniques and Analysis for Cementitious Materials Under Dynamic Loading); Delaware State Univ. (Center for Advanced Algorithms); Howard Univ.(2) (Bayesian Imaging and Advanced Signal Processing for Landmine and IED Detection Using GPR, and Extracting Social Meaning From Linguistic Structures in African Languages). These Centers were selected to: enhance programs and capabilities through Army-relevant, topic-focused, near-transition-ready innovative research; strengthen the			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H04: *HBCU/MI Programs*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
capacity of the HBCUs to provide excellence in education; and to conduct research critical to the national security functions of the DoD. ***FY 2012 Accomplishments:*** Continued research efforts at the five new Centers of Excellence. ***FY 2013 Plans:*** Continue research efforts at the PIRT Centers of Excellence; conduct major program-wide review of all center research progress. ***FY 2014 Plans:*** Will continue research efforts at PIRT Centers of Excellence that began in FY11 and continued in FY12 and FY13 for centers showing sufficient progress toward research goals and transition.			
Title: Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) ***Description:*** The Historically Black Colleges and Universities and Minority Institutions (HBCU/MI) program provides support for research and collaboration with DoD facilities and personnel; the research grants further knowledge in the basic physical scientific and engineering disciplines through theoretical and empirical activities; collaborative research allows university professors to work directly with military laboratories or other universities. ***FY 2013 Plans:*** Conduct a Broad Agency Announcement and solicitations to execute funding for grants and awards following legislative and executive policy and guidance when Congress directs.	0.000	15.599	0.000
Accomplishments/Planned Programs Subtotals	2.215	18.507	2.960

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H05: *Institute For Collaborative Biotechnologies*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H05: *Institute For Collaborative Biotechnologies*	-	11.823	12.326	12.458	-	12.458	12.877	12.976	13.234	13.437	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project supports research at the Army's Institute for Collaborative Biotechnologies (ICB), 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 was established as a University Affiliated Research Center (UARC) to support leveraging biotechnology for: advanced sensors; new electronic, magnetic, and optical materials; and 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Institute for Collaborative Biotechnologies	10.795	10.908	11.014
Description: Perform sustained multidisciplinary basic research supporting technology to provide the Army with bio-inspired materials and biomolecular sensor platforms.			
FY 2012 Accomplishments: Research efforts pursued development of mass-based assays for detecting molecular, viral and cell-based pathogens relevant to the Army; developed shell and bone-inspired passive actuators aimed toward dissipating energy targeted against buildings,			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H05: *Institute For Collaborative Biotechnologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
barracks and bunkers; expanded use of synthetic biology for engineering novel materials and fuels; developed first-principles molecular design rules to create honeycomb micro-trusses for fabrication into composite blast-resistant materials. ***FY 2013 Plans:*** Investigate engineering glucosidases (enzyme class responsible for catalyzing breakdown of plant and other biomaterials into nutrients) and assessing bio- mixtures with thermally-stable cellulases for potential future applications in biofuel production; research concepts and designs for bio-inspired energy-dispersive composites. ***FY 2014 Plans:*** Will investigate methods for designing and characterizing bio-inspired materials such as exploring new architectures for mechanical strength which can form the basis for new protective materials for the Soldier; will expand computational tools that allow for improved selection of engineered enzymes as candidates for potential use in biofuel production; will design biomolecular circuitry and control systems within cells to enable rapid detection and response to environmental effects; will examine the effects of oligoelectrolyte insertion within the membranes of a variety of bacterial species to better determine the effects of membrane modification on the potential for generating power from wastewater remediation.			
Title: Neuroscience ***Description:*** Perform multidisciplinary basic research in the area of neuroscience. ***FY 2012 Accomplishments:*** Continued the study of spatial and temporal dynamics of brain function via simultaneous fMRI-EEG neuroimaging and integrating cognitive theory and biologically constrained computational models with multimodel imaging to further develop enabling technologies that support improved methods for Soldier training; continued investigations of genetic markers that can be linked to abilities in classification learning; investigated the shared neural substrates for action simulation and intention understanding. ***FY 2013 Plans:*** Study genetic, anatomic, and strategic differences of cognitive performance using EEG and fMRI methods to characterize individual differences of brain activity; begin design and validation of new methods to characterize brain anatomic networks and dynamical patterns relevant to neuroimaging studies. ***FY 2014 Plans:*** Will assess the relationship between brain structural and functional connections with behavior to gain a better understanding of the relationship between a Soldier's hardwired brain structure and cognitive ability; will assess whether neural measurements (e.g., functional magnetic resonance imaging or electroencephalography) can predict the performance of an individual to	1.028	1.418	1.444

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H05: *Institute For Collaborative Biotechnologies*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
correctly perceive and detect targets placed at unusual locations within natural environments; will identify neural and physiological biomarkers associated with adaptive cognitive capacity under stress and fatigue.			
Accomplishments/Planned Programs Subtotals	11.823	12.326	12.458

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H09: *Robotics CTA*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H09: *Robotics CTA*	-	5.115	5.550	6.649	-	6.649	5.945	5.842	5.940	6.047	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

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; understanding the interaction of humans with machines focusing upon intuitive control by Soldiers to minimize cognitive burden; dexterous manipulation of the environment by unmanned systems; and unique modes of mobility to enable unmanned systems to seamlessly navigate complex or highly constrained three dimensional environments. The program will conduct both analytic and validation studies.

Work in this projects builds fundamental knowledge for and complements the companion applied technology program, PE 0602120A, project TS2 (Robotics).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by the Army Research Laboratory (ARL) at the Aberdeen Proving Ground, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Autonomous systems	5.115	5.550	6.649
Description: 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.			
FY 2012 Accomplishments: Explored principles for constructing and managing a hierarchical world model combining cognitive higher level representations with lower level planning to enable formation of effective human robot teams; evaluated the learned recognition of terrain and			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H09: *Robotics CTA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
objects with placement into context; assessed situational awareness within human-robot teams; and explored methodologies for coordinated manipulation. ***FY 2013 Plans:*** Investigate incorporation of learning into recognition of relationships between both static and dynamic elements of the environment; Explore mechanisms for common understanding between humans and machines to enable effective teaming; Examine fundamental principles and mechanics of grasping, manipulation, and ambulation. ***FY 2014 Plans:*** Will expand investigation of learning and recognition of relationships to include more complex dynamic environments and adversarial intent; will continue investigation of cognitive approaches to machine perception and creation of a shared mental model to reduce reliance upon communication between humans and robots; will continue exploration of whole body (dynamic) manipulation of objects in the environment; and will continue exploration of novel ground locomotion techniques to enable rapid mobility in three-dimensional and confined environments			
Accomplishments/Planned Programs Subtotals	5.115	5.550	6.649

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H50: *Network Sciences CTA*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H50: *Network Sciences CTA*	-	12.494	12.968	14.201	-	14.201	14.879	14.844	14.894	15.033	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project supports a competitively selected university and industry consortium, the Network Sciences Collaborative Technology Alliance (NS CTA), formed to leverage commercial research investments to provide solutions to Army's requirements for robust, survivable, and highly mobile wireless communications networks, while meeting the Army's needs for a state-of-the-art wireless mobile communications networks for command-on-the-move. The NS CTA performs foundational, cross-cutting network science research leading to: a fundamental understanding of the interplay and common underlying science among social/cognitive, information, and communications networks; determination of how processes and parameters in one network affect and are affected by those in other networks; and prediction and control of the individual and composite behavior of these complex interacting networks. This research will lead to optimized human performance in network-enabled warfare and greatly enhanced speed and precision for complex military operations. 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.
Beginning in FY12, all funds from PE 61104/project J22 were realigned to this project.

Work in this project builds fundamental knowledge for and accelerates the transition of communications and networks technology to PE 0602783A (Computer and Software Technology).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Network Sciences Collaborative Technology Alliance (NS CTA)	12.494	12.968	14.201
Description: The Network Sciences CTA focuses on four major research areas: Information Networks, Communication Networks, Social/Cognitive Networks, and Interdisciplinary Research to develop a fundamental understanding of the ways that information, social/cognitive, and communications networks can 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 develops the fundamental understanding of autonomous network activities and its linkage to the physical and human domains as related to human decision making within the networked command and control (C2) structure. Social/Cognitive			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H50: *Network Sciences CTA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Networks research is developing the fundamental understanding of the interplay of the various aspects of the social and cognitive networks with information and communications. Communications Networks research is developing 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 is focused 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. ***FY 2012 Accomplishments:*** Developed models of network performance that capture the complex interactions between social, cognitive, information and communication networks; Extended the initial trust model that will improve network fidelity and reliability in the tactical mobile ad hoc network (MANET) environment; developed theoretically grounded empirical models of emergence and propagation of trust and beliefs in insurgent-civilian populations and in battle command decision-making; produced experimentally-confirmed results in dynamics and stability of large-scale, dynamic, distributed, human-centric networks of information; and investigated the impacts of mobility and adversarial attacks on the dynamics of information quality delivered through mobile communication networks. ***FY 2013 Plans:*** Using human-in-the-loop and simulation-emulation experiments, along with collections of empirical data, extend, calibrate and validate theories and models of complex interactions between social, cognitive, information and communication networks, particularly in the evolution and propagation of information, trust and beliefs in insurgent-civilian populations, as well as in battle command decision-making under the conditions of dynamics and adversarial attacks. ***FY 2014 Plans:*** Will explore mathematical representations of dynamic communications, information, and social networks that enable the analysis of their joint behavior. Techniques will be developed for discovering node roles and hierarchical structures in noisy, uncertain social networks, and techniques to maximize information (not bits) delivered based on quality of information needs and the context of decisions (semantics). Techniques will also be developed for social and information-aware caching to improve performance and robustness of composite networks. These efforts will result in analytical techniques for the design of better Army tactical networks that are more resilient in disruptive environments.			
Accomplishments/Planned Programs Subtotals	12.494	12.968	14.201

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H50: *Network Sciences CTA*

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H53: *Army High Performance Computing Research Center*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H53: *Army High Performance Computing Research Center*	-	4.215	4.516	4.902	-	4.902	6.193	6.991	7.109	7.237	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

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 Robotics Technology (PE 0602618A, project H03). 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: AHPCRC	4.215	4.516	4.902
Description: The AHPCRC research mission is to advance computational science and its application to critical Army technologies through an Army-university-industry collaborative research program in such areas as combat systems survivability, and chemical and biological defense.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H53: *Army High Performance Computing Research Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Developed computational approaches for coupling light weight fabric structural mechanics with computational electromagnetics to study contact mechanics between electromagnetically charged fabrics and structures; scalable approaches for nano-fluidics for Army medical applications; quantum level approaches for an all electron battery; and programming models for emerging hybrid computing architectures for Army applications. Investigated scalable algorithms for large-scale social networks and validate multi-scale computational approach for micro-systems design. ***FY 2013 Plans:*** Continue to develop reduced order modeling (ROM) concepts for underbody blast problems by developing and solving high-fidelity fully-coupled blast-structure interaction application and then developing appropriate complex mathematical formulations for accurate reduced models; develop scalable approaches for drug delivery through non-fluidic methods for Army medical applications; validate preliminary simulations for all electron battery; validate ion of back projection applications for battle command applications on new hybrid computing architecture; and investigate scalable algorithms for large-scale graphene modeling software and associated validation approaches with Army Research Laboratory experiments. ***FY 2014 Plans:*** Will implement reduced order modeling (ROM) approach for underbody blast application. This application will include occupant in addition to IED blast and vehicle structural response. Will reinforce simple verification and validation with RDEC's on the ROM approach and will implement nano-fluidic based multi-scale/multi-physics approach on scalable computers. Will work with US MRMC in validating this approach for blood flow and drug delivery. Will develop domain specific language (DSL) for Finite Element based approaches, and will explore emerging hybrid and memory hierarchy computer systems. Beginning in FY14, will support education and outreach activities formerly funded in PE/Project 65803/731.			
Accomplishments/Planned Programs Subtotals	4.215	4.516	4.902

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H54: *Micro-Autonomous Systems Technology (MAST) CTA*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H54: *Micro-Autonomous Systems Technology (MAST) CTA*	-	7.689	8.127	8.096	-	8.096	8.348	8.381	8.419	8.630	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project fosters basic research through 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.

Work in this project complements and is fully coordinated with the Tank and Automotive Research, Development, and Engineering Center (TARDEC); the Natick Soldier Research, Development, and Engineering Center (NSRDEC); and the Special Operations Command (SOCOM).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Micro Autonomous Systems Technology CTA	7.689	8.127	8.096
Description: Enhance tactical situational awareness in urban and complex terrain by enabling the autonomous operation of a collaborative ensemble of multifunctional mobile Microsystems.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H54: *Micro-Autonomous Systems Technology (MAST) CTA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Experimentally validated the ability of small air and ground platforms to identify points of ingress into a structure and to navigate through them in a robust, stable manner and conducted experiments on the ability of small air and ground platforms to navigate to a waypoint based on sensor input. ***FY 2013 Plans:*** Experimentally validate the ability of small air platforms to navigate autonomously in disturbed air and develop technology to allow micro ground platforms to move over rough terrain. Conduct experiments on the ability of small air and ground platforms to work collaboratively to enter and explore an urban structure. ***FY 2014 Plans:*** Will study and develop bio-inspired robotic platform mobility and control methods for Micro Autonomous Systems in real world environments, sensors for on-board state estimation and perception, architectures and algorithms for heterogenous teaming, and study trades between increased risk and uncertainty and increased operational tempo. Will conduct joint experiments on emerging technology to assess the ability of small air and ground platforms to work collaboratively to enter and explore urban and complex 3D environments.			
Accomplishments/Planned Programs Subtotals	7.689	8.127	8.096

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H59: *International Tech Centers*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H59: *International Tech Centers*	-	6.175	7.503	7.609	-	7.609	7.708	7.832	7.964	8.107	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

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 the 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 organizations 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 early assessments of the technology's potential contributions to the Army's S&T strategy.

Work in this project related to the USMA Basic Research Center for Network Science is fully coordinated with and complementary to PE 0601104/Project H50 (Network Science CTA).

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed by Headquarters, Army Research, Development and Engineering Command (RDECOM), the Army Research Laboratory (ARL) in Adelphi, MD, and the United States Military Academy, NY.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: International Technology Centers (ITC)	5.273	6.514	6.602
Description: Funding is provided for the following effort.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H59: *International Tech Centers*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Continued to solicit projects and build on the success of the FTAS Program; continue to enhance and refine technology search capabilities using feedback from customers (RDECs, PMs and labs) to focus on near and long term capabilities. ***FY 2013 Plans:*** Continue to solicit projects and build on the success of the FTAS Program; continue to enhance and refine technology search capabilities using feedback from customers (RDECs, PMs and labs) to focus on near and long term capabilities. ***FY 2014 Plans:*** Will continue to solicit projects and build on the success of the FTAS Program; will continue to enhance and refine technology search capabilities using feedback from customers (RDECs, PMs and labs) to focus on near and long term capabilities.			
Title: Basic Research Center in Network Science at the United States Military Academy (USMA) ***Description:*** Network science research at USMA in coordination with the NS CTA. ***FY 2012 Accomplishments:*** Greater emphasis was given on studying emerging markets and the role they play in the economic development of a country; research biological networks to understand the impact of environmental contaminants on genetic and metabolomic circuits in the human body. ***FY 2013 Plans:*** Investigate cooperation networks and how these theoretical frameworks can improve systems and organizations; continue to research biological networks and implement these insights towards improvement in communication and organizational networks; study economic cascading events in order to better understand obstacles to the economic development of a country. ***FY 2014 Plans:*** Develop an algorithm based on the convergence of "vertex probabilities" that will improve the ability to "influence" a social network; will refine initial findings concerning cooperation networks and how these theoretical frameworks can improve systems and organizations; study network topologies and features linked to network vulnerabilities and efficient network-level power management will occur; development of a new network classification model that assists policy makers with economic development strategy will be another focus of this research.	0.902	0.989	1.007
Accomplishments/Planned Programs Subtotals	6.175	7.503	7.609

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H59: *International Tech Centers*

C. Other Program Funding Summary ($ in Millions)

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H62: *Institude for Advanced Technology (IAT)*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H62: *Institude for Advanced Technology (IAT)*	-	1.378	0.000	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project funds a University Affiliated Research Center (UARC), 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.

In January 2012, the UARC contract with IAT is scheduled to ended. New efforts beginning in FY12 will be conducted via competitive solicitation and performed under PE 0601104/Project VS2, Center for Advanced ResearchMulti-Scale Materials Modeling Centers.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Electromagnetic Lethality	1.378	0.000	0.000
Description: Funding is provided for the following effort. ***FY 2012 Accomplishments:*** Completed theoretical investigations of novel lethal concepts and document findings; and finalized contract obligations.			
Accomplishments/Planned Programs Subtotals	1.378	0.000	0.000

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H62: *Institude for Advanced Technology (IAT)*

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H64: *MATERIALS CENTER*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H64: *MATERIALS CENTER*	-	2.826	0.758	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

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): Composite Materials Research; Advanced Metals and Ceramics Research; and 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.

Work in this project built fundamental knowledge supporting ARL in-house materials research projects (PE 0601102A, project H42) and accelerated the transition of technology to PE 0602105A (Materials Technology). In FY12, work in this effort concluded. In FY13, the advanced materials emphasis for the Army focuses on multi-disciplinary, multi-scale materials behavior in extreme environments conducted in PE 0601104A Project VS2 titled Multi-Scale Materials Modeling Centers.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Materials Research for vehicle protection	2.826	0.758	0.000
Description: Materials Research for vehicle protection performs research and exploits promising breakthroughs in multi-functional composites, advanced armor ceramics, dynamic response of metals, protective polymers, and hybrid systems to enable revolutionary vehicle protection.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H64: *MATERIALS CENTER*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Investigated the role of non-traditional deformation mechanisms in the failure and flow of potential armor materials; and modeled the twinning (local intermediate plastically) behavior of non-cubic metals and ceramic materials. ***FY 2013 Plans:*** Finalize mechanism-based multi-scale approach to microstructure design for dynamic applications; and develop understanding of size effects in magnesium vis-a -vis etching and orientation for quantifying demonstrated enhanced mechanical properties. Complete effort in FY13.			
Accomplishments/Planned Programs Subtotals	2.826	0.758	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 H73: *Automotive Research Center (ARC)*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
H73: *Automotive Research Center (ARC)*	-	3.870	4.092	4.195	-	4.195	4.197	4.251	4.321	4.399	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project fosters basic research in 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.

Work in this project complements and is fully coordinated with work under PE 0602601A (Combat Vehicle and Automotive Technology). Selected university partners include: University of Michigan, Virginia Tech, Wayne State University, University of Iowa, Oakland University, 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Automotive Research Center (ARC)	3.870	4.092	4.195
Description: Funding is provided for the following effort.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 H73: *Automotive Research Center (ARC)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Researched fundamental challenges synthesizing and advancing ground vehicle technologies as well as power systems to improve mobility and reliability; addressed novel electronic architectures, alternative fuels and advanced materials for weight reduction. ***FY 2013 Plans:*** Conduct research in areas that include: non-traditional off-road vehicle dynamics and controls, soldier/vehicle interaction modeling, high-performance/lightweight structures and materials, advanced alternative propulsion systems including hybrids, strategic and innovative thermal management schemes, and vehicle system optimization and design for reliability with robustness. Research targeting key areas such as fuel economy, safety, system compactness, soldier/vehicle performance, cost savings, vehicle control (including autonomous vehicles), and system optimality/reliability. ***FY 2014 Plans:*** Will synthesize and test new hybrid propulsion concepts with novel energy conversion and storage devices; perform engine experiments with combustion modeling to characterize JP-8 performance; design lightweight and safe structures to address impact protection and reliability; integrate physical and cognitive human models to represent driving behavior; classify driver distraction, fatigue and stress; characterize Soft Soil Terra-mechanics and effects on mobility, safety and fuel economy; perform vehicle system integration through verification, validation and certification of vehicle tests, and multi-level vehicle design.			
Accomplishments/Planned Programs Subtotals	3.870	4.092	4.195

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 J08: *Institute For Creative Technologies (ICT)*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J08: *Institute For Creative Technologies (ICT)*	-	7.764	8.003	8.104	-	8.104	8.751	9.355	9.623	9.805	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

A. Mission Description and Budget Item Justification

This project supports simulation and training technology research at the Army's Institute for Creative Technologies (ICT) at the University of Southern California. The ICT was established as a University Affiliated Research Center (UARC) to support Army training and readiness through research into simulation and training technology for applications such as mission rehearsal, leadership development, health and medical, and distance learning. The ICT actively performs research and engages industry to exploit dual-use technology and serves as a means for the military to learn about, benefit from, and facilitate the transfer of applicable technologies into military systems. In addition the ICT works with creative talent from the entertainment industry to leverage techniques and capabilities and adapt concepts of story and character to increase the degree of participant immersion in synthetic environments in order to improve the realism and usefulness of these experiences. In developing a true synthesis of the creativity, research, technology, and capability of industry and the research and development community, the ICT is revolutionizing capabilities for the Army by making it more effective in terms of cost, time, range of experiences and the quality of the result. Resulting research, techniques, and technologies and techniques are transitioned for maturation to PE 0602308A /project D02.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Immersive Environments	3.016	3.063	3.116
Description: 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, simulation and application solutions and tools.. Research includes investigation of techniques and methods to address the rapid development of synthetic environments and the study of perception and cognition to help direct the development of new technologies and techniques that evoke more realistic responses from users.			
FY 2012 Accomplishments:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J08: *Institute For Creative Technologies (ICT)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Investigated the use of large scale 3D displays for immersive simulation and learning environments; and completed social perception as well as reactivity studies to improve virtual human responsiveness and rapport. ***FY 2013 Plans:*** Implement psychophysiology measures to improve the simulation fidelity of virtual immersive environments; and continue evaluation of techniques and methods to address the rapid development of synthetic environments. ***FY 2014 Plans:*** Will investigate integrated augmented reality environments that add virtual elements (people, objects, and events) onto real world visualization for training and learning purposes. Will examine techniques for the creation of virtual training content from sources such as mobile devices, mobile sensors, public databases, and sensor networks to make training and distance learning more accessible.			
Title: Graphics and Animations ***Description:*** 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 provides the sound stimulus for increasing the realism for military training and simulation devices. ***FY 2012 Accomplishments:*** Researched novel approaches for using specialized light sources to facilitate 3D modeling; and developed algorithms that provided real-time reconstruction of geometric shapes using a single photographic view of an object. ***FY 2013 Plans:*** Further research the creation of photo-real characters and environments and demonstrate these capabilities; develop comprehensive facial performance capture techniques; develop software for rendering multiple faces; and complete the research investigation of high-fidelity eye models for virtual characters. ***FY 2014 Plans:*** Will develop facial animation techniques that accurately mimic human facial expressions. Will develop a pipeline which combines automated rigging based on high-fidelity facial scans.	1.698	1.788	1.878
Title: Techniques and Human-virtual Human Interaction ***Description:*** Conduct basic research to investigate methods and techniques for improving the perception, communication, understanding, and responsiveness of virtual humans when interacting with live humans. ***FY 2012 Accomplishments:***	3.050	3.152	3.110

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J08: *Institute For Creative Technologies (ICT)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Enhanced toolkits for virtual humans to accelerate the development of virtual humans via collaborations with external organizations; and developed statistical models of culture-specific behaviors for conversations. ***FY 2013 Plans:*** Integrate virtual human system with life-like graphics, facial and body animations and develop multiple forms of learning algorithms as a part of Virtual Humans; and develop group behavior prediction models and algorithms to include social cognition, social perception and social reactivity models and algorithms for virtual humans. ***FY 2014 Plans:*** Will conduct evaluations of the social impact of virtual humans on human users and will develop social cues that predict cooperative/competitive orientation in a bargaining task to expand understanding of effectiveness of virtual characters as role players in training exercises. Will implement graphical cognitive architecture into Virtual Humans that will lead to less complex but more human-like systems.			
Accomplishments/Planned Programs Subtotals	7.764	8.003	8.104

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 J12: *Institute For Soldier Nanotechnology (ISN)*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J12: *Institute For Soldier Nanotechnology (ISN)*	-	10.441	10.706	10.558	-	10.558	10.646	10.689	10.884	11.096	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project supports sustained multidisciplinary research at the Army?s Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN was established as a University Affiliated Research Center (UARC) to support research to devise nanotechnology-based solutions for the Soldier. 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 Research, Development and Engineering Center (NSRDEC), and other Army Research Development and Engineering Command (RDECOM) elements, as well as several major industrial partners, including Raytheon and DuPont, in pursuit of its goals. This project 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Nanomaterials	2.639	2.705	2.700
Description: Nanomaterials research efforts focus on light-weight, multifunctional nanostructured fibers and materials.			
FY 2012 Accomplishments: Designed and fabricated photoconducting and photodiode fibers with bandwidth and noise equivalent power commensurate with communication system specifications; investigated the electrical tunability of conductive electrospun fibers establishing a clear			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J12: *Institute For Soldier Nanotechnology (ISN)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
processing-structure-property relationship for these fibers; examined properties of nanoparticle-containing layer-by-layer films, including films designed to be self-cleaning and with decontamination properties. ***FY 2013 Plans:*** Examine carbon nanotube/conducting polymer composite films assembled onto electrospun nanofibers to determine sensing properties; study properties conferred by various functional group additions/modifications to polymers for potential sensing applications; investigate the range of electrical robustness of conductive electrospun fibers for future signal communications; investigating mechanical properties of electrospun materials. ***FY 2014 Plans:*** Will characterize a variety of quantum dot and graphene-based structures as detection elements for night vision applications; will perform preliminary characterization of thermal properties at ceramic/polymer interfaces that may provide materials for improved cooling and power generation from waste heat; will model hybrid structure architectures of semiconductor materials within pre-drawn fibers to optimize the semiconductor performance within a fiber; will investigate methods for imaging light and sound within arrays of fibers designed for optical and acoustic detection.			
Title: Blast Effects on Soldier	5.166	5.295	5.250
Description: Blast Effects on Soldier research involves the areas of Battle Suit Medicine and Blast and Ballistic Protection. ***FY 2012 Accomplishments:*** Modeled shock propagation in new polymeric materials; examined the underlying biomechanical motion mechanisms of the P. senegalus (dinosaur eel) exoskeleton as well as the effect of curvature on the exoskeleton mechanics of this fish; examined properties of new aluminum nanoscale crystalline alloys and developed underpinning theory for stabilizing these alloys; continued development of nanostructured contractile polymers to serve as new actuator material technologies. ***FY 2013 Plans:*** Investigate natural armor systems to determine related mechanical behavior and penetration resistance; explore how new biological-design concepts can be scaled to resist forces proportional to blast or ballistic impact; assess new membranes for peptide immobilization and potential as a high-throughput assay of peptide activity; synthesizing and characterize continuous shape memory alloy fibers. ***FY 2014 Plans:*** Will synthesize a library of brain-lipid nanoparticles as a potential encapsulating agent for potential use in targeted therapies to treat traumatic brain injury; will measure structure and properties of two-layer aluminum-alloy nanostructures for future design of improved lightweight materials with optimized strength, hardness and toughness; will synthesize new protein-based hydrogels as tissue stimulants and test the effects of these hydrogels against blast and ballistic impact; will design and test atomistic level			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J12: *Institute For Soldier Nanotechnology (ISN)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
models for ceramic and polymer systems toward an ultimate multi-scalar model that provides more accurate predictive tools for material failure under blast and ballistic loading conditions.			
Title: Soldier Protection ***Description:*** Soldier Protection research efforts focus on Soldier Survivability and Protection and Nanosystems Integration. ***FY 2012 Accomplishments:*** Optimized quantum dot synthesis in pursuit of new schemes and collaborations with Army partners to improve the performance of quantum detector (QD) sensors in detecting biological warfare agents; evaluated hemorrhagic shock device and continue to develop rapid reconstitution prototype to be integrated in a spring-loaded syringe; and characterized novel nanoscale virucidal and bactericidal coatings for equipment surface protection. ***FY 2013 Plans:*** Investigate nanotube-based assemblies for detection of DNA and determine whether structures can be adapted to detect other chemicals and biological warfare agents; synthesize and characterize high-quality nanoscale virucidal and bactericidal coatings of sensory polymers using photochemical grafting and other fabrication methods; develop and characterize new fiber designs to determine structures that improve fiber sensing functionality; functionalize surface of graphene sensing devices to confer different electrochemistries and determine changes in selectivity. ***FY 2014 Plans:*** Will investigate modification of a graphene surface toward the design, fabrication and testing of a first-generation graphene sensor optimized for the detection of food pathogens; will determine various polymeric structures bound to carbon nanotubes and to screen these complexes against a panel of explosive compounds to potentially enable the future design of a highly-sensitive chemical detection platform, and will investigate methods for fabrication and testing of artificial protein polymer hydrogels for potential use as a biodegradable hemostat that can stop blood flow from a wound.	2.636	2.706	2.608
Accomplishments/Planned Programs Subtotals	10.441	10.706	10.558

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J12: *Institute For Soldier Nanotechnology (ISN)*

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 J14: *Army Educational Outreach Program*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J14: *Army Educational Outreach Program*	-	6.029	9.593	9.738	-	9.738	9.864	9.935	10.038	10.219	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Consolidated funds from 0605803 729 and 06061104 J14 to align educational outreach program elements into a central funding line of accounting.

A. Mission Description and Budget Item Justification

This project supports science activities that encourage elementary/middle/high school and college youths to develop an interest in and pursue higher education and employment in the science, mathematics, and engineering (STEM) fields. These activities are consolidated within the Army Educational Outreach Program (AEOP) that links and networks appropriate components to derive the best synergies to present the Army to a larger pool of technical talent and to provide students with Army-unique practical experiences at Army laboratories, centers, and institutes to fill future Army Science and Technology workforce needs. AEOP increases interest and involvement of students and teachers across the nation in science, mathematics, and engineering at all proficiency levels and backgrounds to include under-represented and economically disadvantaged groups through exposure to Army sponsored research, education, competitions, internships, and practical experiences. This project enhances the national pool of science and engineering personnel that in turn supports defense industry and Army laboratory and research, development, and engineering center needs.

In FY13, activities and funds for educational outreach are consolidated PE65803/729 into this PE 61104/J14.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus area, the Army Modernization Strategy, the Department of Defense STEM Educational Outreach Strategic Plan and the President's "Educate to Innovate" campaign for STEM education.

Work in this project is performed by the Research, Development, and Engineering Command (RDECOM), the Army Research Institute (ARI) for the Behavioral and Social Sciences, the Army Corps of Engineers' Engineer Research and Development Center (ERDC), Medical Research and Materiel Command (MRMC), and Space and Missile Defense Command (SMDC), and the United States Military Academy (USMA).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: eCYBERMISSION	3.628	3.628	3.892
Description: This program supports a nation-wide, web-based, science, technology, engineering and mathematics (STEM) competition for students in grades 6 through 9, designed to stimulate interest and encourage continued education in these areas among middle and high school students nationwide.			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J14: *Army Educational Outreach Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
FY 2012 Accomplishments: Increased participation from existing levels and increased geographic diversity; sustained eCYBERMISSION and implemented enhancements based on lessons learned from previous years. ***FY 2013 Plans:*** Continue to increase participation from existing levels with a concentrated effort in underserved populations and geographic diversity; sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years. ***FY 2014 Plans:*** Will work to further increase participation from existing levels with a concentrated effort in underserved populations, and to increase geographic diversity; will sustain eCYBERMISSION and implement enhancements based on lessons learned from previous years.			
Title: Educational Outreach and Workforce Development ***Description:*** In FY13, funds for this effort transferred from PE 0605803 Project 729 to align educational outreach program elements within a single Project. ***FY 2013 Plans:*** Continue AEOP support to reach under-represented and economically disadvantaged areas to enhance STEM education through student experiences in Army labs and academic partner institutions. Provide direct mentorship to students to broaden their interest in and their development of STEM education. ***FY 2014 Plans:*** Will continue AEOP support to reach under-represented and economically disadvantaged areas to enhance STEM education through student experiences in Army labs and academic partner institutions. Will provide direct mentorship to students to broaden their interest in and their development of STEM education.	0.000	2.416	2.430
Title: Army Educational Outreach Program Cooperative Agreement ***Description:*** The youth science cooperative outreach agreement (COA) encompasses a variety of outreach activities under AEOP. This activity supports a strong partnership with government, academia and industry to address the shortfall of clearable STEM skilled talent preparing for the workforce. These activities include Army-sponsored research, education, competitions, internships and practical experiences designed to engage and guide students and teachers in Army sponsored STEM programs. The funding for this line item was consolidated from PE 0605803 Project 729. ***FY 2012 Accomplishments:***	2.401	3.211	3.073

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J14: *Army Educational Outreach Program*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Funding was executed for the Army Educational Outreach program support. Efforts for this were fully rolled into 0601104 J14 from 0605803 729 in 2013. ***FY 2013 Plans:*** Continue to increase Army lab and research center sponsorship of students and STEM education opportunities. Provide competition incentives in STEM competitions that include scholarships, experiences, and mentorships as well as exposing students to DoD career opportunities; streamline processes, leverage funding and building educational partnerships. ***FY 2014 Plans:*** Will continue to increase Army lab and research center sponsorship of students and STEM education opportunities. Will provide competition incentives in STEM competitions that include scholarships, experiences and mentorships as well as expose students to DoD career opportunities. Will streamline processes, leverage funding and build educational partnerships. Will continue annual comprehensive review and educational assessments for programs to make data driven decisions and support best practices.			
Title: West Point Cadet Research ***Description:*** In FY13, funds for this effort are transferred fromPE 0605803 Project 729 to align educational outreach program elements within a single Project. ***FY 2013 Plans:*** Conducting West Point cadet research internship programs to enhance cadet training through field experience within Army research labs and centers. ***FY 2014 Plans:*** Will conduct West Point cadet research internship program to enhance cadet training through field experience within Army research labs and centers.	0.000	0.338	0.343
Accomplishments/Planned Programs Subtotals	6.029	9.593	9.738

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 J15: *Network Sciences ITA*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J15: *Network Sciences ITA*	-	7.453	4.048	4.125	-	4.125	4.192	4.221	4.301	4.384	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project supports research at a competitively selected United States (US)/United Kingdom (UK) government, university, and industry consortium established to perform fundamental network and information science investigations 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 with the emphasis on integration of multiple technical disciplines in an international arena. 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 cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Network and information science basic research for US/UK coalition operations information.	7.453	4.048	4.125
Description: This research will address the fundamental science underpinning the complex information network issues that are vital to future US/UK coalition military operations and to fully exploit the joint development of emerging technologies necessary to enable coalition operations.			
FY 2012 Accomplishments: Devised mathematical models to reason about network behaviors and composite security metrics to improve the security of heterogeneous coalition networks; investigated efficient and effective distributed federated database techniques to fuse and aggregate data from heterogeneous networks in support of dynamic coalition operations.			
FY 2013 Plans:			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J15: *Network Sciences ITA*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Develop scaling laws for hybrid networks with less restrictive assumptions regarding network homogeneity (relax the assumptions to account for variable bandwidth, network management information, etc.). Develop techniques for the management and control of hybrid coalition networks and techniques for the security of distributed services. These efforts contribute to the creation of novel capabilities to assist coalition Warfighters' capability to manage secure distribution of information in coalition networks, with efficiency and agility. ***FY 2014 Plans:*** Will develop controlled natural language that enables information extraction from structured and unstructured data sources to improve interactions between analyst and machine processing. This research will develop techniques to enable dynamic group coalition information exchange in hybrid mobile ad hoc and cellular networks. This research will also develop efficient and secure access to distributed data as a service among coalition partners without disclosure of security policies. These efforts will enhance network security and information sharing in coalition operations.			
Accomplishments/Planned Programs Subtotals	7.453	4.048	4.125

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 J17: *Vertical Lift Research Center Of Excellence*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
J17: *Vertical Lift Research Center Of Excellence*	-	2.569	2.771	3.062	-	3.062	3.026	3.189	3.243	3.301	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project fosters research to provide vertical lift capability and engineering expertise for the Army. The focus of the Vertical Lift Research Center of Excellence is 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 Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

Work in this project is performed extramurally by the Aeroflightdynamics Directorate of the Aviation and Missile Research, Development, and Engineering Center (AMRDEC) (located at the NASA Ames Research Center, Moffett Field, CA).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Vertical Lift Research Center of Excellence	2.569	2.771	3.062
Description: Funding is provided for the following effort			
FY 2012 Accomplishments: Fully implemented multiple new VLRCOE agreements, with substantial participation by Navy and NASA that included experimental and analytic work toward basic research applicable to future DoD rotorcraft fleet requirements.			
FY 2013 Plans: Implement year two of new VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology; secure Navy and NASA funding to supplement a robust experimental and analytic basic research program in			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 J17: *Vertical Lift Research Center Of Excellence*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
rotorcraft technologies including: Aeromechanics, Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations. ***FY 2014 Plans:*** Will implement year three of VLRCOE agreements with Penn State University, University of Maryland, and Georgia Institute of Technology to conduct a robust experimental and analytic basic research program in rotorcraft technologies including: Aeromechanics, Structures, Flight Dynamics and Control, Rotorcraft Design and Concepts, Vibration and Noise Control, Propulsion, Affordability, Safety and Survivability, and Naval Operations.			
Accomplishments/Planned Programs Subtotals	2.569	2.771	3.062

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army			DATE: April 2013
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 VS2: *Multi-Scale Materials Modeling Centers*	

COST ($ in Millions)	All Prior Years	FY 2012	FY 2013#	FY 2014 Base	FY 2014 OCO ##	FY 2014 Total	FY 2015	FY 2016	FY 2017	FY 2018	Cost To Complete	Total Cost
VS2: *Multi-Scale Materials Modeling Centers*	-	5.033	8.326	8.614	-	8.614	9.263	9.462	9.990	10.441	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project supports two competitively awarded Collaborative Research Alliances (CRAs) to provide the Army with next generation multi-functional materials for ballistic and electronic applications and to address the extreme challenges associated with understanding and modeling materials subject to Army operational environments. The Materials in Extreme Dynamic Environments consortium, led by Johns Hopkins University partnered with CalTech, Rutgers University, and University of Delaware, focuses on understanding materials under high strain-rates. The Multiscale/Multidisciplinary Modeling of Electronic Materials consortium, led by University of Utah partnered with Boston University, and Rensselaer Polytechnic Institute, focuses on microscale properties to design macroscale behavior for electronics. Research at both CRAs will address the modeling and experimental challenges associated with developing multidisciplinary physics simulations across multiple length scales for materials to include: a limited ability to relate materials chemistry, structure, and defects to materials response and failure under extreme conditions; an inadequate ability to predict the roles of materials structure, processing, and properties on performance in relevant extreme environments and designs; and the lack of experimental capabilities to quantify multiscale response and failure of materials under extreme conditions.

The cited work is consistent with the Assistant Secretary of Defense for Research and Engineering science and technology priority focus areas and the Army Modernization Strategy.

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

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
Title: Multi-Disciplinary, Multi-Scale Materials Behavior in Extreme Environments.	5.033	8.326	8.614
Description: Research will focus on the following areas: two-way multiscale modeling for predicting performance and designing materials, investigating analytical and theoretical analyses to effectively define the interface physics across length scales; advancing experimental capabilities for verification and validation of multiscale physics; and modeling and strategies for the synthesis of high loading rate tolerant materials so that all of the latter lead to the development of a comprehensive set of metrics that define high loading rate tolerant material systems. The multi-scale modeling capability will be applied across multiple			

Exhibit R-2A, RDT&E Project Justification: PB 2014 Army		DATE: April 2013
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 VS2: *Multi-Scale Materials Modeling Centers*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2012	FY 2013	FY 2014
disciplines to facilitate revolutionary advances in materials for coupled environments (electromagnetic, high rate, high pressure and other extreme environments). ***FY 2012 Accomplishments:*** An external center was competitively awarded to establish first- generation modeling and experimental techniques for multi-scale materials modeling. ***FY 2013 Plans:*** Demonstrate real-time microstructural interrogation of materials during high-rate experiments; identify key microstructural phenomena related to high-rate deformation, fracture, and failure at critical length and time scales; and accurately predict one or more bulk dynamic properties based upon models built up from smaller size scales in each of the four selected material systems (metallic, polymeric, ceramic, and composite). ***FY 2014 Plans:*** Will experimentally and computationally model and characterize the in-situ materials response to extreme dynamic environments in metallic, polymeric, ceramic and composite material systems through the incorporation of selected algorithms to enhance the fidelity of continuum simulation codes that optimize hybrid multi-material protection for soldier and vehicle systems. Will implement physics based modeling of electronic materials by developing a set of multiscale algorithms/theories for a range of electronic materials that enable better understanding of material, electronic, optical and opto-electronic properties. Will develop multiscale models and algorithms that predict the bulk and interfacial properties of fuel cells and electrochemical energy sources. Resulting models and algorithms will enable the advancement of the next generation sensors and power and energy devices on the battlefield.			
Accomplishments/Planned Programs Subtotals	5.033	8.326	8.614

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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, RDT&E Project Justification: PB 2014 Army					DATE: April 2013							
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 VS3: *Center For Quantum Science Research*			
COST ($ in Millions)	**All Prior Years**	**FY 2012**	**FY 2013#**	**FY 2014 Base**	**FY 2014 OCO ##**	**FY 2014 Total**	**FY 2015**	**FY 2016**	**FY 2017**	**FY 2018**	**Cost To Complete**	**Total Cost**
VS3: *Center For Quantum Science Research*	-	0.000	0.000	0.000	-	0.000	1.175	1.180	1.487	1.743	Continuing	Continuing

FY 2013 Program is from the FY 2013 President's Budget, submitted February 2012

The FY 2014 OCO Request will be submitted at a later date

Note

no funding for this program in FY13

A. Mission Description and Budget Item Justification

No funding for this program in FY13

B. Accomplishments/Planned Programs ($ in Millions)

N/A

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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.