Exhibit R-2, RDT&E Budget Item Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040: *Research, Development, Test & Evaluation, Army* / BA 2: *Applied Research*					R-1 Program Element (Number/Name) PE 0602716A / *Human Factors Engineering Technology*							
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
Total Program Element	-	21.118	23.778	23.681	-	23.681	23.671	24.034	24.636	25.094	-	-
H70: *Human Fact Eng Sys Dev*	-	21.118	23.778	23.681	-	23.681	23.671	24.034	24.636	25.094	-	-

A. Mission Description and Budget Item Justification

This program element (PE) conducts applied research on aspects of human factors engineering that impact the capabilities of individual and teams of Soldiers operating in complex, dynamic environments. The results of the research will enable maximizing the effectiveness of Soldiers and their equipment for mission success. The aspects of human factors that will be studied include sensing, perceptual and cognitive processes, ergonomics, biomechanics and the tools and methodologies required to manage interaction within these areas and within the Soldiers' combat environment. Project H70 research is focused on decision-making; human robotic interaction; crew station design; improving Soldier performance under stressful conditions such as time pressure, information overload, information uncertainty, fatigue, on-the-move and geographic dispersion; and enhancing human performance modeling tools.

Work in this project leverages basic research performed in PE 0601102A (Defense Research Sciences), and complements and is fully coordinated with PE 0602601A (Combat Vehicle and Automotive Advanced Technology), PE 0602786A (Warfighter Technology), PE 0602120A (Sensors and Electronic Survivability), PE 0602784A (Military Engineering Technology), PE 0602783A (Computer and Software Technology), PE 0602308A (Advanced Concepts and Simulation), PE 0602785 (Manpower/ Personnel/Training Technology), PE 0603005A (Combat Vehicle and Automotive Technology), PE 0603710A (Night Vision Advanced Technology), PE 0603015A (Next Generation Training and Simulation), and PE 0603007A (Manpower, Personnel, and Training Advanced Technology).

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

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

B. Program Change Summary ($ in Millions)	FY 2014	FY 2015	FY 2016 Base	FY 2016 OCO	FY 2016 Total
Previous President's Budget	21.328	23.783	23.822	-	23.822
Current President's Budget	21.118	23.778	23.681	-	23.681
Total Adjustments	-0.210	-0.005	-0.141	-	-0.141
• Congressional General Reductions	-	-0.005			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.210	-			
• Adjustments to Budget Years	-	-	-0.141	-	-0.141

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army											Date: February 2015	
Appropriation/Budget Activity 2040 / 2					R-1 Program Element (Number/Name) PE 0602716A / *Human Factors Engineering Technology*				Project (Number/Name) H70 / *Human Fact Eng Sys Dev*			
COST ($ in Millions)	**Prior Years**	**FY 2014**	**FY 2015**	**FY 2016 Base**	**FY 2016 OCO**	**FY 2016 Total**	**FY 2017**	**FY 2018**	**FY 2019**	**FY 2020**	**Cost To Complete**	**Total Cost**
H70: *Human Fact Eng Sys Dev*	-	21.118	23.778	23.681	-	23.681	23.671	24.034	24.636	25.094	-	-

Note

Not applicable for this item.

A. Mission Description and Budget Item Justification

This project conducts applied research on human factors to maximize the effectiveness of Soldiers in concert with their equipment. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks, and Soldier training as well as manpower requirements to improve equipment operation and maintenance. Application of this research will yield reduced workload, fewer errors, enhanced Soldier protection, user acceptance, and allows the Soldier to extract the maximum performance from the equipment.

Major efforts research sources of stress, potential stress moderators, and intervention methods, and identify and quantify human performance measures and methods to address current and future warrior performance issues. Individual efforts exploit adaptive learning methods and strategies, enhance and validate human performance modeling tools; investigate integration of advanced concepts in crew stations designs, optimizes interfaces for information systems and improves human robot interaction (HRI) in a full mission context.

Efforts in this program element support the Army science and technology Soldier portfolio.

Results of these efforts are transitioned to the Research, Development, and Engineering Centers, the Program Executive Offices (PEO) & Program Managers, U.S. Army Training and Doctrine Command (TRADOC), U.S. Army Medical Command (MEDCOM), Manpower and Personnel Integration (MANPRINT) G1, U.S. Army Test and Evaluation Command (ATEC), etc.

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

Work is performed by the U.S. Army Research Laboratory (ARL), Aberdeen, MD.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Title: Interfaces for Collaboration and Decision Making	3.324	3.361	2.711
Description: Beginning in FY14, the title of this effort is renamed from Adaptive Learning Methods and Strategies to Interfaces for Collaboration and Decision Making to more accurately reflect the current nature of the project. This effort looks at the study of how networks influence, and are influenced by, human behavior in the context of military decision making. The studies, which range from computational modeling to networked simulations in a laboratory environment, to large-scale simulation exercises,			

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
Appropriation/Budget Activity 2040 / 2	**R-1 Program Element (Number/Name)** PE 0602716A / *Human Factors Engineering Technology*	**Project (Number/Name)** H70 / *Human Fact Eng Sys Dev*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
will investigate the effects of technology on information flow, cognitive workload, team collaboration, organizational effectiveness, situational awareness, and decision making. ***FY 2014 Accomplishments:*** Concentrated on influencing network-enabled operations at the Company level; assessed mission command work/information flow, network knowledge requirements, cognitive workload, situation awareness, and unit performance; developed and validated a cognitive work analysis/computational model of the Company Intelligence Support Team and its relationship to Company planning, execution and Commander's decision-making; assessed networked handheld decision support tools; continued development and validation of key models (Social Network Analysis, Command, Control and Communication Techniques for Reliable Assessment of Concept Execution (C3TRACE), and Chemical Warfare Agents) of the evolving mission command work domain; supported Mission Command Battle Lab network simulation exercises. ***FY 2015 Plans:*** Examine communication capabilities of small team operations at the "edge" of the battlefield, with a focus on the effectiveness of different types of interfaces and (information) presentation techniques; enhance experimental platforms for studying mission command network operations in civil-military scenarios. Goals are to develop techniques for improved information sharing, more effective use of available information, and new and enhanced metrics and methods leading to a better understanding of how human-network interactions impact distributed team performance. Research is conducted via human-system information flow modeling, lab, simulation, and field experimentation using novel information and collaboration technologies in realistic networked environments with teams ranging from squads to command headquarters sizes. ***FY 2016 Plans:*** Will identify and investigate aspects of information displays and interfaces that best support the effective conduct of tactical intelligence; Validate the effectiveness of interface type and information presentation techniques in experimental decision aids such as the Warfighter Associate; and conduct research to identify elements critical to information display and presentation for the development of future decision aids applicable to civil-military, tactical (Company level), and cyber security.			
Title: Human Performance Modeling ***Description:*** Enhance human performance modeling tools to reduce workload and human errors and increase user acceptance of developing technologies allowing the Soldier to extract the maximum performance from the equipment. Collect and analyze empirical data on human perception (vision and hearing) to support human and system performance models used for equipment design and training. Efforts are coordinated with PE 0602786/project H98. ***FY 2014 Accomplishments:***	3.494	3.521	2.672

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Collected and analyzed empirical data to support human and system performance models used for equipment design and training; continued to investigate the effects of physical and cognitive stress on Soldier performance, and transitioned results to Soldier performance models; investigated Soldier load physical and cognitive algorithms developed in FY13 and their application to the human performance models; and examined human performance as a function of cognitive stress, weapon system dynamics, load distribution, etc. ***FY 2015 Plans:*** Develop Human System Integration (HSI) tools and methodologies to quantify the usability of systems developed to support team environments. These tools provide quantitative data that can be used to support acquisition and design trade off decisions. Research is conducted using findings from human sciences, algorithm development, field trials with military use cases, and feedback from the research, military, analyst, and system design and development communities. ***FY 2016 Plans:*** Will enhance the analytic capabilities and usability of current human performance modeling tools by incorporating cognitive distraction driving scales, updating military specialty lists and improving reporting and visualization capabilities; expand human figure digital library by developing 3D models of Air Soldier clothing and equipment items to perform early human figure modeling assessments of future aviation platform designs; investigate the importance of coping style and working memory capacity for improved prediction of cognitive performance while driving; and investigate the feasibility of incorporating Soldier Systems Engineering Architecture (SSEA) drawings and Human View concepts into the Improved Performance Research Integration Tool (IMPRINT) to improve system design predictions and drive design requirements early in acquisition.			
Title: Brain-Computer Interaction ***Description:*** Beginning in FY14, this effort was renamed from Interfaces for Vehicle and Mobility Systems to Brain-Computer Interaction Technologies to more accurately reflect the nature of the project, a 6.2 program in neuroscience. Investigate the use of neurophysiological and behavior-based technologies for enhancing the interaction between Soldiers and systems such as autonomous systems and advanced crew stations. Implement guidelines for: algorithms for characterizing Soldier brain activity in operational contexts; real-time techniques to integrate neurally-based information into systems designs. ***FY 2014 Accomplishments:*** Developed mitigation techniques for enhancing Soldier-system performance that can be triggered by on-line brain-computer neuro-technologies that predicts deficits in Soldier cognitive state and performance. ***FY 2015 Plans:***	2.256	2.278	3.338

Exhibit R-2A, RDT&E Project Justification: PB 2016 Army		Date: February 2015
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Develop and mature brain-computer interaction technology for image analysis that is capable of adapting to the user for increased joint Soldier-system performance. ***FY 2016 Plans:*** Will investigate novel approaches for image analysis that fuse computer vision and brain-computer interaction technologies for enhanced target identification capabilities.			
Title: Dismounted Soldier Performance ***Description:*** Beginning in FY14, this effort was renamed from Improved Man Machine Interfaces to Dismounted Soldier Performance in order to more accurately reflect the nature of the project. Investigate equipment design standards and human performance measures and create guidelines for maneuver team information systems solutions that improve situational understanding and decision cycle time; identify, mature, and quantify human performance limitations to address future warrior performance issues. ***FY 2014 Accomplishments:*** Conducted applied research and analysis on the effects of physical and cognitive loads on Soldier performance for step-wise improvements in equipment design that will contribute incrementally to lightening the Soldier load; characterized effects of weapon recoil on shooting performance by refining multivariate techniques/analyses regarding marksmanship performance; and transitioned results to Army Marksmanship Unit. ***FY 2015 Plans:*** Expand applied research and analysis on the effects of physical and cognitive loads on Soldier performance to more operationally relevant environments; determine and mature guidelines for equipment developers and the Research and Development Centers that will lighten the Soldier physical, sensory and cognitive burden and enhance Soldier and small team performance; apply techniques developed for quantifying the effects of weapon recoil on shooter performance to a broader area of research (such as the effects of small arms equipment on marksmanship performance); and transition results to the U.S. Army Marksmanship Unit. ***FY 2016 Plans:*** Will investigate effects of cognitive stress on physical performance; Develop techniques to employ basic science principals discovered in highly controlled laboratory experiments in more operationally relevant environments using more militarily relevant physical and cognitive stressors to enhance research results; conduct research to inform guidelines for equipment developers and the Research and Development Centers that will enhance Soldier and small team performance; Investigate the effects of small arms recoil on shooter performance and transition results to research and development centers and the U.S. Army Marksmanship Unit.	5.306	6.354	6.204
Title: Human-Robot Interaction (HRI)	4.530	4.242	3.164

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Description: Develop human-centered design requirements and technologies for supervision and Soldier interaction with multiple semi-autonomous unmanned vehicles in urban and unstructured environments. ***FY 2014 Accomplishments:*** Continued to focus on human-robot interaction by examining such issues as Soldier-robot interaction modes, communication, situation awareness, trust and transparency in coordination with the ARL autonomous systems enterprise partners. ***FY 2015 Plans:*** Continue to focus on human-robot interaction by examining such issues as Soldier-robot interaction modes, communication, situation awareness, trust and transparency in coordination with the ARL Autonomous Systems Enterprise partners. ***FY 2016 Plans:*** Will develop concepts for efficient Soldier-robot interaction and teaming, multimodal bidirectional communication between Soldiers and autonomous systems, and trust and transparency between Soldier and robot; and investigate the impact of social-cultural context on usage of autonomous systems in coordination with the ARL autonomous systems enterprise partners.			
Title: Understanding Socio-cultural Influence ***Description:*** Investigate and model cognitive aspects of socio-cultural influences on Soldier/Commander decision making and communication to enhance Soldier performance with systems, within teams and in the mission context. Extend models of individual and teams to societal levels to support regional understanding, training, mission rehearsal, and influence. This work complements and is coordinated with PE 0602784/project T41 (Socio-Cultural Modeling) and PE 0602785/project 790 (Leader Development). ***FY 2014 Accomplishments:*** Developed proof-of-concept decision support tools that effectively present relevant socio-cultural information to the Soldier/ Commander to enhance Soldier/Commander decision making in diverse environments. ***FY 2015 Plans:*** Validate cognitive framework and proof of concept decision support tools; develop guiding principles for the presentation of socio-cultural information using validated cognitive framework; initiate extension of cognitive framework to encompass societal-level perspective leveraging historical OSD-investments; and determine experiment requirements for validation of extension. ***FY 2016 Plans:*** Will conduct experiments on the effectiveness of information presentation using the socio-culturally informed design principles; integrate cognitive framework into select experimental decision support and training tools and validate tools with experiments	1.219	2.022	2.019

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
designed to determine if relevant socio-cultural information is presented effectively to enhance Soldier decision making in diverse environments.			
Title: Incorporating MANPRINT Considerations Early in the Acquisition Process ***Description:*** Develop system-relevant human performance and human-system interaction requirements for inclusion early in acquisition to ensure that human-system capabilities and limitations are properly reflected and that their associated cost, benefits, and risks are considered during analysis of alternatives when making trade-offs among effectiveness, suitability, and life-cycle costs. ***FY 2014 Accomplishments:*** Applied promising methodologies to test case scenarios for selected acquisition programs; and calculated the return on investment realized by incorporating MANPRINT considerations early in the acquisition process.	0.989	-	-
Title: Soldier Sensory Performance ***Description:*** In FY16, the effort described here as Soldier Sensory Performance and the associated funding will be separated from the effort entitled Interfaces for Collaboration and Decision Making. Conduct Soldier-oriented research to understand the attentional and cognitive challenges of interpreting unaided and aided tactile signals, visual imagery, and auditory events in complex, dynamic battlefield environments. Results are used for enhancing sensory performance by providing the materiel development community with the knowledge necessary to effectively design systems that maximize mission effectiveness and survivability of the dismounted Soldier. ***FY 2016 Plans:*** Will conduct Soldier-centric research on personnel-borne IED detection technologies to characterize operator/system strengths and constrains, and maximizing IED detection performance; conduct research on enhancements to night-vision goggle technologies, including studies designed to optimize processing parameters (e.g., image latency and frame rate) for electronically coupled night-vision and thermal detection systems; continue to support equipment development by providing human auditory performance data to research development and engineering centers (RDECs) in order to develop evaluation standards that are tied to the impact of auditory capabilities on operational requirements; conduct a study to examine the efficacy of two-way tactile communication to support squad-level communications; explore the integration of bone conduction technology communication systems into chemical, biological, radiological and nuclear protective masks to improve Soldier communication and validate their effectiveness in a field environment.	-	-	1.473
Title: Training Effectiveness Research ***Description:*** Novel technologies and their implementation in Army systems may result in demands on Soldiers that exceed their knowledge, skill, or memory capacity. When demands cannot be remediated by human systems integration, training may	-	1.000	1.000

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
enable the demands to be met. This effort will identify human operator tasks in complex, intelligent, and emerging systems critical to mission employment of new technologies. The aspects (particularly knowledge and skill) of those tasks will be determined through experimentation and analysis to inform development of training and simulation technologies, fundamental research on the effectiveness of training regimes, and simultaneous task combinations that must be trained. ***FY 2015 Plans:*** Investigate emerging technologies and target those likely to place significant demands on human operators, in particular intelligent, decision-aiding, and autonomous systems for which transparency and trust are crucial; conduct analyses of two emerging or projected technologies in the context of mission performance to determine combinations of tasks, such as, those resulting from use of the emerging technology and those from legacy systems, those requiring understanding of dynamic system models, required for mission performance; and conduct research on task combinations to determine parameters that may inform the development of training technologies. ***FY 2016 Plans:*** Will identify user skills that are critical to interacting with intelligent, autonomous systems and appropriate methods for measuring the user's skill level; identify or develop approaches for evaluating the effectiveness of various types of training to conduct select human operator tasks.			
Title: Soldier System Architecture ***Description:*** Soldier performance is affected by mission demands, environment, human characteristics, equipment, and technology. System development requires considering tradeoffs among these factors and sufficient data about them on which to base analyses. This effort will identify and develop human performance measures of effectiveness and performance (MOEs and MOPs) critical to performing individual and team tasks in a mission text. Empirical data will be mined from existing sources or collected where gaps exist to inform the interaction among factors affecting Soldier mission performance for emerging technologies. ***FY 2015 Plans:*** Conduct research to identify relative contributions and interactions of factors critical to Soldier and team system performance; work within Human Systems community to identify and prioritize critical human performance MOEs and MOPs; conduct research to support development of high priority measures not supported by sufficient empirical data involving interaction among factors such as mission demands, environment, human characteristics, equipment and technology; and propose modifications to individual measures to account for small team performance. ***FY 2016 Plans:***	-	1.000	1.100

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2014	FY 2015	FY 2016
Will develop model-based predictive analyses of Dismounted Infantry (DI) missions that will provide DOD leadership with analytic data to inform requirements development and trade-off decisions as early as Milestone A. These analyses will integrate Human Systems Integration (HSI) and Systems Engineering (SE) inputs to generate critical tasks combinations that provide the necessary analytical data to support cognitive workload measurement, MOEs, and MOPs for DI.			
Accomplishments/Planned Programs Subtotals	21.118	23.778	23.681

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

N/A