

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2008

BUDGET ACTIVITY		PE NUMBER AND TITLE					
2 - Applied Research		0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY					
COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate
Total Program Element (PE) Cost	40705	39763	17348	18656	19042	19463	19901
H70 HUMAN FACT ENG SYS DEV	18916	17312	17348	18656	19042	19463	19901
J21 HUMAN FACTORS APPLIED RESEARCH CA	21789	22451					

A. Mission Description and Budget Item Justification: This program funds the investigation and evaluation of aspects of human factors engineering that may limit or improve capabilities of individuals and teams of Soldiers operating in complex, dynamic environments. The knowledge gained through this applied research will enable maximizing the effectiveness of Soldiers and their equipment for mission success. Key research areas 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. 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. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of Soldiers, with particular emphasis on Soldier and equipment interaction. Application of advancements and tools yields reduced workload, fewer errors, enhanced Soldier protection, user acceptance and allows the Soldier to extract the maximum performance from the equipment. Work in this program element (PE) is related to, and fully coordinated with, efforts in 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 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). Project J21 funds Congressional special interest items.

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

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

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<u>B. Program Change Summary</u>	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2008/2009)	40902	17426	17169
Current BES/President's Budget (FY 2009)	40705	39763	17348
Total Adjustments	-197	22337	179
Congressional Program Reductions		-263	
Congressional Rescissions			
Congressional Increases		22600	
Reprogrammings	508		
SBIR/STTR Transfer	-705		
Adjustments to Budget Years			179

Two FY08 congressional adds totaling \$22600 were added to this PE.

- (\$1600) High Optempo Performance Soldier Training
- (\$21000) LWI Training-based Collaborative Research

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COST (In Thousands)	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate	FY 2012 Estimate	FY 2013 Estimate	
H70 HUMAN FACT ENG SYS DEV	18916	17312	17348	18656	19042	19463	19901	

A. Mission Description and Budget Item Justification: The goal of this project is to maximize the effectiveness of Soldiers in concert with their equipment, in order to survive and prevail on the Future Force battlefield. Major efforts in this project include research to identify sources of stress, potential stress moderators, intervention methods, adaptive learning, and supporting information technology to reduce uncertainty and improve decision quality for leaders and teams engaged in Command and Control (C2) planning and execution; enhancement of human performance modeling tools to optimize Soldier machine interactions for Future Force Systems and the collection of empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models; investigations on the effects on Soldier performance from integration of advanced concepts in crew stations designs; the identification, assessment, and mitigation of the effects of vehicle motion on Soldier performance; investigations to determine interface design solutions for brigade combat teams (BCT) information systems that enhance situational understanding and decision cycle performance; identification and quantification of human performance measures and methods to address future warrior performance issues; and improvement of human robotic interaction (HRI) in a full mission context. The barriers to achieving the goal include incomplete Soldier performance data and models of the new missions, organizations, and new and complex technologies transforming the Army. Specialized laboratory studies and field evaluations are conducted to collect performance data on the capabilities and limitations of Soldiers, with particular attention on Soldier and equipment interaction. The resulting data are the basis for weapon systems and equipment design standards, guidelines, handbooks, and Soldier training and manpower requirements to improve equipment operation and maintenance. Application of advancements yields reduced workload, fewer errors, enhanced Soldier protection, user acceptance, and allows the Soldier to extract the maximum performance from the equipment. Work in this project is conducted in cooperation with Tank and Automotive Research, Development, and Engineering Center (TARDEC); Natick Soldier Research, Development, and Engineering Center (NSRDEC); Communications-Electronics Research, Development, and Engineering Center (CERDEC); Simulation and Training Technology Center (STTC); Engineer Research and Development Center (ERDC); Army Research Institute (ARI); and Army Materiel Systems Analysis Activity (AMSAA).

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<u>Accomplishments/Planned Program:</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Identify sources of usability deficiencies and mismatches between Soldier capabilities and technological advances and provide tools to enable adaptive learning, reduce uncertainty, and increase situational awareness to improve decision quality for leaders and teams engaged in Command and Control (C2) planning and execution. In FY07, validated a suite of tools to improve C2 capabilities in uncertain and urban environments; and conducted cognitive task analysis of multi-player training modules. In FY08, assess team performance while performing multiple concurrent tasks and functions using integrated Intelligence, Surveillance, and Reconnaissance (ISR) technologies. Use field and lab venues to investigate real-time human-system/-network interaction measurement, monitoring and facilitation techniques. In FY09, will determine methods to identify and monitor neural and behavioral markers of pending performance drops; will consider	4637	4095	3855

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correlates such as fatigue and system reliability issues. These methods will be incorporated into the cognitive fight-ability model-based evaluation tool for use within the acquisition and system design process as a candidate information system to recommend design modifications before prototypes are developed.			
Enhance human performance modeling tools to optimize Soldier machine interactions for Future Force. Collect empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models. In FY07, identified and applied analysis metrics aimed at distinguishing performance of teams embedded within system-of-system (SoS) and joint operations; created and distributed a protected web-based repository of human performance models used in Manpower and Personnel Integration (MANPRINT) analyses; modeled terrain-hazard detection that integrated terrain-hazard detection data by human and machine-vision algorithms. In FY08, incorporate stressor algorithms contributed by other Services into Improved Performance Research Integration tool (IMPRINT 8 (Pro)), re-verify and distribute the tool; collect human performance data using head-mounted, dual waveband sensors for room clearing, and other operations in urban environments. In FY09, will verify and distribute linked basic task, cognitive and human motion models to the human systems integration community and platform developers; will validate approach to modeling body size increase due to clothing; will transition data to Army Night Vision and Electronic Sensors Directorate to verify metrics for the evaluation of algorithms for fusing imagery from multiple-waveband sensors.	3160	2909	2574
Investigate effects on Soldier performance from integration of advanced concepts in crew stations designs. Identify, assess, and mitigate the effects of vehicle motion on Soldier performance. In FY07, leveraged lessons learned from Crew-station Integration and Automation Testbed (CAT) experimentation to generate recommendations to improve Soldier performance using drive-by-wire systems and identified and evaluated concepts for advanced visualization and auto-adaptive driving aids. In FY08, explore techniques to improve Soldiers' ability to simultaneously perform visual scanning for targets and mobility-related tasks and transition recommendations to TARDEC. In FY09, will determine Soldier machine interface design recommendations to enable the local area security function and the optimization of performance in mixed autonomous driving environments.	2100	2100	2240
Investigate and determine interface design solutions for maneuver team information systems that enhance situational understanding and decision cycle performance. Identify, mature, and quantify human performance measures and methods to address future warrior performance issues. In FY07, matured physics-based models of human locomotion to predict Soldier mobility and range of motion; investigated individual Soldier physical and cognitive performance using prototype FFW Soldier systems; and linked human performance predictor variables to dismounted Soldier performance metrics. In FY08, explore the effects of advanced technologies, weight distribution, and focusing on small arms shooting performance and incorporate data to refine Soldier small arms shooter model. In FY09, will explore advanced technologies to identify improvements in dismounted squad performance; and will transition the small arms shooter model to the Soldier Program Executive Office.	5009	4538	4879
Improve human robotic interaction (HRI) in a full mission context for aerial and ground unmanned vehicles (UVs). In FY07, addressed Soldier-robotics team performance for mounted-dismounted combined arms missions using models and metrics with the goal of identifying optimal HRI interfaces for particular operational contexts; utilized metrics and diagnostics based on field studies and simulation experiments to determine optimal span of control and adaptive automation for UVs during Future Force missions. In FY08, transition HRI modeling results and design guidelines for automation and interface design and provide empirically-based recommendations for improving teaming performance to TARDEC; contribute to data collection and HRI analysis of TARDEC's field experiments using multiple UVs to validate workload reduction and performance effects. In FY09, will develop multimodal and performance based adaptive automation interfaces to control multiple, non-heterogeneous, aerial, and ground robotic systems.	4010	3668	3800
Small Business Innovative Research/Small Business Technology Transfer Programs		2	

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