ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY**

COST (In Thousands)		FY 2006 Actual	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	27549	40902	17426	17169	18574	18956	19373	19799
H70	HUMAN FACT ENG SYS DEV	16670	18650	17426	17169	18574	18956	19373	19799
J21	HUMAN FACTORS APPLIED RESEARCH CA	10879	22252						

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 to 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).The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work in this project is performed by the Army Research Laboratory (ARL).

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B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	28420	18858	18312	18450
Current BES/President's Budget (FY 2008/2009)	27549	40902	17426	17169
Total Adjustments	-871	22044	-886	-1281
Congressional Program Reductions		-156		
Congressional Rescissions				
Congressional Increases		22500		
Reprogrammings	-871	-300		
SBIR/STTR Transfer				
Adjustments to Budget Years			-886	-1281

Four FY07 congressional adds totaling $21566 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

($1917) Manpower & Personnel Integration (MANPRINT)
($1054) Team Perf & Optimization in Agent/Human Agent Team
($2492) High Optempo Performance Soldier Training
($16103) Leonard Wood Research Institute

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602716A - HUMAN FACTORS ENGINEERING TECHNOLOGY**	**H70**

COST (In Thousands)		FY 2006 Actual	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	16670	18650	17426	17169	18574	18956	19373	19799

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 Warrior (FFW) and 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 Center (NSC); 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). The cited work is consistent with Strategic Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP). Work is performed by the Army Research Laboratory (ARL).

Accomplishments/Planned Program:	FY 2006	FY 2007	FY 2008	FY 2009
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 FY06, refined decision aids to optimize visualization and information sharing requirements and investigated the usability and effectiveness of interactive technology for immersive training scenarios. In FY07, validate a suite of tools to improve C2 capabilities in uncertain and urban environments; and conduct cognitive task analysis of multi-player training modules. In FY08, will assess team performance while performing multiple tasks and functions occurring simultaneously when using integrated Intelligence, Surveillance, and Reconnaissance (ISR) technologies in uncertain situations. Will transition a report to the Simulation and Training Technology Center (STTC) on the ability of cognitive readiness metrics to predict performance in multi-user simulation implemented by the School for Command Preparation, Ft Leavenworth. In FY09, will determine methods to measure such attributes as motivation, mental resiliency, adaptability, and psychomotor skills that are needed for successful performance for the Future Force. These methods will be incorporated into the cognitive fight-ability model-based evaluation tool for use within the acquisition and	3959	4437	4095	3855

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 FFW and Future Force. Collect empirical data on human perception (vision and hearing) to support the development and validation of human and system performance models. In FY06, incorporated ability to model human performance in joint operations with the Improved Performance Research Integration tool (IMPRINT 8 (Pro)); provided data to the Army Night Vision and Electronic Sensors Directorate (NVESD) to develop an object-recognition-based metric for the evaluation of algorithms for fusing imagery from multiple wavebands compared with the component, single-waveband imagery, and determined the feasibility of eye-movement data as a measure of effectiveness (MOE) of fusion algorithms. In FY07, identify and apply analysis metrics aimed at distinguishing performance of teams embedded within system-of-system (SoS) and joint operations; create and distribute a protected web-based repository of human performance models used in Manpower and Personnel Integration (MANPRINT) analyses; model terrain-hazard detection that integrates terrain-hazard detection data by human and machine-vision algorithms. In FY08, will incorporate stressor algorithms contributed by other Services into IMPRINT Pro, will re-verify and distribute the tool. Will 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 NVESD to verify metrics for the evaluation of algorithms for fusing imagery from multiple-waveband sensors.	2194	3115	3025	2535
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 FY06, extended mitigation solutions to a broad cross section of ride problems and integrated with multimodal display and control approaches for a comprehensive solution. In FY07, leverage lessons learned from Crewstation Integration and Automation Testbed (CAT) experimentation to generate recommendations to improve Soldier performance using drive-by-wire systems and identify and evaluate concepts for advanced visualization and auto-adaptive driving aids. In FY08, will explore techniques to improve Soldiers' ability to simultaneously perform visual scanning for targets and mobility-related tasks and will 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.	2108	2100	2100	2100
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 FY06, transitioned display design guidelines to the Future Combat Systems Manned Integration team and the FFW technical program office based upon the experiment and model results. In FY07, mature physics-based models of human locomotion to predict Soldier mobility and range of motion; investigate individual Soldier physical and cognitive performance using prototype FFW Soldier systems; and link human performance predictor variables to dismounted Soldier performance metrics. In FY08, will 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 FFW program.	4509	5009	4538	4879
Improve human robotic interaction (HRI) in a full mission context for aerial and ground unmanned vehicles (UVs). In FY06, conducted empirical investigations of multitasking effects on HRI scaleable interfaces for mounted and dismounted Soldiers, multimodal and 3-D operator control units (OCUs), and adaptive automation. Collected data on OCU concepts during field experimentations and transitioned results to the TARDEC; and investigated HRI implications of mixed asset teaming concepts in realistic simulation and field experiments. In FY07, address 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; utilize metrics and diagnostics based on field studies and simulation experiments to determine optimal span of control and adaptive automation for UVs during FFW and Future Force missions. In	3900	3910	3668	3800

FY08, will transition HRI modeling results and design guidelines for automation and interface design and provide empirically-based recommendations for improving teaming performance to TARDEC; will 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.				
Small Business Innovative Research/Small Business Technology Transfer Programs		79		
Total	16670	18650	17426	17169