ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
Total Program Element (PE) Cost		22710	27416	16181	17083	17462	17941	18308
C90	Advanced Distributed Simulation	9838	10435	10166	10934	11186	11541	11780
D01	PHOTONICS RESEARCH	3354	3351	0	0	0	0	0
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	4631	5350	6015	6149	6276	6400	6528
D14	Advanced Modeling and Simulation Initiatives (CA)	4887	6900	0	0	0	0	0
HB4	IMMERSIVE ENVIRONMENT APPLIED RSCH INITIATIVE (CA)	0	1380	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element funds applied research in modeling and simulation technologies for application to training and evaluation of the Future Combat System (FCS), the Future Force (FF) and the Current Force. It establishes standards, architecture, and interfaces essential to realizing the Army vision of creating a verified, validated, and accredited synthetic "electronic battlefield" environment as an acquisition evaluation, training, and mission planning and rehearsal tool. The creation of this electronic battlefield environment requires advanced distributed simulation technologies, such as networking of models, complex data interchange, and collaborative training. The application of this electronic battlefield environment to support training requires applied research in modeling, simulation, and training technologies, such as immersive training, leadership development, and concept exploration. This environment will help the Army to investigate and refine new warfighting concepts, including the next generation of tactics, doctrine, training techniques, soldier support systems, and system upgrades. Project C90 focuses on advancing technologies required for real time interactive linking within and among constructive, virtual, and live simulation and training by maturing technologies for advanced distributed interactive simulation. Project D02 provides applied research in immersive training at the Institute for Creative Technologies (ICT) at the University of Southern California, Los Angeles, California, to leverage the entertainment and game industries in advancing the Army's modeling and simulation technology and applications. This program will ensure the transition of the research results of the ICT into the Army technology base and future Army training products. Projects D01 and D14 fund Congressional special interest items. Work in this program element is related to and fully coordinated with efforts in PE 0603015A, Project S28 (Institute for Creative Technologies (ICT) - Advanced Technology Development) and PE 0603015A, Project S29 (Modeling and Simulation - Advanced Technology Development); and PE0601104A, Project J08 (Institute for Creative Technology). This work does not duplicate an effort within the military Departments. 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 PE is performed by the Research Development and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

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B. Program Change Summary	FY 2005	FY 2006	FY 2007
Previous President's Budget (FY 2006)	22721	16013	16858
Current BES/President's Budget (FY 2007)	22710	27416	16181
Total Adjustments	-11	11403	-677
Congressional Program Reductions		-120	
Congressional Rescissions		-277	
Congressional Increases		11800	
Reprogrammings	-11		
SBIR/STTR Transfer			
Adjustments to Budget Years			-677

FY 05 increase of +$2.4 million (after adjustment for Congressional Undistributed Reductions) is attributed to reprogramming of two Congressional Adds. $1.4M for Standoff Hazardous Agent Detection and Evalutation Systems Research and $1.0M for Advanced Laser Electric Program, both from PE 0603627 for proper execution.

Four FY06 Congressional adds totaling $11800 were added to this PE.

FY06 Congressional adds with no R-2A (appropriated amount is shown):
($1000) Automated Man-In-Simulant-Test (MIST)
($1400) Institute for Creative Technologies
($3400) Photonics Center
($6000) Surveillance and Targeting Robot Platform (Red Owl)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**	**C90**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
C90	Advanced Distributed Simulation	9838	10435	10166	10934	11186	11541	11780

A. Mission Description and Budget Item Justification: This project develops enabling technologies for advancing distributed interactive simulation in synthetic environments such as networking of models, complex data interchange, and collaborative training. It will enhance the use of modeling and simulation as an acquisition and training evaluation tool by providing that ability to create a virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that constructive (event driven) simulation cannot provide. Such environments permit the evaluation of new system concepts, tactics and doctrine, and test requirements with a warfighter-in-the-loop throughout the acquisition life cycle at a reduced cost and in less time. This project develops technologies to support embedded simulation, intelligent forces representation, rapid and cost-effective generation of synthetic environments, simulation interface and linkage technologies, and complex data modeling. 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 Research Development and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Live, Virtual, Constructive Simulations: In FY05, enhanced modeling of unconventional threats in complex virtual urban environments; reduced size, weight, and power consumption of inertial sensor packaging for use in urban area training exercises and simulated tactical engagement training. Increased constructive simulation realism by maturing single-processor Graphics Processing Unit (GPU) software architecture and coprocessor algorithms to overcome current constructive simulation computational bottlenecks. In FY06, establish a standard flexible framework composed of a toolset for high-resolution urban environment development. Increase interoperability of multi-service virtual simulations networked with live systems in training environments. Demonstrate components with inertial sensor and software optimizing sensor fusion for more robust navigation during training exercises and increase accuracy for simulated tactical engagement training; and develop multiple GPU cluster architecture using algorithms from GPU coprocessor research. In FY07, will extend research of alternative data sources from Corps of Engineers to rapidly create urban environments for training, mission planning and rehearsal to reduce the dependence on training specific databases. Design navigation software for further robustness during GPS outages and continued miniaturization, reduction in power consumption, and early manufacturability analysis of system components. Will prototype large constructive simulations using multiple GPUs to increase the computational output for the simulation of highly complex urban environments.	3750	3717	3567
Modeling and Simulation Training Technologies. In FY05, created a field deployable patient simulator incorporating realistic medical training in simulated combat environments. Developed prototype dismounted soldier training systems for augmented reality and fully-immersive combined arms training environments. Developed models to facilitate the assessment of the effectiveness of mixed teams of humans and autonomous vehicles. In FY06, evaluate patient simulator use during military training exercises and Develop computer based simulation environment to support Combat Casualty Care training. Evaluate a field capable embedded training system integrated with a Future Combat System (FCS) surrogate to evaluate deployable collective training and distributed after-action review technologies for the dismounted Soldiers. Design human wearable augmented reality training technologies; and develop tools to evaluate mixed human-intelligent agent team performance. In FY07, will design new severe trauma simulation capabilities including advances in haptics, 3D visuals, olfactory, fluid, and sensors to simulate soft tissue, orthopedic, and organ casualties. Will evaluate the use of flexible displays and the application of nano-sensors embedded in the Soldiers' clothing and weapon systems for embedded training. Will design intelligent and	3521	3666	3478

adaptive behaviors to represent autonomous systems to enhance the human-intelligent agent team training.			
Collaborative and Immersive Environment Technologies. In FY05, continued to develop new behaviors in the One Semi-Automated Forces Objective System (OOS) constructive simulation baseline and design the linkages between the asymmetric warfare virtual training technology and the OOS. Performed user evaluations with combat units; and expanded our understanding of the student learner model to identify aspects of learning scenarios that facilitate the enhancement of virtual learning environments. In FY06, develop tools required for a trainer to address new types of asymmetric warfare training scenarios. Use the student learner model to evaluate the effectiveness of the single-user training module for immersive training. Research the incorporation and effectiveness of cultural simulation models creating appropriate asymmetric behaviors in immersive environments. In FY07, will research and prototype an immersive asymmetric warfare training environment for Joint, Interagency Multi-National (JIM) distributed training, mission planning and mission rehearsal. Will conduct experiments to validate the metrics, tools, and methods of the single-user framework and extend the single-user framework to accommodate multi-user small team collaborative requirements. Will design an adaptive learning environment using asymmetric behaviors to replicate the complex conditions experienced in the contemporary operating environment.	2567	3052	3121
Total	9838	10435	10166

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February 2006

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
2 - Applied Research	**0602308A - Advanced Concepts and Simulation**	**D02**

COST (In Thousands)		FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate	FY 2010 Estimate	FY 2011 Estimate
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	4631	5350	6015	6149	6276	6400	6528

A. Mission Description and Budget Item Justification: This project enables the transfer and maturation of simulation and training research results to the Army from Program Element (PE) 0601104, Project J08 (Institute for Creative Technologies). Goals of this research are to make training applications widely available and enhance the Army's ability to train any time and any place by researching modeling, simulation, and training technologies, such as immersive training, leadership development, and concept exploration; by creating a true synthesis of creativity and technology by leveraging the capabilities of industry and the Research and Development (R&D) community; and by conducting research in virtual humans to enable them to embody natural language, speech recognition in noisy environments, gesture, gaze, and conversational speech. Achieving these goals requires research in techniques and methods for integrating different sensory cues into virtual environments to enhance training and leader development; investigating the application of emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques to advanced experience learning applications; and enhancing the efficiency of 3-dimensional sound techniques in virtual environments that vary from medium sized immersive environment rooms with high-end graphics and computing systems to low-cost, game console applications using commercial off the shelf speakers. 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 Research Development and Engineering Command (RDECOM), Simulation and Training Technology Center, Orlando, FL.

Accomplishments/Planned Program	FY 2005	FY 2006	FY 2007
Immersive Technology Environments. In FY05, investigated verbal communication techniques for virtual human interactions with soldiers; and examined the concept of an integrated learning environment framework and identified interdependences to increase the realism of immersive environments used for training. In FY06, investigate nonverbal communication techniques for virtual human interactions with soldiers; and integrate the representations of selectable ethnicity and situational impact of emotions into the human to virtual human interaction. In FY07, will integrate enhanced virtual humans into a framework for leader training environments and will design virtual human component technologies utilizing feedback from concept evaluations.	2171	2461	2628
Immersive Technology Techniques. In FY05, developed techniques to create a single-user learning environment using advanced computer generated coaching and mentoring tools (artificial intelligence). Designed prototype tool sets that allow training developers to rapidly create immersive learning scenarios. Developed and evaluated next generation global illumination algorithms. In FY06, extend the tool sets and techniques for maturation of a single-user immersive learning environment; begin usability and effectiveness testing of single-user prototype components and tools. Develop new programming technology that allows a system's performance to be self-documenting by explaining its reasoning and how it works in easily understood English. Integrate captured photo-real images into a real-time simulation. In FY07, will design techniques for creating a multi-user learning environment integrating advanced computer generated coaching and mentoring tools (artificial intelligence) into an immersive simulation environment. Will investigate concepts and begin to design the tool sets that will allow training developers to rapidly create multi-user immersive learning scenarios. Will advance and incorporate explainable artificial intelligence technology in computer coaches that provide advice and corrections to learners as they use training systems. Will design tools for rapid simulation development.	2460	2889	3387
Total	4631	5350	6015