

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

February 2007

BUDGET ACTIVITY		PE NUMBER AND TITLE						
2 - Applied Research		0602308A - Advanced Concepts and Simulation						
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	25848	25001	16654	17131	17691	18058	18461	18872
C90 Advanced Distributed Simulation	9336	10054	10850	11166	11541	11780	12039	12304
D01 PHOTONICS RESEARCH	3258	3560						
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	5202	5948	5804	5965	6150	6278	6422	6568
D14 Advanced Modeling and Simulation Initiatives (CA)	6710	5439						
HB4 IMMERSIVE ENVIRONMENT APPLIED RSCH INITIATIVE (CA)	1342							

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 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. This environment helps 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 refining 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 ensures 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); PE0601104A, Project J08 (Institute for Creative Technology), PE0602716A, Project H70 (Human Factor Engineering Systems Development), PE0603007A, Project 792 (Personnel Performance and Training) and PE0602787, Project 874 (Medical 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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2 - Applied Research	0602308A - Advanced Concepts and Simulation			

<u>B. Program Change Summary</u>	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	27416	16181	17083	17462
Current BES/President's Budget (FY 2008/2009)	25848	25001	16654	17131
Total Adjustments	-1568	8820	-429	-331
Congressional Program Reductions		-95		
Congressional Rescissions				
Congressional Increases		9100		
Reprogrammings	-1568	-185		
SBIR/STTR Transfer				
Adjustments to Budget Years			-429	-331

Three FY07 congressional adds totaling \$8721 (after adjustment for Congressional Undistributed Reductions) were added to this PE.

- (\$3450) Photonics Research - Congressional Increase
- (\$958) Automated Man-In-Simulant-Test (MIST)
- (\$4313) Surveillance and Targeting Robot Platform (Red OWL)

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY 2 - Applied Research		PE NUMBER AND TITLE 0602308A - Advanced Concepts and Simulation					PROJECT C90		
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	
C90 Advanced Distributed Simulation	9336	10054	10850	11166	11541	11780	12039	12304	

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 enhances 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. This project leverages and coordinates with work at the Army Research Institute, the Army Research Laboratory, and the Medical Research Materiel Command. 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.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Live, Virtual, Constructive (LVC) Simulations: In FY06, established standard process and tools for development of high-resolution urban virtual environments that are common to training, mission planning/rehearsal, and testing applications. Increased interoperability of multi-service virtual simulations networked with live systems in training environments. Demonstrated components with inertial sensor and software optimizing sensor fusion for more robust navigation during live training exercises and increased accuracy for simulated tactical engagement training. Developed multiple graphical processor unit (GPU) cluster architecture using algorithms from GPU coprocessor research and developed concept for using GPU coprocessors in training systems. In FY07, extend research to rapidly create urban environments for training, mission planning, and rehearsal. Design navigation software, embedded training tracking devices and Soldier system prototypes to provide deployable LVC embedded training. Develop tools to integrate large constructive simulations using multiple GPUs to increase the computational output for the simulation of highly complex urban environments. In FY08, will research database scaling and distribution to support embedded training on small footprint computers of current force vehicles. Will integrate embedded training databases and tracking systems into dismounted Soldier embedded training prototype to support LCV embedded training. Will research and conduct lab and field demos of small, accurate, low cost, low power tactical engagement simulation sensors to demonstrate LVC embedded training functionality on dismounted Soldier systems. In FY09, will integrate live sensors and a virtual/constructive mission rehearsal capability on a current Soldier system prototype. Will conduct a field demonstration of integrated LVC embedded training to mitigate risks associated with weight, size and battery life limitations of Soldier systems.	3008	2871	3147	3383
Modeling and Simulation Training Technologies: In FY06, evaluated patient simulator use during military training exercises. Developed computer-based simulation environment to support Combat Casualty Care training for time when patient simulator use is not practical. Evaluated a field capable embedded training system integrated with a Future Force (FF) surrogate to evaluate deployable collective training and distributed after-action review technologies for the dismounted Soldiers. Designed human wearable augmented reality training technologies and developed tools to evaluate mixed human-intelligent agent team performance. In FY07, design new severe	3276	3225	3744	3719

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY	PE NUMBER AND TITLE			PROJECT
2 - Applied Research	0602308A - Advanced Concepts and Simulation			C90
trauma simulation capabilities including advances in the look, feel, and smell of simulated soft tissue, orthopedic, and organ casualties that support combat medic training with realistic battlefield injuries. Develop low cost embedded training devices for use on Soldier systems. Design intelligent and adaptive behaviors to represent autonomous systems and enhance the human-intelligent agent team training. In FY08, will complete prototype patient trauma simulations in collaboration with Army medical trauma research and with advances in material sciences to include realistic skin, flesh, blood, bone, fluids, and organs, sensor technologies, and simulated fluid loss technologies. Will research the use of man-worn immersive systems and reconfigurable mobile immersive systems and will conduct experiments using locomotion and man-worn systems for immersive environments. Will conduct experiments using autonomous systems to enhance the human intelligent agent team training. In FY09, will test prototypes in the current program of instruction to assess Army medical training effectiveness. Will research and develop a mobile immersive training environment that includes the appropriate mix of man-worn systems, locomotion systems and the ability to control autonomous agents for team training.				
Collaborative and Immersive Environment Technologies: In FY06, developed tools required for trainers to address new types of asymmetric warfare scenarios. Used the student learner model to evaluate the effectiveness of the immersive training single-user module. Researched concepts to incorporate cultural simulation models to create appropriate asymmetric behaviors in immersive environments. In FY07, research and prototype an immersive asymmetric warfare training environment for Joint, Interagency Multi-National (JIM) distributed training, mission planning, and rehearsal. Conduct experiments to validate the metrics, tools, and methods of the single-user framework and extend it to accommodate a macro-level module for senior level command training. Identify methods to represent cultural behaviors/effects within an adaptive learning environment. Research using multi-sensory environments to capture and measure human performance to increase learning effectiveness. In FY08, will extend JIM environment capabilities for mission planning/rehearsal; integrate geo-specific environments and virtual human agents. Will enhance the tools and methods of single-user and macro-level training modules. Will integrate representative cultural behaviors/effects within adaptive learning environments. Will conduct experiments using multi-sensory environments, virtual humans, and effects for leader and critical thinking development. Will develop adaptive learning environments for non-kinetic warfare focused training using social simulations. In FY09, will conduct experiments utilizing JIM environment to evaluate training methods and mission planning/rehearsal tools. Will expand multi-sensory environment to enable virtual human and intelligent decision support entities to incorporate awareness of trainee actions. Will expand training development tools to rapidly portray additional representative cultures. Will expand non-kinetic simulation to squad/team level for training and battle command.	3052	3675	3959	4064
Small Business Innovative Research/Small Business Technology Transfer Programs		283		
Total	9336	10054	10850	11166

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY 2 - Applied Research		PE NUMBER AND TITLE 0602308A - Advanced Concepts and Simulation					PROJECT D02		
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	
D02 MODELING & SIMULATION FOR TRAINING AND DESIGN	5202	5948	5804	5965	6150	6278	6422	6568	

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 for individual and team training and leadership development; through the 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 that result in enhanced 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. This project leverages and coordinates with work at the Army Research Institute and the Army Research Laboratory. 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:	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
Immersive Technology Environments: In FY06, investigated nonverbal communication techniques for virtual human interactions with Soldiers. Integrated the representations of selectable ethnicity and situational impact of emotions into the human to virtual human interaction. In FY07, conduct concept evaluations of leader training environments with enhanced virtual humans and integrate feedback into design for virtual human component technologies. In FY08, will investigate portrayal of dynamic effects in mixed reality environments and the use of new and emerging display technologies. Will investigate methods to capture trainee physical and emotional responses in the environment. In FY09, will create a mixed-reality immersive environment that uses sensors to provide near real-time perspective of the surrounding real world allowing a user and the world model to share a common view of the environment for high fidelity training environments. Will investigate new and flexible display technologies for development of new training environments.	2313	2628	2762	2853
Immersive Technology Techniques: In FY06, extended the tool sets and techniques for maturation of a single-user immersive learning environment. Conducted usability and effectiveness testing of single-user prototype components and tools. Developed 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. Integrated captured photo-real images into a real-time simulation. Investigated a large-scale social simulation for visualizing and modeling densely populated urban environments and culturally-affected behaviors of the populace. In FY07, design techniques for creating a learning environment integrating a large-scale social simulation, advanced computer generated coaching and mentoring tools (artificial intelligence) into an immersive simulation environment. Investigate concepts and begin to design the tool sets that allow training developers to rapidly create or modify immersive learning scenarios. Advance explainable artificial intelligence technology in computer	2889	3153	3042	3112

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February 2007

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2 - Applied Research	0602308A - Advanced Concepts and Simulation			D02
coaches that detect learner impasses and provide advice and corrections to learners as they use training systems. Design tools for rapid simulation development. In FY08, will mature intelligent tutoring, computer coaching, and rapid simulation development tools. Will integrate virtual humans with large-scale social simulations. Will create simulation environment in which social and anthropological data and knowledge is used to affect virtual human behavior and hence shape the educational experience for a trainee to achieve the defined learning objectives established for a program of instruction. In FY09, will explore techniques for developing distributed asymmetric tutoring and coaching methods to support team training, performance assessment and, team after action reviews. Will expand single student tutoring capabilities to distributed multi-student and team assessments and reviews.				
Small Business Innovative Research/Small Business Technology Transfer Programs		167		
Total	5202	5948	5804	5965

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R2a Exhibit)

February 2007

BUDGET ACTIVITY 2 - Applied Research		PE NUMBER AND TITLE 0602308A - Advanced Concepts and Simulation					PROJECT D14		
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	
D14 Advanced Modeling and Simulation Initiatives (CA)	6710	5439							

A. Mission Description and Budget Item Justification: Not applicable for this item.

<u>Accomplishments/Planned Program:</u>	<u>FY 2006</u>	<u>FY 2007</u>	<u>FY 2008</u>	<u>FY 2009</u>
New Accomplishment	6710	5439		
Total	6710	5439		