ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

February 2003

BUDGET ACTIVITY
2 - Applied Research

PE NUMBER AND TITLE
0602308A - Advanced Concepts and Simulation

COST (In Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
	Total Program Element (PE) Cost	30319	30150	15941	15643	16777	17331	17657	18115
C90	ADVANCED DISTRIBUTED SIMULATION	16113	13980	10658	10538	11060	11193	11370	11683
D01	PHOTONICS RESEARCH	2373	2382	0	0	0	0	0	0
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	6453	7123	5283	5105	5717	6138	6287	6432
D03	JOINT MODELING & SIMULATION SYSTEM (JMASS)	2502	2664	0	0	0	0	0	0
D14	COMBAT TRAUMA PATIENT SIMULATION PROGRAM (CTPS)	0	4001	0	0	0	0	0	0
MC8	THREE DIMENSIONAL ULTRASOUND IMAGING	2878	0	0	0	0	0	0	0

A. Mission Description and Budget Item Justification: This program element conducts applied research in modeling and simulation technologies for application to testing and training of the Future Combat Systems (FCS) and the Objective Force (OF). It develops standards, architecture, and interfaces essential to realizing the Army vision of creating a verified, validated, and accredited synthetic "electronic battlefield" environment as an acquisition and training evaluation 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 generation of tactics, doctrine, training techniques, soldier support systems, and system upgrades. This program directs and stimulates advances in those technologies required for real time interactive linking within and among constructive, virtual, and live simulation and training by developing technologies for advanced distributed interactive simulation. This program 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 project will ensure the transition of the research results of the ICT into the Army technology base and future Army training products. These programs are fully coordinated with other Army applied research programs, the Defense Advanced Research Projects Agency (DARPA), and the Defense Modeling and Simulation Office. Results from this applied research will feed the new PE 0603015A (Next Generation Training & Simulation Systems). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the Provisional Research Development and Engineering Command (RDE Command).

This program element supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the program.

B. Program Change Summary	FY 2002	FY 2003	FY 2004	FY 2005
Previous President's Budget (FY 2003)	31333	20634	23000	23298
Current Budget (FY 2004/2005 PB)	30319	30150	15941	15643
Total Adjustments	-1014	9516	-7059	-7655
Congressional program reductions				
Congressional rescissions		-703		
Congressional increases		11200		
Reprogrammings	-212	-173		
SBIR/STTR Transfer	-802	-808		
Adjustments to Budget Years			-7059	-7655

Change Summary Explanation:

Significant Changes:
FY04/05 - Funds realigned to Advanced Technology ICT and Modeling and Simulation efforts.

FY03 Congressional Adds:
Combat Trauma Patient Simulation Program (CTPS), Project D14 ($4200); On-Line Contract Document Management, Project C90 ($1000); Institute for Creative Technologies (Simulations for Capabilities for the Warfighter), Project D02 ($3500); Photonics, Project D01 ($2500).

Projects with no R2-A:

- ($4001) Combat Trauma Patient Simulation Program (CTPS), Proj. D14: The objective of this one-year Congressional Add is to provide a CTPS prototype that advances the present CTPS system and system components. No additional funding is required to complete this project.

- ($2382) Photonics, Proj. D01: The objective of this Congressional Add is to manufacture, assemble and characterize optical components and laser output for an unique fiber laser combiner. No additional funding is required to complete this project.

- ($2664) Joint Modeling & Simulation System (JMASS), Proj D03: In FY03, the objective is to complete the JMASS simulation software development effort by bringing the Electro Optical/Infrared (EO/IR) environment player, Virtual Autonomous Teaming Tool (VATT), and the Helo Flares/Jammers Modules into JMASS compliance; distributing the software to users; providing the Army's portion of the first year configuration management effort; re-establishing the JMASS User Web Site; and transitioning the completed software to the JMASS sustainment program.

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

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

COST (In Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
C90	ADVANCED DISTRIBUTED SIMULATION	16113	13980	10658	10538	11060	11193	11370	11683

A. Mission Description and Budget Item Justification: This project applies enabling technologies for advancing distributed interactive simulation in a synthetic environment by maturing advanced distributed simulation technologies, such as networking of models, complex data interchange, and collaborative training. It will provide the representation of the battlefield needed to support the use of modeling and simulation as an acquisition and training evaluation tool and a virtual representation of a lethal combined arms environment with the warfighter-in-the-loop that constructive simulation cannot provide. This environment permits 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 matures 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 and interchange. Work is performed by the Provisional Research Development and Engineering Command (RDE Command). This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
Collaborative and Immersive Environment Technologies. In FY02, prototyped intelligent tutoring systems to provide soldier individualized instructional support of cognitive training tasks. Prototyped architecture for speech, gesture, and gaze integration into virtual humans. In FY 03, evaluate interface between learning management system, game engine assessment tool, courseware, and intelligent tutoring system to provide tailorable training in a web-based environment. Explore technologies to support intelligent tutoring in an embedded environment. Conduct research on 3-dimensional graphics, and photorealistic rendering of human features and motions to support realistic interactive simulation environments. Investigate simulation "engines" (operating systems to run simulations) that will support persistent interactive simulation over the internet and allow users to create unconventional threats. In FY 04, expand 3-dimensional advanced distributed learning environments to provide realistic training on the move. Prototype testbeds for distributed component simulations to support FCS and Objective Force Warrior (OFW) training missions. Investigate concepts for an embedded training decision aid utilizing 3-dimensional virtual environments. Apply rendering of human features and motions to interactive training environments. In FY 05, demonstrate 3-dimensional learning environment to support reachback capability. Demonstrate component simulations supporting FCS and OFW training missions. Expand high performance and large scale robotic simulations. Demonstrate 3-Dimensional and human features modeling simulations in an interactive training environment.	4430	3033	3207	5988

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
Modeling and Simulation Training Technologies. In FY 02, completed advanced trauma patient simulation holographic airway visualization prototype. Prototyped trauma patient simulator interface to constructive simulation (OneSAF Testbed (OTB)). Prototyped personal computer based trainer to support initial experimentation at Fort Gordon, Georgia. Developed a composable robotics simulation testbed for capabilities analysis and behavior construction for FCS and established OTB baseline control of unmanned systems. In FY 03, experiment with trauma patient simulation components to verify interoperability across live, virtual, and constructive domains, including Multiple Integrated Laser Engagement System (MILES) XXI (live), Virtual Emergency Response Training System (VERTS - virtual), and Dismounted Infantry Semi-Automated Forces (DISAF). Extend the composable robotics simulation testbed through the addition of higher level mission behaviors and prototype man/machine interfaces to allow a single user to control multiple unmanned systems. In FY 04, conduct team performance assessment for multiple unmanned robotic systems and enhance robotic behavior interaction with use of intelligent agents. Includes multiple users controlling multiple robots in a coordinated team environment. Supports embedded simulation and training concepts for FCS and OFW. In FY 05, optimize robotic simulation behavior toolset and collaborative team behaviors at the FCS and OFW cell level to maximize the number of robots and complex robotic team behaviors that can be controlled by a single soldier.	1735	1989	1951	0
Embedded Training for Dismounted Soldiers. In FY 02, investigated and developed concepts for embedded training for dismounted soldiers. Established initial embedded training testbed utilizing commercial off the shelf and government furnished hardware components. In FY 03, extend testbed functionality and conduct experiments to evaluate proposed concepts for a mobile training network for dismounted soldiers. Investigate concepts for technologies to precisely track a soldier's location and weapon orientation inside/outside of buildings in order to support Military Operations in Urban Terrain (MOUT) at the FCS and OFW cell level. In FY 04, extend testbed functionality to include augmented reality (virtual targets, weapon effects, threats, and friendlies) for a mobile training network for dismounted soldiers. Mature embedded training through augmented reality. Prototype testbeds and algorithms to support assessment of tracking technologies. In FY 05, prototype mobile range and conduct experiments to evaluate an augmented reality training environment for the OFW cell level at Fort Benning, Georgia. Conduct experiments with advanced tracking testbed to validate/improve MOUT training.	2902	2500	2800	1375

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
RDEC Federation. In FY 02, developed JAVA middleware tool "cookbook" for interfacing industry models to the DoD's High Level Architecture (HLA) to allow quicker model incorporation into federations of interoperable simulations and training systems. In FY 03 Implement a Joint Virtual Battlespace (JVB)/RDEC Federation reference implementation architecture for interfacing with the FCS Advanced Collaborative Environment. Conduct analysis of interface requirements and identify human performance modeling requirements. Address and incorporate engineering-level M&S, virtual prototypes, and distributed requirements. Develop a concept of operations for reference implementation to support FCS and OF experimentation. Identify technologies from the ICT for incorporation into reference implementation. In FY 04 and beyond, this effort is funded in PE 0603015A, Project S31 (RDEC Federation).	505	3000	0	0
Rapid Generation of Synthetic Natural Environments. In FY 02, developed tools and improved synthetic natural environment (virtual terrain and 3-dimensional models/features) development processes. Tested methodologies to assess interoperability of shared synthetic environments for virtual, constructive, and live systems. Prototyped virtual immersive simulation system for dismounted soldiers to support MOUT. Researched technologies for rapid construction of urban terrain databases for training. Matured technologies for the modeling and simulation of asymmetrical warfare. In FY 03, investigate environmental data model representation of urban terrain structures (building components: windows, floors, rubble, etc.) to improve realism of virtual urban training environments. In FY 04, investigate toolsets to rapidly generate additional terrain structures in existing databases. Prototype simulation engine that will support persistent interactive simulation over the internet and allow users to create unconventional threats. In FY 05, assess performance of rapid generation technologies and recommend a standard toolset for OF training environments. Evaluate simulation engine that will support persistent interactive simulation over the internet and allow users to create unconventional threats.	1251	2500	2700	3175
Modeling, Simulation, and Training Infrastructure & Community Development. This one-year Congressional Add developed and demonstrated a concept for a learning management system, game engine assessment tool, courseware, and intelligent tutoring system to provide tailorable training in a web-based environment. No additional funding is required to complete this project.	4323	0	0	0
Online Contract Document Management. In FY 02, this Congressional Add developed, prototyped, and began testing three automated acquisition tools that mirror the DOD 5000 and FAR process. In FY 03, will continue the development of the automation for the acquisition process by integrating prototype tools with external legacy acquisition systems and an enterprise management system. No additional funding is required to complete this project.	967	958	0	0

Accomplishments/Planned Program (continued)	FY 2002	FY 2003	FY 2004	FY 2005
Totals	16113	13980	10658	10538

ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

February 2003

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

COST (In Thousands)		FY 2002 Actual	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	FY 2006 Estimate	FY 2007 Estimate	FY 2008 Estimate	FY 2009 Estimate
D02	MODELING & SIMULATION FOR TRAINING AND DESIGN	6453	7123	5283	5105	5717	6138	6287	6432

A. Mission Description and Budget Item Justification: This project enables the rapid transfer and development of simulation and training research results to the Army from the Institute for Creative Technologies (ICT). The ICT provides research in modeling, simulation, and training technologies, such as immersive training, leadership development, and concept exploration. This project creates a true synthesis of creativity and technology by leveraging the capabilities of industry and the R&D community. It revolutionizes military training and mission rehearsal by making it more effective in terms of cost, time, types of experiences that can be trained or rehearsed, and the quality of the result. This project accomplishes this by maturing research in virtual humans to enable them to embody natural language, speech recognition in noisy environments, gesture, gaze, and conversational speech. This will make training applications widely available and enhance the Army's ability to train any time and any place. This project also investigates and matures techniques and methods for integrating different sensory cues into virtual environments to enhance training and leader development. This project investigates and matures the application of emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques to advanced experience learning applications. These efforts will mature the efficiency of 3-dimensional sound techniques in virtual environments. The environments will 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. These techniques and environments will impact education and training systems for the OF and enhance Army Transformation. Work is performed by the Provisional Research Development and Engineering Command (RDE Command). This project supports the Objective Force transition path of the Transformation Campaign Plan. No Defense Emergency Response Funds were provided to the project.

Accomplishments/Planned Program	FY 2002	FY 2003	FY 2004	FY 2005
Immersive Technology Environments. In FY 02, defined architectural structure for integrating speech, gesture, gaze, and speech synthesis into a virtual human. Also, began a concept demonstration in the use of virtual humans in advanced leader development environments. In FY 03, refine the architecture and identify research shortfalls for human to virtual human interactions. In FY 04, create solutions for shortfalls in human to virtual human interactions where feasible. Mature research approach for additional study to solve the more complex phenomena. In FY 05, collaborate with TRADOC to integrate virtual humans into leader training and the development advanced technology demonstrations.	2376	1366	2399	2400
Immersive Technology Techniques. In FY 02, integrated emerging photo-realistic rendering algorithms and 3-dimensional signal processing techniques into the Sensory Environment Evaluation (SEE) and Mentoring Prototype (MP) proof-of-principle venues. Collected and formatted audio data for integration into the SEE and MP experimental test beds at the ICT. In FY 03, incorporate algorithms developed by ICT into the next generation of personal computer graphics cards to make recent advances in computer graphics commercially available. Investigate and mature techniques for using low-cost training platforms like game-based consoles and emerging high-speed hardware. Complete development of personal computer based proof-of-principle and work on evaluation of proof-of-principle with TRADOC and ARI. In FY 04, provide concept demonstration of photo-realistic rendering of human faces and integrate into SEE and MP. Integrate audio and sensing cues implemented in algorithms and techniques into the SEE and MP. In FY 05, mature next generation global illumination algorithms and facilitate their adoption into military training applications.	4077	2421	2884	2705
Institute for Creative Technologies (Simulations for Capabilities for the Warfighter). The objective of this one-year Congressional Add is to conduct applied research in immersive environments to provide an enhanced simulations capability at Fort Sill. No additional funding is required to complete this project.	0	3336	0	0
Totals	6453	7123	5283	5105