STO NOMINATION FACT SHEET

RDEC/SRA: U.S. Army Soldier and Biological Chemical Command – Natick Soldier Center (Lead), U.S. Army Research Laboratory – Human Research & Engineering Directorate, U.S. Army Research Laboratory – Survivability/Lethality Assessment Directorate

STO NUMBER: NRD-01

FLAGS: HTI_____ ATD CANDIDATE_____ LOGISTIC INITIATIVE_____
SPACE TECHNOLOGY APPLICATION_____

TITLE: Warrior Systems Modeling Technology

ARMY NEED: Warrior Systems materiel developers, user representatives, system testers/evaluators, and milestone decision authorities are in need of credible/validated Modeling, Simulation and Analysis tools to reduce program time, cost and risk. The current Army/DoD focus on rapid development and simulated testing demands accurate representation of the physiology and behavior of the individual warfighter if the models are to be used with a high degree of confidence. Detailed, valid information about the physiological and cognitive capabilities of the individual combatant is needed for: specifying material system design parameters, integration of function across all soldier system domains (survivability, lethality, command and control, mobility and sustainability), as well as the enhancement of simulated combat environments for material acquisition analysis that focus on the soldier system. STO outputs will provide the capability to reduce program risk by 50% in the areas of prototype development, system downselection, concepts of deployment, and identified operations & support costs. These applications have high program "cost avoidance" paybacks. This workpackage was rated 4 in the 1998 TRADOC S&T Review by the Infantry Center, DBBL and BCL.

DESCRIPTION: This joint STO will develop the essential analytic tools to evaluate and quantify the military worth of next generation Warrior Systems and future Lightweight Soldier initiatives. This is a key enabler of Simulation Based Acquisition (SBA), Simulation Test & Evaluation Process (STEP), and Simulation and Modeling for Acquisition, Requirements and Training (SMART). The tools will capture the demanding level of human performance representation required in the RDA domain while additionally furnishing the Requirements (ACR) and Training (TEMO) domains with improved warrior representation. By the end of FY00, develop required scenario vignettes that will appropriately exercise warrior systems and components. By the end of FY01, provide algorithms, data model and vignettes to include both battlefield and restricted terrain, e.g. rooms, hallways, tunnels, trenches, etc., and other environmental features, e.g. lighting levels and dynamic weather to improve the range and accuracy of combat assessments. By the end of FY02, implement improved close combat/MOUT algorithms that have been validated with ground truth data provided by the Human Systems/Modeling & Analysis for Warrior Systems Program. By the end of FY03, demonstrate a 1st generation modeling capability to evaluate the combat worth of Warrior Systems in a close combat/MOUT environment. Validate Operational Requirement-based Casualty Assessment (ORCA) non-lethal sub-models and model extensions. By the end of FY04, demonstrate a verified and validated, High Level Architecture (HLA) compliant, modeling capability to evaluate the combat worth of Warrior Systems in the following approved critical infantry squad battle drills and rifle platoon collective tasks:

Drills	Tasks
Conduct Squad Attack	Movement To Contact
React To Contact	Attack
Break Contact	Raid
React To Ambush	Ambush
Knock Out A Bunker	Reconnaissance And Security
Enter Building And Clear A Room	Defend
Enter And Clear A Trench	Retrograde

The model will provide the capability to reduce program risk by 50% in the areas of prototype development, system downselection, concepts of deployment, and identified operations & support costs.

TECHNICAL CONCEPT: This model will dramatically improve both human representation (physiological and behavioral capabilities) and terrain representation to provide highly credible data in support of warrior systems integration decisions. This joint STO effort will integrate the scientific disciplines of experimental psychology, physics, physiology, ergonomics, and operations research to identify and quantify the elemental behaviors and performance attributes of warfighters that are essential to their effective use of materiel enhancements to their warfighting abilities. The warrior system will consist of everything worn, carried or consumed by individuals and small teams. The technical challenge is to develop a credible, HLA compliant, individual combatant object model that sufficiently replicates real world situations and environments and that can be used with confidence by analysts and major program decision makers. The joint STO will provide a unique framework where new models (objects), developed to address specific requirements of proposed system alternatives, are easily integrated into the overarching simulation. Once integrated, the implications of the new object can be quickly assessed, i.e. the ballistics survivability object allows rapid assessment of protective vest alternatives in both survivability and mobility terms. The ORCA model will be added to the analytic tool kit. Modifications will include the addition of software that allows initial characterization of soldier physiologic states and baselines capabilities. The ability to update these states to reflect exposure from battlefield stressors and insults will be developed. The current model focus will be extended to the close combat/MOUT environment to include non-lethal insults. All Warrior Systems model objects will be verified to provide a consistent operational assessment of all proposed clothing, equipment, and operational concepts. To this end, as each new object is integrated, it will undergo rigorous review to ensure that its battlefield attributes are accurately portrayed. Finally, the results of the integration will also be subjected to a rigorous review and independent verification. This will result in a simulation that can be confidently used to support individual combatant systems development, investment, and milestone decisions.

PRODUCT: This joint STO will produce algorithms (objects), descriptive models, and databases that describe and account for several of the major variables affecting the physical and behavioral performance of the individual combatant on the battlefield. This program will produce validated and verified engineering level simulation tools that simulate the operational employment of proposed and current soldier system equipment. In addition, baseline soldier performance data will be collected and archived. All source code, data, and associated configuration control will be entered in the Army's Modeling and Simulation Resource

Repository (MSRR) available for use to support system acquisition, testing, fielding and employment of individual combatant systems.

BENEFIT(s) TO THE ARMY: This joint STO will develop the analytic tools and databases to support Army/DoD Modeling & Simulation initiatives to reduce system development and testing costs. This will be achieved through reducing the need for large numbers of physical prototypes, supporting Basis Of Issue decisions, combat worth assessments, trade and downselection decisions, life cycle cost projections and program risk reduction. This joint STO will potentially support the augmentation of several mission planning and training systems, facilitating integration and maximum transition of its product models throughout the Army and Marine Corps.

PLANNED WARFIGHTER PARTICIPATION: : Participation by the Dismounted Battlespace Battle Lab, USMC Commandant's Warfighting Lab, U.S. Army Infantry Center Directorate of Combat Development, TRADOC Analysis Center, Joint Readiness Training Center (JRTC), and the Combat Service Support Battle Lab is planned for the data collection, peer review and verification & validation effort. Opportunities for field test data collection will be coordinated with these organizations.

OTHER SERVICES OR AGENCY RELATED PROGRAMS AND LINKAGES:
DTO Title: IS.40.01 Individual Combatant & Small-Unit Operations Simulation (IC/SUOS). This effort will build on the accomplishments of the current IC/SUOS DTO and MOUT ACTD, and Soldier System Modeling STO. Specifically, the data collected during the MOUT ACTD field trials and the modeling & simulation accomplished in support of the MOUT ACTD data collection will be leveraged. The Special Weapons Agency sponsored Fixed Facility Weapons of Mass Destruction Effects Simulation Program will be leveraged to enhance the representation of chemical, nuclear and biological effects. This joint STO addresses a high priority need identified by the Human Systems TARA, the Defense Modeling & Simulation Office, and the National Research Council study panel on Behavioral Representation in Modeling. The products of this joint STO will result in enhancements to SBA capabilities that will benefit Land Warrior programs, such as Lightweight Warrior, and AAN analyses by allowing those programs to more fully exploit SBA/SMART analytical capabilities. Maximum leveraging of existing sources (academic, DoD, and industry consortia) and/or concurrent opportunities for collecting behavioral performance data with our NATO allies will also be exploited.

PROPOSED PROGRAM BY FISCAL YEAR (FY) WITH MAJOR MILESTONES:

Major Milestones	FY00	FY01	FY02	FY03	FY04
	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
1a. Identify sources of extant physiological and behavioral performance data, as well as existing models that can be leveraged.	X x x x				
1b Insert baseline vignettes for operational analyses (close combat/MOUT) into the IUSS	X x x x				

1c. Complete 1st generation Soldier System Data Model, identify remaining gaps, initiate data collection plan to fill major voids.	X x x x				
1d. Transition behavioral data and algorithms (objects) in areas that are sufficiently mature to appropriate models. Transition descriptive models to R&D/MANPRINT customers. Prioritize data gaps for subsequent research.	X x x x				
1e. Complete development of the 1st generation Soldier System Architecture	X x x x				
1f. Modify ORCA Injury Impairment mappings and incorporate non-lethal assessment capability.	X x x x				
2a. Conduct experiments to fill identified behavioral data gaps.		X x x x	X x x x		
2b. Complete 1st generation combat ID modeling capability		X x			
2c. Construct environmental representations for restricted terrain		X x x			
2d. Complete baseline scenario vignettes for operational analyses of the full representative range of potential environments		X x x			
2e. Develop appropriate ORCA algorithms to account for injury susceptibility		X x x x			
3a. Validate and demonstrate capability for assessment of integrated functionality of multiple Soldier System components			X x		
3b. Complete integration of restricted terrain effects on mobility and survivability			X x x		
3c. Develop algorithms/descriptive models of warfighter performance, based upon behavioral performance data analyses.			X x x x		

3d. Transition behavioral databases, algorithms (objects), and descriptive models to existing SBA architectures and R&D/MANPRINT customers, respectively.			X x x x		
3e. Refine ORCA non-lethal injury sub-models, as appropriate			X x x x		
4a. Incorporate physiological/behavioral effects of fatigue (anaerobic and aerobic exertion) and other behavioral algorithms into appropriate Soldier System models				X x	
4b. Complete system performance baselines for close combat model demonstration				X x	
4c. Complete verification and validation (V&V) studies as required to establish the fidelity and accuracy of models of warfighter behaviors				X x x x	
4d. Demonstrate 1st generation close combat assessment model				X x x x	
4e. Validate ORCA sub-models and model extensions				X x x x	
5a. Demonstrate V&V'd, HLA compliant model in stated drills tasks					X x x x

RISK: The development risk of the modeling technologies is moderate in schedule and cost. The technical risk associated with collection of the necessary supporting data is moderate to high due to the immaturity of the supporting data collection devices. Current data collection devices have been oriented towards laboratory settings. These tools must be adapted to support data collection under operational field conditions and exercises. The schedule and cost for operational data collection are moderate to high due to the availability of test units operating in a wide range of operational environments. The risk associated with accomplishing tool and data verification and validation is high because an effort of this complexity has never been attempted. The portion of this STO devoted to representing warfighter behavior, properly viewed, is the beginning of a major effort to represent selected behavioral performance aspects of the individual warfighter in models and simulations of the combatant. It should be emphasized that while this effort is a movement toward that end, constructing a comprehensive, data-driven representation of the physical and psychological capabilities of the individual combatant in all possible scenarios is a high-risk effort, unattainable in the period proposed.

TRANSITION: All tools and data will be transitioned to the Army Modeling & Simulation Resource Repository (MSRR) and the Defense Modeling, Simulation Tactical Technology Information Analysis Center (DMSTTIAC) as they are developed. The outputs of the

behavioral representation work will be tailored for direct insertion into the Warrior Systems Model, and existing SBA/SMART architectures including the Integrated Unit Simulation System (IUSS, Developed by Natick RDEC & Simulation Technologies, Inc.) and those under development by ARL-HRED. The outputs will also be published and disseminated within DA and DoD, both as fundamental descriptive models of behavior of the combatant, as more refined algorithms (objects) for potential insertion into other SBA, mission planning, and training simulation systems, and as data archives for use in validation studies of these types of systems.

PRINCIPAL PERFORMERS: Simulation Technology, Inc., Institute For Defense Analysis, Mission Research Corporation; MultiGen, Inc.

POCs:

RDEC: AMSSB-RSS-A, 508-233-4940, Fax 4256, modeling@natick.army.mil l
ARL-HRED, DSN 298-5969,
ARL-SLAD, 410-278-6335

Customer: PM-SDR; TSM-SDR
TRADOC: DBBL, ATZB-WC, 706-545-6391 (DSN: 835), FAX: 706-545-3096

FOCs SUPPORTED:

AR 97-016	IN 97-210	TR 97-048
CM 97-001	220	055
DBS 97-020	300	057
021	301	310
022	310	TRD 97-008
030	MP 97-001(b,c)	009
031	MP 97-013	010
034	QM 97-001	015
EN 97-030	TR 97-003	
IN 97-200	023	

LOGISTICS IMPLICATIONS: This joint STO has no direct logistics implications. However, it seeks to improve the Army's ability to quantitatively evaluate the ultimate warfighting value of proposed logistical improvements, e.g., reductions in weight and trade-offs among specific materiel alternatives.

HORIZONTAL TECHNOLOGY INTEGRATION: A major focus of this STO is to gather human scientific data to be able to better understand and model the capabilities and behaviors of the human dynamic as related to military operations. As a result of the human being the most prevalent system on the battlefield and his integration with virtually every other system, application of this STO across multiple systems is guaranteed.

SPACE TECHNOLOGY APPLICATIONS: N/A