ADST-II-CDRL-VISULT-9900340
23 December 1999

ADVANCED DISTRIBUTED SIMULATION TECHNOLOGY II (ADST II)

VIRTUAL INFANTRY SMALL UNIT LEADER TECHNOLOGY (VISULT) DEVELOPMENT AND EVALUATION
DO #0114

CDRL AB01

FINAL REPORT

DID: DI-MISC-80711

For:

United States Army
Simulation, Training, and Instrumentation Command
12350 Research Parkway
Orlando, Florida 32826-3224
Attn: AMSTI-ET

By:

Science Applications International Corporation
12479 Research parkway
Orlando, FL 32826-3248

Lockheed Martin
Information Systems Company
12506 Lake Underhill Road
Orlando, FL 32825

Approved for Public Release; Distribution is Unlimited.
UNCLASSIFIED

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	23 DEC 1999	FINAL

4. TITLE AND SUBTITLE
Advanced Distributed Simulation Technology II (ADST-II) Virtual Infantry Small Unit Leader Technology (VISULT) Development and Evaluation Final Report

5. FUNDING NUMBERS
N61339-96-D-0002

6. AUTHOR(S)

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Lockheed Martin Information Systems
ADST-II
P.O. Box 780217
Orlando Fl 32878-0217

8. PERFORMING ORGANIZATION REPORT NUMBER
ADST-II-CDRL-VISULT-9900340

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

NAWCTSD/STRICOM
12350 Research Parkway
Orlando, FL 32328-3224

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
CDRL AB01

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 Words)* This report summarizes the efforts performed under the Advanced Distributed Simulation Technology (ADST) II Delivery Order #0114, Virtual Infantry Small Unit Leader Technology (VISULT) Development and Evaluation. VISULT was conceived to support a joint Army Research Institute (ARI), Army Research Laboratory (ARL) and STRICOM Science and Technology Objective (STO) investigating Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal. Lockheed Martin Information System's (LMIS) primary role in VISULT was management and technical support during the conduct of experiments at the Land Warrior Testbed (LWTB) at Ft. Benning, GA. ARI and STRICOM are documenting the results of most of the specific work items carried out under VISULT. This report summarizes the overall VISULT program effort and points to documents detailing the results of specific tasks.

14. SUBJECT TERMS	15. NUMBER OF PAGES
STRICOM, ADST-II,	14
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT

Document Control Information

Revision	Revision History	Date
-	Original Release	12/23/99
-		
-		
-		
-		
-		
-		
-		
-		

TABLE OF CONTENTS

1 INTRODUCTION

1.1 SCOPE

This report summarizes the efforts performed under the Advanced Distributed Simulation Technology (ADST) II Delivery Order #0114, Virtual Infantry Small Unit Leader Technology (VISULT) Development and Evaluation. VISULT was conceived to support a joint Army Research Institute (ARI), Army Research Laboratory (ARL) and STRICOM Science and Technology Objective (STO) investigating Virtual Environments for Dismounted Soldier Simulation, Training, and Mission Rehearsal. Lockheed Martin Information System's (LMIS) primary role in VISULT was management and technical support during the conduct of experiments at the Land Warrior Testbed (LWTB) at Ft. Benning, GA. ARI and STRICOM are documenting the results of most of the specific work items carried out under VISULT. This report summarizes the overall VISULT program effort and points to documents detailing the results of specific tasks.

1.2 DESCRIPTION

STRICOM and ARI initiated VISULT to support the evaluations required to meet FY99 STO objectives. ADST II provided the mechanism for STRICOM and ARI to access LWTB simulation assets and support personnel. In order to develop the technologies associated with infantry in the virtual environment, STRICOM and ARI conducted a series of exercises at the LWTB. These exercises enabled Subject Matter Experts (SMEs) to assess the behaviors and models used in the Dismounted Infantry Semi Automated Forces (DISAF) application for the virtual infantryman and to evaluate the value of training infantrymen and small unit leaders in a virtual environment. In addition, these exercises and the LWTB assets will enable STRICOM and ARI to define a preliminary set of small unit leader training tasks that can be performed in a dismounted soldier simulation system. "... The LWTB has the requisite virtual simulation systems and support personnel to conduct these exercises." (Reference a).

At the time of the delivery order award, the exact nature of the exercises to be conducted at the LWTB was undefined. Indeed, to what level the LWTB assets would support the types of exercises envisioned was an open question. Working as an integrated team, STRICOM, ARI, LMIS, and LWTB personnel (the latter being Lockheed Martin Technical Services Group (LMTSG) employees, as the LWTB is a government-owned, contractor operated facility), developed a plan of action. Initially, the ARI Infantry Forces Research Unit (IFRU) would perform a series of soldier-supported exercises to evaluate how well selected tasks could be performed on the dismounted infantry (DI) simulators resident at the LWTB. The results of these tests would shape the exercises to be conducted at the end of FY '99 that were the major milestone for the current year STO effort. The ARI Simulator Systems Research Unit (SSRU) in Orlando, FL led the development of these latter exercises.

A critical factor during the VISULT period of performance was that STRICOM, under a separate ADST II delivery order (#0076 Advanced Concept Research Tools (ACRT)), was to upgrade the existing DI simulators at the LWTB and augment them with additional simulators and support tools, ultimately to develop what is called the Squad Synthetic Environment (SSE). The planned timing of the installation of the SSE was fortuitous for the VISULT test effort, provided that the proposed schedule was met. Thus, it became a *de facto* VISULT task to track the ACRT effort to see if it was proceeding on schedule. An early indication of trouble would trigger a GO/NO-GO decision by the team, along with the development of an alternative plan if necessary.

Thus, there were three primary tasks initially identified for VISULT: the ARI IFRU tests to evaluate soldier task performance on the simulators, monitoring ACRT schedule progression, and the DO-culminating tests to be performed at the end of September 1999, presumably at the LWTB.

STRICOM later added two more tasks that it felt were relevant to the overall STO objectives. These were an evaluation of an effort by Mitre to integrate voice interaction into DISAF control, and face validation of DISAF behaviors developed by Science Applications International Corporation (SAIC) under a BAA (Broad Agency Announcement) contract.

2 REFERENCED DOCUMENTS

The following documents are referenced in this report and provide further explanation and documentation of the ADST II VISULT effort.

a. ADST II Delivery Order Statement of Work (SOW) for Virtual Infantry Small Unit Leader Technology (VISULT) Development and Evaluation, STRICOM, 11 March 1999.

b. Pleban R. J., Eakin, D. E., and Salter, M. S. (1999). Analysis of mission-based scenarios for training soldiers and small unit leaders in virtual environments. (Research Report No. TBD). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

c. DISAF Capabilities Enhancement (DCE) Project's Conceptual Model (Document # SAIC-99/7605&00) Software Test Description (Document # SAIC-99/7608&00) documents.

d. Knerr, B. W., Lampton, D.R., and Cotton, J. (2000). Training small unit Infantry leaders in virtual environments: An evaluation of current capabilities (Research Report XXXX). Alexandria, VA: U.S. Army Research Institute.

e. Results of DISAF Capabilities Enhancement (DCE) Face Validation, Memorandum from Ed Chandler to Matt Kraus and Daryl Siddon, 24 September 1999, Science Applications International Corporation, Orlando, FL.

3 SUMMARY OF VISULT ACTIVITIES

As described in Section 1.2 above, the VISULT effort eventually consisted of five separate tasks. These came to be called phases of the effort. The five phases of VISULT were:

1. Phase 1a: First Pilot Test and Phase 1b: Second Pilot Test. These tests evaluated the DI simulators' capability to support STO test objectives for specific operational behaviors.
2. Phase 2: ACRT Look. This phase provided ongoing assessment of the ACRT execution and SSE build-up to support timely determination of the SSE's readiness and capability to support planned STO activities.
3. Phase 3: DISAF Voice I/O Evaluation. This phase provided an evaluation of a separate STRICOM funded effort to integrate the CommandTalk legacy software with the DISAF functionality. The intent of this effort was to develop and evaluate a voice control interface for DISAF. The results of this effort were to be demonstrated in a separate side experiment conducted at the MITRE facility in Reston, VA.
4. Phase 4: DISAF Face Evaluation. Ongoing DISAF development efforts funded under a STRICOM BAA received face validation support from the VISULT program. The goal was to confirm that the developed DISAF behaviors appear to be operationally valid.

5. Phase 5: STO Training and DISAF Evaluation. This effort represented the culmination of the STO's first-year activities. Tests were conducted using the DI simulators manned by US Army troops along with enhanced DISAF capabilities.

In addition to these five major tasks or phases, other VISULT funded activities included support for overall test planning, integrated team meetings, post-test data analysis, program management, and a final report (this document).

Each of the five phases of effort is described below. References are provided to more detailed documentation where it exists.

3.1 PHASE 1: PILOT TESTS

The plans, procedures, and results of the Phase 1 VISULT effort can be found in Reference b. This initial phase of the VISULT consisted of two test periods at the LWTB, the first over 14 – 18 June and the second over 6 – 9 July 1999. The thrust of this pilot testing was to run teams of soldiers through selected mission scenarios or vignettes to assess, through objective and subjective measures, how well they could perform specific tasks using the DI simulators in place at the LWTB at that time. The effort had the dual aim of evaluating simulator performance and assessing tasks for inclusion in the subsequent Phase 5 testing. An additional goal was to investigate the effectiveness of integrating DISAF troops with live troops in the simulators as a 'mixed' fireteam.

From a technical perspective, these tests provided the first real opportunity to evaluate the improved DI simulators provided under the ACRT effort. Improvements were expected in weapon aiming accuracy, simulator update rate performance, and display resolution. Also, two of the simulators were equipped with enclosures that acoustically isolated the hybrid inertial/acoustic trackers used in the system and visually isolated the user from the surrounding area.

The DI simulator performance was significantly improved over the previous version. The XGA (1024 x 768) display resolution and presumably the new graphics cards provided a clearer visual display and greatly improved spatial and textural perception inside of buildings. This latter improvement is significant for MOUT applications. Previously, it was difficult to maneuver inside of buildings because the gray cinder block texture tended to blur together, making it difficult to see doorways, corners, and other interior structures.

Weapon aiming was also significantly improved. This had been a problem area for the previous simulators. Target hit performance was much better, especially at the shorter ranges that are more typical of MOUT operations. Expanded calibration and boresighting procedures, along with improvements to the tracking system, have improved weapon tracking and thus weapon aiming performance for all postures – standing, kneeling, and prone.

Part of the improvement to the tracking system was increasing its sensitivity. The ability to make this change was due in large part to the addition of the sound (and light) isolating enclosures. Initially, only two enclosures were procured so that their effectiveness could be evaluated prior to making the decision to enclose the remaining seven simulators. The improvements they allowed in tracker performance, along with the overwhelmingly positive soldier feedback during the Phase 1 testing, made the decision to go ahead and procure the remaining enclosures an easy one. A further description of the DI simulator and SSE is provided in the following section.

Several observations were made by test personnel concerning the DI simulators. They included the following:

- Communications between the simulators were good, probably the best they ever had been. Communications upgrades were one component of the system enhancements being delivered by the ACRT program
- The shiny chrome enclosure support structure bothered some users by reflecting the screen image, causing perceived peripheral movement. Reality by Design (RBD), the simulator developer, later fixed this by placing the enclosure fabric walls on the inside of the structure instead of the outside.
- When the DI-Guy model was in a kneeling posture and the user applied a velocity, causing himself and his icon (model) to move, DI-Guy would simply slide along the ground on its knees. This was an implementation decision by RBD due to ambiguities between crawling and crouched walk, along with some problems with the DI-Guy crouched walk behavior.
- Collision detection implementation resulting in the icon merging into and being able to see and be seen through walls was still an issue. This is a large issue with all DI simulations and is one that is difficult to correct.
- Sound localization was difficult in the simulator. The spatialization of sound appears to be implemented fairly crudely, or at least that is the apparent effect.

Other issues identified by the users (soldiers) and data collection personnel are documented in Reference b.

3.2 PHASE 2: ADVANCED CONCEPT RESEARCH TOOLS (ACRT) LOOK

This was essentially a free task for VISULT, since LMIS members of the VISULT team were also engaged in the ACRT DI simulation procurement and installation effort. The overall ACRT DI effort went relatively smoothly, and the simulators were in place and operational for both the Phase 1 and Phase 5 testing. The SSE, and its constituent DI simulator, the SVS™, used during these tests is briefly described in the following section.

3.2.1 Dismounted Infantry Simulation Description

The SSE provides the LWTB with the capability to simultaneously immerse an infantry squad within a virtual environment and allows them to move, shoot, and communicate as individuals and as a coordinated element. It also allows coordinated activity with computer-generated forces supplied by ModSAF, DISAF, or OneSAF. The SSE also contains the capability for exercise control through ModIOS and data collection through either Simulyzer or ModIOS. The SSE is depicted in Figure 1.

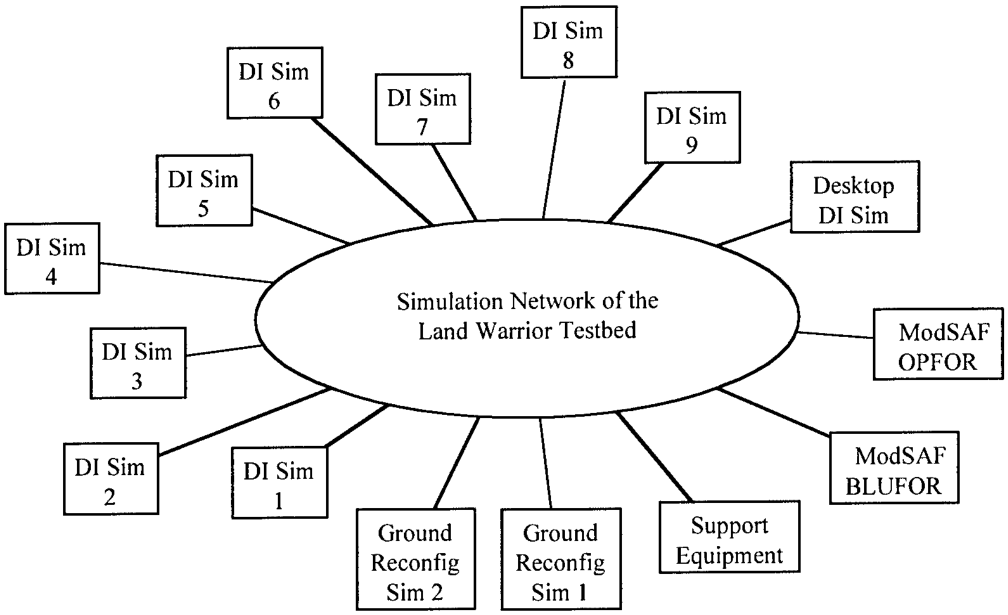

Figure 1. Squad Synthetic Environment Block Diagram

As can be seen in Figure 1, the principal component of the SSE is the DI simulator. There are nine (9) standup configurations of these simulators and one desktop version. The ACRT DI Simulator consists of a Soldier Visualization System or SVS™, a monocular Head Mounted Display (HMD), a DI C4I system, and a virtual radio (see Figure 2). The SVS™ is a low cost, PC based, DIS compatible DI simulator developed by RBD. It uses a surrogate weapon with an integrated thumb transducer for unencumbered movement through the virtual environment. Posture changes (standing, kneeling, or prone) and weapon aiming are captured via a position tracking system.

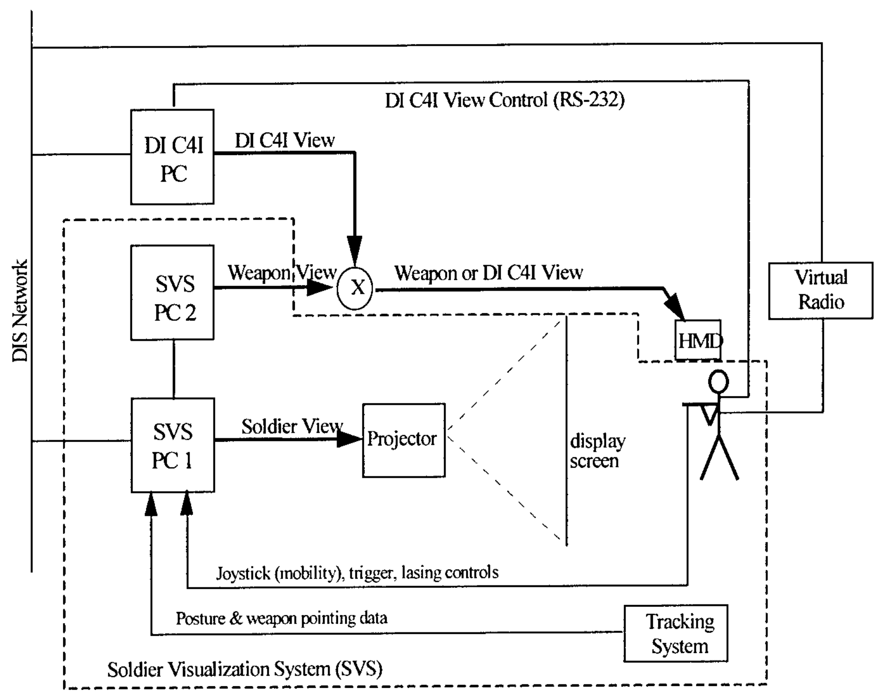

Figure 2. Dismounted Infantry Simulator Block Diagram

Two views are presented to the soldier: an eyeball or soldier view of the environment on a rear projection screen, and a separate, independent line-of-sight video camera view presented on the HMD. This video camera view is normally slaved to the direction the surrogate weapon is pointed, thus it is referred to as the weapon view.

The HMD can also display C4I information to the soldier. The DI C4I simulation is controlled by a dedicated PC that is networked to other DI C4I simulations via DIS to act as a virtual VMF (Variable Message Format) network. Voice communications among the simulators is via a separate ASTi radio network.

3.3 PHASE 3: VOICE I/O DEMONSTRATION

One of the main STO objectives is to develop, integrate and evaluate a prototype voice recognition capability to interface with the Dismounted Soldier Simulation (DISOSIM) prototype system to be developed under this STO. The intent of this voice I/O interface is to enable live soldiers to give voice commands to the SAF entities in the DISOSIM prototype system. For FY99, STRICOM decided to leverage the spoken language technology developed for the DARPA Synthetic Theater of War (STOW) 97 program, CommandTalk, as a means of rapidly demonstrating utility and feasibility. CommandTalk's primary advantage is that it provides, at a low cost, enough capability to demonstrate the utility of speech interfaces with the DISAF application. In its current form CommandTalk does not provide a generic solution to all the requirements of interfacing with a US Army simulation application such as DISAF. CommandTalk is limited to one speaker per ModSAF station, and only the entities hosted on that station can be controlled. Also, CommandTalk supports scenario setup, display manipulation, and command and control of entities.

The goal of this effort was to use CommandTalk in a specific exercise as a spoken language interface for a scenario of a human squad leader commanding DISAF virtual entities. MITRE was tasked to perform the development and integration and to design a test scenario that could be used to demonstrate these new capabilities. The effort was conducted during the FY99 timeframe and demonstrated at the MITRE facility in Reston, VA in September 1999. Demonstration participants included a SME from Ft. Benning GA, Dismounted Battlespace Battle Lab (DBBL), STRICOM representatives, and MITRE personnel. Valuable insight and feedback was captured during this demonstration. This insight and feedback will be used during subsequent voice recognition R&D under this STO.

STRICOM provided the development hardware and MITRE provided the CommandTalk legacy software and the software/systems engineering resources for the development and integration. The voice I/O prototype system developed for this effort was composed of the following elements:

- 1 Silicon Graphics Indigo 2 w/ IRIX 6.2, running ModSAF 5.0.
- 1 Silicon Graphics Indigo 2 w/IRIX 6.2, running CommandTalk / Nuance Speech Recognition Software.
- Headset and microphone with a Pre-Amp interface with the CommandTalk Software.

The main intent of this effort was to demonstrate that voice commands could be used to assist in the set-up and to control various aspects of DISAF during an exercise. Currently, DISAF requires an operator to input all the set-up and operational commands for each entity using the ModSAF Graphical User Interface (GUI). During an actual exercise, the soldiers must communicate their intentions for SAF movements and actions to the operator who in turn uses the GUI to control the entities on the computer. By using the CommandTalk interface, soldiers, immersed in a virtual environment such as the SSE, would be able to input voice commands to the CommandTalk interface software and have DISAF recognize and react to those commands during an exercise. Additionally, the SAF operator would be able to use this interface to assist in the set up of the scenario.

As part of this effort, it was intended to develop an Army-specific speech set for use on the system. The Marine Corps had developed a similar set of speech commands under their Leathernet program, which interfaced with an earlier version of ModSAF. This speech set was to be modified to be in accordance with Army operating procedures and demonstrated with ModSAF 5.0 (i.e., change a unit designation recognition from One Alpha to Alpha One, etc.)

As a result of this effort, MITRE was able to demonstrate that CommandTalk could be integrated with ModSAF 5.0 and was able to perform certain GUI functions associated with the DISAF functionality. During this VISULT Phase 3 demonstration, it was shown that voice commands could be used by the operator to set up the SAF entities by allowing the creation of units, placement of units at specific locations in the scenario, placement of operational points at specific locations, zooming and panning around the scenario, and changing the map scale. The demonstration also showed the utility in aiding the soldier during an exercise to control SAF entities by allowing him to release ModSAF (via 'ON ORDERS'), move units from point to point, and have the unit rally at a certain location.

Due to unexpected funding and schedule constraints during this effort, MITRE was unable to develop an Army specific dismounted infantry speech set. Instead, the existing Marine Corps speech set was used for this effort. Some minor adjustments were implemented during the demonstration in order to use USMC voice commands (based on USMC speech set) in conjunction with US Army DISAF behaviors and entities (call numbers).

After completion of the capability demonstration at the Mitre facility, the system was delivered and set up at STRICOM's Technology Development Center. It is anticipated that further development of the voice command interface will be pursued in the upcoming fiscal years. It is intended to fully implement the voice command architecture, to develop a Voice Federation for use with HLA (High Level Architecture), to develop an Army specific speech set, and to expand the current CommandTalk vocabulary to support typical Army operations.

3.4 PHASE 4: DISAF FACE VALIDATION

Another STO objective is to develop, integrate and evaluate an improved Computer Generated Force (CGF) capability with the Dismounted Soldier Simulation (DISOSIM) prototype system developed under this STO. STRICOM has funded the development of this CGF capability (DISAF) under previous ADST II delivery orders and has continued improvements under a separate BAA contract with SAIC. Phase 4 of the VISULT effort involved the face validation of the new enhancements that were added to the DISAF baseline during the FY99 time frame. The validation was performed under this Delivery Order since the new capabilities would be used to support the Phase 5 evaluations at the LWTB. Additionally, the validation would be used to support the integration of these new enhancements into the OneSAF Testbed Baseline (OTB) version B release. The validations were performed at the SAIC facility in Orlando, FL in September 1999. Face validation participants included a SME from DBBL, Ft. Benning GA, STRICOM representatives, and the SAIC development team and an SME. The face validation was based on the DISAF Software Test Procedures, and Conceptual Model documents developed as part of the DISAF project (see reference c). Problem Tracking Reports (PTRs) were generated for identified discrepancies during the validation activities.

The participants at the end of the validation prioritized these PTRs. The DISAF developers, prior to the VISULT Phase 5 evaluations, fixed the PTRs designated as high priority.

The DISAF enhancements primarily focused on the following areas:

- New and revised behaviors,
- New weapon and munitions types,
- Revised individual combatant (IC) entities and units,
- New sensory model.

These are discussed in the following sections.

3.4.1 Revised Behaviors

The existing Move, Travel, Suppressive Fire, Halt, and Occupy Position behaviors were updated as follows:

- Improved Move / Travel. Improvements in the Movement planning infrastructure allow ICs to plan obstacle-free routes in open terrain.
- Movement with Cover and Concealment. DISAF will evaluate the terrain between the entities and the target location and have the entities use the maximum amount of cover and concealment to approach a position, not just use a direct line. Entities change posture to stay in cover behind low obstacles and rush across exposed areas.
- Improved Occupy Position. Allows ICs to use the terrain analysis task to determine concealed battle position and allows them to move to a new position while monitoring the enemy. The Terrain Analysis task allows the ICs to consider different postures and cover beside "vertical objects".
- Improved Suppressive Fire. Enhancements support the following:
  - Setting IC posture
  - Allows ICs with 2 weapons to choose the appropriate one for the task at hand
  - Allows the user to specify the timing of bursts
  - Allows user to specify input parameters such as Firing Rate, and Duration on the GUI editor
  - Starts the Suppressive Fire task by having the unit Occupy Position
  - Allows the entities to fire at a target that is not visible. All rounds hit an object, and rounds impact at first object, not at the target.
- Improved Halt. Allows ICs to seek a covered position when this task is initiated.

3.4.2 New Behaviors

New behaviors added include:

- React to Contact. This is a reactive behavior in which the unit monitors enemy activity and reacts to contact. The entities go prone, orient to the enemy, and return fire / lay down suppressive fire. Contact Drill options include:

  - Shoot at enemy,
  - Assault the enemy location,
  - Withdraw from the enemy in the opposite direction, and/or
  - Create an objective area to engage the enemy

- Fire and Movement. Allows the Fire Teams to advance on the enemy position by buddy teams using the Cover and Concealment task. Currently this is a fire team behavior and will be expanded in the future to include squad level behaviors.
- Break Contact. When engaged by enemy fire, this behavior allows the unit to move to new location where enemy can not observe them. This is done via buddy teams using Cover and Concealment. This behavior is operator initiated.
- Throw Grenade. Allows ICs to throw grenades.
- React to Ambush. Allows ICs to Return Fire, initiate Suppressive Fire, throw hand grenades, and/or seek covered position.

3.4.3 New Weapon and Munitions types

New weapons, weapon modeling, and entities were developed. These included:

- M203 Grenadier. A new entity was developed to support this capability. The operator can have the entity fire either the M16 rifle or the grenade launcher. Currently, this capability is only modeled in the 2D environment, not on the 3D-stealth viewer.
- Hand Grenade. Provides all BLUFOR entities 5 grenades. The grenade has fuse duration of approximately 5 seconds and can be held for up to 2 seconds to reduce the delay. Currently, this capability is only modeled in the 2D environment, not on the 3D-stealth viewer.
- Assault Rifle Hit Probability. The rifle accuracy model has been improved and made more sensitive to the entity competency dial on the unit editor. This sensitivity allows the operator to set the level of marksmanship from beginner to expert for each IC.

3.4.4 Revised IC Entities and Units

- US IC Fireteams. The existing Fireteams Alpha and Bravo were updated to include the M203 grenadier. Fireteam Alpha now consists of: M16 rifleman, M16/AT8 rifleman, M203 grenadier, SAW gunner, and Fireteam Bravo contains: M16 rifleman, M16 rifleman, M203 grenadier, SAW gunner. These unit configurations more accurately represent a typical Army team / squad. Additionally, a US IC Fireteam Composite (3 M16 riflemen and a SAW gunner) unit was created to support VISULT Phase 5 evaluations.
- USSR IC Squad. A new unit comprised of 6 AK47 riflemen was created to represent the OPFOR.
- Competency Calibration Knob. The calibration knob GUI for the IC entity has been implemented. This allows the operator to set the level of marksmanship from beginner to expert for each IC.

3.4.5 New Sensory Model

- Aural Sensing. Allows all IC entities to hear and react to sound (gunfire or movement) in their vicinity. The current implementation uses a simplistic sound propagation model to support this application and may be upgraded in the future to add some more realism to the model.

A series of tests were run on each of the enhancements listed above to verify that they were performed according to Army doctrine or Army standard operating procedures. Subject Matter Experts (both active duty and retired) were brought in to verify each of the test procedures. A test results report was generated by the SME and is available upon request for review (Reference e). This report details each of the tests that were run and the results of the tests.

It is expected that many of the behaviors incorporated into the latest version of DISAF will be added to and expanded as this STO and other efforts extend the requirements for DISAF.

3.5 PHASE 5: STO TRAINING AND DISAF EVALUATION

Phase 5 testing was the culmination of the current year STO activities and thus was the primary focus of the VISULT delivery order. Team test planning was carried out from the earliest of VISULT meetings, initially looking toward the Phase 1 testing, but always with an eye towards the final Phase 5 tests. As VISULT progressed, all planning shifted to these latter tests. Given the successful results of the Phase 2 effort (i.e., the SSE was successfully installed at the LWTB), the Phase 5 testing was conducted as scheduled during the week of 27 September – 1 October 1999. The plans, procedures, and results of this testing are documented in Reference d.

Since these last VISULT tests followed directly after the final ACRT acceptance tests, final preparations (detailed site procedures, ModSAF scenarios using the latest version of DISAF, OPFOR and civilian distracter placement, scenario dry-runs) were rushed into place during the final day and one-half before the soldiers were to arrive and the tests to begin. One scenario had to be modified (target building changed) due to problems with the chain link fence surrounding the building (soldiers could see through the fence but not shoot through it. Additionally, there was limited access to that building). Dry running the scenarios was patchy and incomplete. A lesson (re)learned is that sufficient time must be allowed between a configuration freeze and the beginning of a test exercise. As it was, first-day training and execution went remarkably smoothly considering this hurried preparation.

The thrust of the testing was to evaluate squad leader performance using the DI simulators. Different training and test scenarios were run each day, with the squad leader commanding either an all 'live' squad (soldiers in the other eight simulators), a 'mixed' squad (four live soldiers and four DISAF entities), or an all SAF squad (eight DISAF entities). Three different groups of soldiers participated in the tests during each of the three days of testing (Tuesday through Thursday). Friday was to be used for any required makeup or to showcase the SSE to any media or visitors who accepted the invitations that were extended beforehand. No media elected to attend, and visitors came throughout the week and were allowed to view the ongoing activities. These visitors caused no interruption to testing.

In summary, all the simulators performed nearly flawlessly over the three days of testing. There were some hardware anomalies, but these did not significantly impact test conduct or data collection. There were only a few issues that were a recurring problem. These were:

- Tracker boxes. Problems were encountered with three of the tracking systems. Two of these were intermittent, and could generally be cleared up by cold restart of the unit. The third had an apparent receiver malfunction, but since there are no spares for the SSE, a work-around was instituted that allowed the simulator to perform acceptably until the unit could be returned to the vendor.

- Radio setup stability. Volume and gains for the soldiers' individual radios seemed to require at least daily adjustment. There were a few instances where communications were temporarily lost but were eventually recovered.
- Weapon ruggedness. With the extended use the simulators' weapons were receiving, there were increasing problems with clips not seating properly, resulting in the weapon not being able to fire. Rubber bands were the temporary albeit inelegant solution to this problem. At least one rifle's thumb transducer became loose and rotated in place, causing a lack of control in that simulator. It was re-oriented and the simulator was able to complete the testing.

There were a number of DISAF issues during the course of the tests. The aural sensing enhancement (i.e. hearing) put in place for the Phase 5 testing had to be removed due to unforeseen interactions with other behaviors or other unintended effects. Problems arose with another simulation application at the LWTB regarding the simulation of civilian entities. Based upon a request from STRICOM and Lockheed Martin, civilian entities were added to DISAF by SAIC prior to the start of the first experiment. This addition permitted the evaluation to continue without requiring a modification to the planned training scenarios. This was one of the main effects of the insufficient setup time available for these tests.

4 CONCLUSION

The VISULT effort achieved all of its task objectives on schedule and within its fairly austere budget. The major continuous thread of the effort, the Phase 1 and Phase 5 testing, was successfully completed primarily by using assets being provided by another ADST II delivery order. This synergy of effort exemplifies the rationale behind the ADST II concept. The Phase 3 and 4 efforts were supplementary acitivities that did not involve the whole VISULT team, but were also successfully concluded as part of the overall VISULT effort. Taken as a whole, VISULT established a solid foundation for the overal STO objectives, and it is hoped that future STO activities can continue the parsimonious utilization of simulation resources available to the Government.