A TC3 Game-based Simulation for Combat Medic Training

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ABSTRACT

The modern battlefield dictates that US Army combat medics, also known as 91Ws, be capable of operating effectively and independently as members of highly dispersed and mobile combat formations. These Soldiers must have the necessary skills to accurately assess and initially treat a wide variety of life-threatening illnesses and injuries. US Army medical personnel are incorporating lessons learned from operations in Iraq and Afghanistan to improve the training of combat medics and therefore, the quality of medical care available for our Soldiers.

Many of these lessons learned are being incorporated in the 16-week, 91W10 Healthcare Specialist course administered by the US Army Medical Department (AMEDD) Center and School at Fort Sam Houston, TX. In addition to using lessons learned to modify course content, the Army has also introduced the use of simulation technologies into the program of instruction to improve the overall effectiveness of the training. The 91W10 Healthcare Specialist – Tactical Combat Casualty Care (TC3) prototype trainer is an example of this type of technology advancement. Developed in partnership by the AMEDD Center & School and the US Army Research, Development and Engineering Command, Simulation and Training Technology Center (RDECOM-STTC), the TC3 prototype provides an excellent example of how advanced, interactive, virtual training technologies can be utilized to enhance training for Army combat medics.

This paper will look in detail at the changing requirements of the combat medic and will document the results of a four month architecture design / requirements study performed by the RDECOM-STTC. It will discuss the role that Advanced Distributed Learning and commercial game technologies may play in the development of the TC3 courseware application. It will also identify the current state of these technologies in supporting additional opportunities for improving combat medic training.

ABOUT THE AUTHORS

Ms. Sandy Fowler is a Principal Investigator for Medical Simulation Technologies in the U.S. Army Research Development and Engineering Command, Simulation and Training Technology Center. She is currently working various aspects of a joint Army Technology Objective (ATO) Program and various Small Business Innovation Research projects. Ms. Fowler previously worked for the Naval Air Warfare Center Training Systems Division designing web applications and databases for the Naval Aviation Survival Training Program, as well as the design and procurement of the Payload Data Management System for NASA at the Kennedy Space Center. She has over fifteen years of experience developing large-scale database applications and three years of experience in military modeling and simulation. Ms. Fowler has a Bachelor of Science in Computer Science from the University of Central Florida.

Mr. Brent Smith has served as Chief Technology Officer, Vice-President, Director of Development and Project Manager for ECS, Inc since 1997. While at ECS, he has performed extensive research in the areas of collaborative distributed learning architectures, distributed simulations, and the use of commercial gaming technologies as educational tools for the US military. He is currently developing distributed courseware simulations for the National Guard and the Army Medical Department Center and School. He has proven skills in building strategic affiliations to manage and solve complex training issues for a variety of clients. His professional focus is on the research and development of new technologies to enable new learning methods and tools to improve effectiveness. Mr. Smith is a frequent speaker on the topic of simulation and training development and as an adjunct professor at the University of Central Florida, designed a course on game engine development. He has testified before Congress and spoken at the e-learning Guild's Annual Conference, TechLearn, I/ITSEC and the Military Operations Research Society's (MORS) Training Transformation Conference. He is a member of the Association of the US Army (AUSA), MORS, the National Defense Industry Association (NDIA), and the Interservice / Industry Training, Simulation and Educations Conference (I/ITSEC) Subcommittee for Education.

CSM David Litteral joined the Army in 1981 as a Combat Medic. He is currently serving as the Command Sergeant Major of Blanchfield Army Community Hospital, Fort Campbell, KY. His most recent assignment was the Chief Enlisted Instructor, Department of Combat Medical Training, AMEDD Center and Schools, at Ft. Sam Houston, TX. CSM Litteral has served in a variety of key leadership and technical assignments throughout his 24-year military career to include First Sergeant, Operations NCO, Chief Medical NCO, and Flight Medic. CSM Litteral's education includes: Basic and Advanced Medical Specialist, Basic and Advanced NCO Courses, and the EMT Basic and Paramedic Training. He is a graduate of the US Army Sergeants Major Academy. He is currently completing his undergraduate work toward a Bachelor of Science in Occupational Education. CSM Litteral is the recipient of several military awards and decorations to include the Defense Meritorious Service Medal, Meritorious Service Medal (w/3OLC), and Army Commendation Medal (w/3OLC). He was recently awarded the Sergeant Major Larry L. Strickland Excellence in Education Leadership Award. He wears the Senior Aviation Badge, the Expert Field Medical Badge, and in 2000, was inducted into the Order of Military Medical Merit.

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INTRODUCTION

US military personnel continue to face ever-changing and potentially dangerous situations in the day-to-day performance of their duties. Unfortunately, some of these personnel will require medical treatment for serious illnesses or injuries resulting from combat or non-combat related events. In many cases, the Army combat medic, or 91W as they are also known, provides the first line of medical support and assistance to those injured Soldiers.

The ultimate goals of combat medicine are the return of the greatest number of Soldiers to combat and the preservation of life, limb, and eyesight in those who must be evacuated. Most combat casualties still result from penetrating trauma with up to 90% of combat deaths occurring on the battlefield before a casualty reaches a military medical treatment facility. Many casualties, both combat and non-combat related, occur far from medical facilities and may require immediate and sustaining care far from those facilities for extended periods of time. As the nature of the modern battlefield changes, the importance of an efficient and highly responsive medical support system grows proportionately[1]. As the "medical first responder" on the battlefield, the Army combat medic plays an indispensable role in saving lives and meeting the goals of combat medicine.

Training is the primary method for ensuring combat medics achieve and maintain the required state of readiness. Army medics must have the ability to quickly think, assess a situation, develop an appropriate course of action, and act decisively to save lives. Army trainers are focused on providing these Soldiers with the latest and most relevant technologies, techniques, procedures, and equipment that will ensure their success on the battlefield. Future joint force leaders are working to define new joint education and training standards for all medical care professionals. New technologies such as game engine-based trainers and immersive, virtual training simulations may prove to be effective tools that will help medical trainers throughout the Department of Defense achieve these goals and objectives.

91W10 HEALTHCARE SPECIALIST COURSE

The mission of the Army Medical Department (AMEDD) Center and School at Ft. Sam Houston, TX is to provide the Army with trained and ready warrior medics. At the core of this mission is the Combat Medic Training program. The Department of Combat Medic Training (DCMT) is part of the 232nd Medical Battalion and is responsible for training and graduating approximately 7,000 combat medics per year. The DCMT serves as the proponent for the 91W Healthcare Specialist program and the Army Emergency Medical Service. The primary role of DCMT instruction is to provide fundamental instruction in principles of tactical medicine for Soldier medics based on the principles of Tactical Combat Casualty Care (TC3).

The 91W10 Healthcare Specialist Course provides the Army with entry level medics capable of saving lives on the battlefield. The purpose of the 91W10 Healthcare Specialist Course is to qualify these Soldiers for classification to the Military Occupational Specialty (MOS) 91W by providing specific training in combat and military medical skills. The course is designed to train junior enlisted Soldiers to perform emergency medical treatment and routine patient care duties in field units and military treatment facilities. The course supports the training of both active Army and reserve component Soldiers.

The major training components include combat trauma, invasive procedures, Force Health protection, evacuation, CBRNE (chemical, biological, radiological/nuclear and explosive), and support of care which encompasses some basic nursing skills. The course is taught as part of a 16-week, residence training program and requires 440 hours of classroom training, 192 hours of situational training exercises and 128 hours of field training exercises. The course also prepares students to pass the test requirements of the National Registry of Emergency Medical Technicians – Basic (EMT-B) as a foundation for the Health Care Specialist.

Lessons learned from recent conflicts have identified a number of areas requiring modification in the 91W10 curriculum. Specifically, DCMT has increased emphasis on incorporating additional "warrior" tasks

and immersive, relevant training scenarios in field training exercises. These scenarios are designed to "put Soldiers in the 'train as we fight' environment before they deploy to that environment2."

OVERVIEW OF TC3

Military medical personnel must be prepared to treat trauma patients injured in both combat and non-combat situations. Trauma care training for military corpsmen and medics has traditionally been based on the same systematic approach for Basic, Advanced and Pre-hospital Trauma Life Support (BTLS, ATLS, and PHTLS) courses used for training Emergency Medical Technicians (EMTs). These courses and their principles are well accepted as the standard of care in a civilian setting. Once again, lessons learned from recent combat experiences have caused military medical personnel to modify some of the treatment methods previously taught in these courses.

The preponderance of Soldiers who die in combat, do so within minutes of being injured due to penetrating trauma and the resulting hemorrhage. In order to save lives, treatment that includes prompt localization, resuscitation, and stabilization, followed by timely evacuation, is essential.

ATLS procedures form the basis for many of the treatment principles still followed for tactical combat care. However, factors uniquely found under today's combat conditions can force a medic to modify those standard procedures. Factors such as darkness, hostile fire, severe resource constraints or limitations, prolonged evacuation times and competing tactical battlefield decisions can require the combat medic to depart from established treatment principles in order to save a fellow Soldier's life.

The following are just a few of the factors that can differentiate combat casualty care from trauma care provided by EMTs in a civilian setting:

- Enemy fire / environmental conditions can prevent treatment of casualties
- Limitations in available medical equipment
- Evacuation times can vary significantly from a few minutes to several hours or even days
- Tactical considerations may place greater emphasis on mission accomplishment over administering immediate medical care

Tactical Combat Casualty Care recognizes a particularly important principle – performing the correct intervention at the correct time in the continuum of combat care. A medically correct intervention performed at the wrong time in combat may lead to further casualties[3]. Casualty management and treatment during combat operations can be divided into three distinct phases - Care under Fire, Tactical Field Care, and Combat Casualty Evacuation Care. Each of these phases will be described in more detail below.

Phase I - Care Under Fire

The term "Care under Fire" refers to the medical treatment rendered by a combat medic at the scene of an injury while the medic and the casualty are still subject to hostile enemy fire. The amount or type of medical supplies and equipment that is available to the medic will most likely be limited to that carried by the Soldier or the medic. Additional injury from enemy fire is possible to both the casualty and the medic.

Limited medical care should be attempted during this phase until either the enemy fire has been suppressed or the casualty has been withdrawn to a safer location. The priority of actions by the medic under Phase I include:

- The additional firepower provided by the medical personnel may be required to defeat the immediate enemy threat. The medic should take cover and return fire assisting fellow Soldiers in suppressing or defeating the enemy. Casualties who are able to assist in returning fire should be allowed to do so. Engaging in direct action against an enemy will likely result in a delay to providing direct medical treatment for casualties.
- Assist casualties in moving to covered positions.
- Stop any life-threatening hemorrhage with a tourniquet since injury to a major vessel can result in a casualty quickly going into Hypovolemic shock. Only major bleeding is addressed during Phase I.
- No immediate management of the airway is necessary under Phase I; however, it may be required based on the length and intensity of the enemy fire.

Phase II - Tactical Field Care

Tactical Field Care refers to the medical treatment rendered by a combat medic once the casualty and the medic are no longer being subjected to effective hostile fire. The treatment may be administered at the site of the enemy engagement or may be administered after the

casualty has been moved to a nearby secure Casualty Collection Point. The term may also refer to the treatment of wounds or injuries which occur in a non-combat situation. The amount and type of medical supplies and equipment that are available will likely be limited to that carried into the field by medical personnel. The time required for evacuation to a medical treatment facility may vary considerably.

The key steps involved in Phase II include assessing the casualties, prioritizing treatment, treating the casualties, and preparing the wounded Soldiers for evacuation. The initial assessment focuses on the following:

- Airway
- Breathing
- Circulation

The appropriate management plan for a particular casualty must be developed with an appreciation for the entire tactical situation. Individuals other than combat medics may be called upon to assist in providing medical care on the battlefield. Examples include the Army "Combat Lifesaver," one who is not a medic, but who has received basic medical training in specified life-saving skills.

Phase III - Combat Casualty Evacuation Care

Combat Casualty Evacuation Care refers to the medical treatment provided during the evacuation of a patient from the battlefield to medical treatment facility. Evacuation may be accomplished through a variety of means such as aircraft, vehicle or boat. Care during this phase more closely approximates ATLS guidelines. The opportunity to carry additional equipment and a more favorable environment in which to work makes a more varied selection of medical interventions possible.

ARMY TECHNOLOGY OBJECTIVE (ATO) ADVANCED MEDIC TRAINING TECHNOLOGIES

The approach being used to provide military medical training for 91Ws has shifted focus from presenting course content using sterile textbook procedures to stressing medical tasks in a hands-on, tactical, battlefield environment. Pre-hospital casualty care continues to be the most important aspect of battlefield medicine[4]. The AMEDD Center & School is using a variety of instructional development strategies to effectively prepare combat medics for administering care and saving lives on the battlefield.

The field exercises that are being conducted during the 91W10 course at Ft. Sam Houston have increased the emphasis placed on mass casualties and patient evacuation. Currently, simulated patients participating in the field exercises are represented by live actors, or fragile mannequins. The live actors and mannequins provide some level of realism, but additional fidelity is needed to optimize the training experience. Additional opportunities to conduct realistic, "hands-on" training under a variety of simulated conditions are needed to help the students develop a deeper understanding of the medical procedures that are likely to be required on the battlefield.

The U.S. Army Research Development and Engineering Command, Simulation and Training Technology Center (RDECOM-STTC) has initiated a research effort aimed at developing enhanced tools and technologies for training combat medics. This effort is defined under an ATO entitled, Advanced Medic Training Technologies. The research is being pursued in partnership with the AMEDD Center and School at Ft. Sam Houston, TX.

One of the key projects being pursued under the ATO is research designed to use game engine technology to develop a prototype trainer to support the 91W10, Tactical Combat Casualty Care training course. This research will demonstrate how game engine-based training tools can be used to provide effective and relevant training for Army combat medics. The long term goal of the research will be to transition the prototype to an acquisition program for final development and distribution throughout the Army.

Overview of 91W10 - TC3 Simulation

The 91W10-TC3 simulation is a game-engine based simulation which combines advanced interactive training techniques with Advanced Distributed Learning (ADL) technologies and immersive 3D

simulations. The simulation will use a variety of instructional development strategies to support a student's need to master a variety of competencies and to apply them in unique situations. Drawing upon adult learning theory, performance-based training principles, and a suite of authoring tools and techniques, the 91W10-TC3 simulation will provide the capabilities to generate diagnostic instruction and immediate feedback that will automatically address different levels of student proficiency within the range of complex training objectives.

The simulation will immerse students into scenario driven events to teach procedures relating to the combat medic's initial arrival on the scene, scene assessment, scene security, triage, initial treatment and evacuation of the casualty. Each scenario within the simulation is designed to be a short, goal-oriented training exercise that provides the means to train a group of closely related tasks within the context of a specific mission. It is this contextual experience of knowledge acquisition in an authentic environment that facilitates the learner to create the constructs that can be applied to new unfamiliar situations.

An additional goal of this effort is to provide a foundation for integrating Advanced Distributed Learning courseware into the program while giving training developers the capability to mix and combine live, constructive, and virtual training simulations to meet institutional, operational and self development training requirements.

How does the TC3 simulation fit into the existing Program of Instruction

While defining requirements for the TC3 simulation, a primary concern was on how to integrate it within the existing Program of Instruction for the 91W10 Healthcare Specialist Course. The TC3 simulation is intended to be integrated into the course after students have been previously exposed to the concepts of basic and advanced trauma life support. After completing the 91W10 Healthcare Specialist Course, medics are required to revalidate 23 critical hands-on skills every six months. The TC3 simulation is being designed for use in the following capacities for initial and sustainment training:

- When used in a classroom environment at the AMEDD Center & School, the TC3 simulation will provide an opportunity for student medics to assume key positions and perform their duties under the guidance of an instructor. This approach also allows instructors to pause the simulation to discuss key points within the context of a lecture.
- The AMEDD Center & School may install the TC3 simulation in one of their Learning Resource Centers. It is expected that this will foster independent learning by encouraging students to learn for themselves based on their understanding of how and why new knowledge and skills learned in the 91W10 Healthcare Specialist course are related to their own experiences in the TC3 simulation.
- The TC3 simulation may eventually be deployed as a distance-learning tool for sustainment training. Programs such as this are numerous in the civilian sector of emergency medicine. However, very few of them meet the needs of the Army or meet the stringent requirements of the Continuing Education Coordinating Board of Emergency Medical Services (CECBEMS).

91W10-TC3 DEVELOPMENT PHASE 1 STUDY

The RDECOM-STTC commissioned a four-month instructional design study in 2004 to review the architectural and instructional requirements of the prototype 91W10-TC3 simulation. The study was conducted by Engineering & Computer Simulations, (ECS) Inc. of Orlando, FL in cooperation with the RDECOM-STTC and AMEDD Center and School. The study resulted in the development of a design document for the creation of the TC3 prototype which will be accomplished under a Phase II effort extending through the end of the Advanced Medical Training Technologies ATO.

The Phase I study produced three major deliverables that contributed to the Phase II plan. The first of these outputs was an instructional design document, which provided an overview of how the many TC3 training objectives taught in the course may be included and sequenced within the simulation. From this, specific objectives were selected for inclusion into the prototype application. As previously described, this document also discussed how the TC3 simulation may be integrated with the existing program of instruction.

The second deliverable was a clear description of the scenario that would be replicated in the prototype. The third deliverable was a report summarizing an evaluation of technologies, to include possible game engines for use in the prototype. A section of this document provided a detailed outline of a recommended approach to build the TC3 prototype.

The following sections discuss the results of this study and how they have been applied to the development of the prototype.

Defining Instructional Requirements

From a learning sciences perspective, cognition is based on the interactions that take place in the social and material world. Through participation, an individual comes to understand the world from the perspective of that, which is around them. The TC3 simulation requires a level of "fidelity" to ensure that learning occurs in a sufficiently real-world context.

While simulations offer the opportunity to undergo informative interactive experiences, they do not, by themselves, constitute training or instruction. One of the greatest challenges in this development is the creation of a framework or model of collaborative learning that allows problem-solving and analytic skills to be tested individually and collectively within the simulation.

To this end, the TC3 simulation is making a push to adopt a more systematic approach for evaluating human performance, both for individuals and teams. Performance-based testing is a methodology used to evaluate individuals and groups by having them actually complete tasks relevant to a particular training objective. This methodology promotes higher-order thinking skills by combining the use of declarative knowledge (why you do something) and procedural knowledge (how you do something) [5]. Declarative knowledge would focus on the criteria that determine when to perform a task, such as whether the combat medic should return fire or treat the casualty. While procedural knowledge focuses on building proficiency in the task steps that each task is comprised of.

Task steps are a listing of actions that are required to complete each mission essential task. Under each task step are listed the performance measures that must be accomplished to correctly perform the task step. These actions are stated in terms of observable performance for evaluating training proficiency. The Unified Commanders-in-Chief fully support this approach and have been using Joint Mission Essential Tasks Lists (JMETLs) to set priorities for joint exercises designed to train joint force commanders and joint forces.

Feedback and Guidance

One key challenge in developing these capabilities in an interactive environment is to qualitatively process information, recognize patterns of behavior, identify misconceptions in performance and establish a plan of instruction tailored to the student's learning style[6]. A crucial part of this process is the ability to assess the underlying causes of observed learner performance. Three methodologies are commonly used within simulated environments.

- **Outcome-based models** provide instructional environments in which the learner is engaged in pursuing and accomplishing a series of goals. The student is an active participant in each scenario and is assessed on the successful completion of these goals[7].
- **Event-based models** track a series of events within a scenario based on learning objectives. These events are often process oriented and designed around student interaction with the environment.
- **Four Quadrant Human Performance Measurement Models** (see Table 1) distinguish between individual and team behaviors. They also distinguish between process and outcome behaviors. Specifically, this model addresses both declarative and procedural knowledge for both teams and individuals[8].

Table 1. Four-Quadrant Human Performance Measurement Model

	Individuals	**Groups**
Processes Made up of events	Decision making Task Strategy Critical Thinking	Coordination Communication Team Strategies
Outcome	Latency Accuracy Timliness	Mission overall Effectivenss Error propogation

The TC3 simulation will allow assessments that follow the four quadrant human performance measurement model. By dividing performance, evaluation among the four quadrants, assessment strategies within the TC3 simulation can be specified for individual processes, individual outcomes, team processes and team outcomes. This becomes especially important in future iterations of the TC3 simulation where combat medics and combat lifesavers may train together to treat multiple casualties.

Defining Training Objectives

Arguably, one of the most important deliverables from Phase I was a clear definition of the specific training objectives to be achieved by students using the TC3 prototype. These objectives were defined over several meetings through close coordination between the three project partners – RDECOM- STTC, ECS, and the subject matter experts at DCMT.

The key objectives included the following:

- Explain and demonstrate combat medic activities including mission pre-operational procedures, equipment preparation, safety guidelines and patient assessment techniques
- Trainee must accurately assess the medical condition of his patients, prioritize treatment, treat the patients, and prepare the patients for evacuation
- Trainee must accurately report the condition of patients to higher headquarters by properly filling out a Field Casualty Card

These objectives served as the "landmark behaviors" of the training progress and were broken into discrete training objectives that were translated into measurable observable behaviors on the part of trainees.

Instructional Design Process

The simulation, as initially presented to instructors and staff at the AMEDD Center & School, was designed to present the student with a problem, provide the student with the tools to solve the problem and offer customized suggestions as a resource to solve the problem. In this fashion, the student would produce a solution, receive consequences based on their solution and be guided to suggested areas for review before beginning another scenario.

The first step in the development process for the prototype TC3 simulation was to specify the constructs of each training objective to be measured within the prototype scenario. Once performance measures were determined for each training objective, they were mapped to events within the simulation.

A formalized event tracking system needed to be developed to publish all of the events within each scenario that are necessary to satisfy each objective. These events are ultimately processed through a rule-based assessment module that has the capability to apply the events to a model that tracks the state of each training objective.

Data warehousing ensures that all of the activities that take place during each training exercise are logged and available for review. From such data, patterns of routing cognitive activities can be discerned.

From the developers' perspective, "expectation management" played a key role in balancing the desires of the schoolhouse against a realistic description of what could be created given the limited amount of time and funding available. In the end, the clear definition of training objectives made it much easier to define the target scenario and the key measures of performance used in the assessment process.

Defining the Prototype Scenario

The ability of an individual to learn is highly dependent upon the person's aptitude, attitude and motivation[9]. Motivation is regarded as essential for the success of the TC3 simulation. The combat medic must have the desire to learn the tasks and the training must be challenging and relevant to the mission.

In addition to the aforementioned objectives, the DCMT instructors requested that the scenario require the student to perform a mixture of both tactical (warrior skills) and medical skills, stating that TRADOC has directed that all Initial Entry Training programs, such as the 91W10 Healthcare Specialist course, integrate 40 core warrior skills and 9 battle drills into their respective programs[10]. They also stressed the need for the game to be engaging and fun.

Once the objectives were established, a number of possible training scenarios were considered by the three partners. In each case, the trainee was expected to assume the role of a combat medic assigned to a light infantry squad operating either in Iraq or Afghanistan.

In the first scenario, the medic would be a member of a convoy that is attacked by an Improvised Explosive Device (IED). The explosion causes a number of casualties that must be treated by the trainee. In the second scenario, the medic is a member of a foot patrol operating in an urban environment somewhere in the Middle East. In this instance, the squad is attacked by an IED causing four casualties – one KIA (killed in action) and three serious injuries (an amputation, a sucking chest wound, and a serious burn). The third scenario was a variation of the second; however, the injuries in this scenario are caused by enemy fire thereby requiring the trainee to exercise more "warrior skills" before beginning to treat the casualties.

The partners agreed that the training objectives established for the prototype could be accomplished in each of the three scenarios.

Technology Evaluation

Skillful management of new information technology must play a prominent role in the development of the TC3 simulation. These technologies can reach large numbers of people quickly with timely and relevant information, allow for the tailoring of training to local situations and provide simulated experiences that transfer efficiently into high levels of performance in an actual emergency.

A technology review was conducted to evaluate different technology solutions to provide an overview of potential paths for the successful achievement of the defined TC3 requirements. Technology requirements such as inter-operability with other combat medic training systems, third party physiology engines and intelligent tutoring systems were identified so that future instantiations of the TC3 simulation may accommodate them. A number of factors were used to evaluate these different technologies to include costs, licensing restrictions, Sharable Content Object Reference Model (SCORM) integration, artificial intelligence, scripting capabilities, and High Level Architecture (HLA) integration.

Where content design and development is concerned, the Department of Defense has mandated the use of SCORM guidelines for learning materials to be used within all ADL courseware. SCORM 2004 promotes reusable and interoperable learning resources, while also providing the ability to define complex instructional logic across Sharable Content Objects (SCO) from multiple developers. SCORM provides a rules-based "learning strategy" that enables these SCOs to set the state of global records called objectives. These records can store the learner's degree of mastery in the form of a score or a pass/fail state, or they may store the progress of the learner in terms of completion.

While the technology-related challenges were not trivial, the TC3 simulation was developed to have the potential to communicate with SCORM conformant Learning Management Systems (LMSs) to track the student's progress against multiple training objectives simultaneously. One example of this requirement can be identified within a future iteration of the TC3 simulation where the scenario must follow the policy of Soldiering skills first and MOS second with regards to training priorities. Students must be evaluated in the context of the mission in addition to specific TC3 training objectives.

In this case, the TC3 simulation will be able to aggregate the learner's actions into learning objectives and report them using the SCORM 2004 Global objectives data model. As the simulation unfolds, a LMS communications layer communicates through SCORM 2004 global objectives to update any SCORM conformant LMS on the status of the simulation's training objectives.

Building the TC3 Prototype

This existing prototype concentrates on developing a combat medic trainee's ability to assess and prioritize a number of casualties, and then select the appropriate treatments. Initial development on the TC3 prototype was completed from January to May 2005. Accomplishments made during this period of time include the following:

- Developed the underlying architecture for the prototype
- Developed a limited planning phase in which the trainee receives a mission briefing, identifies personal equipment for the mission, and prepares medical supplies and equipment for the mission
- Developed a scene-setting video that is used to set the stage for the remainder of the scenario
- Developed the initial game engine-based scenario to include a terrain database, multiple avatars and behaviors, a graphical user interface (GUI), a method for the trainee to select various treatment options, and an architecture for assessing and evaluating student performance
- Developed high resolution depictions of three injuries – amputated arm, sucking chest wound, and burned torso
- Developed a limited After-Action-Review (AAR) capability

The prototype was exhibited in May 2005 at the annual 91W/EMS, Department of Combat Medic Training Educators Conference in San Antonio, Texas. Approximately 1,200 educator, trainers, and vendors attended the conference. Feedback received from the attendees was outstanding.

Road Ahead

Continued funding is expected through the Advanced Medic Training Technologies ATO and potential customer investments. Future efforts will continue the medic interface research, develop and populate the limited proof-of-principle framework and will also

expand scenarios to include more general Soldiering skills, such as moving in formation, seeking covered positions, and returning fire. The combat medic will also acquire new capabilities such as throwing smoke grenades, firing his weapon at opposing forces, and interacting with non-player characters (NPC's) in his squad. The 3-D environment will also be expanded to include an entire village, complete with helicopter landing and medical evacuation sites. Finally, this expansion will also increase the scope of the training mission whereas the scenario will begin at deployment and end with the evacuation of casualties.

Discussions have also occurred on leveraging components of the TC3 architecture and its associated assessment models into training programs within other training domains such as the One Tactical Engagement Skills System (OneTESS) and the Combat Trauma Patient Simulator (CTPS). OneTESS will provide a live, precision, combined arms training and testing capability that exploits recent advances in technology to significantly improve real-time casualty assessment in a live training environment. The CTPS is a DoD-sponsored distributed interactive medical simulation system which includes individual training, team training and AAR capabilities and utilizes laptop virtual triage capabilities and instrumented mannequins to manifest symptoms and wound types while permitting treatments by human users of the system.

CONCLUSION

The process of researching and developing the TC3 simulation for the 91W10 Healthcare Specialist Course has created an enormous opportunity to look at the different learning strategies for combat medic training being used across the spectrum of live, virtual and constructive training domains.

In the future, the DCMT will augment "traditional" institutional training by relying heavily on the use of distance learning technologies, fielded simulations and embedded training to meet training and readiness objectives. The TC3 simulation architecture is being developed to facilitate the integration of multiple learning and assessment strategies, as well as other learning technologies across domains to help provide a foundation to make this a reality. This fantastic range of possibilities will require far reaching technological innovation to make this a reality: innovation that is already well underway under the guidance of the RDECOM-STTC and the AMEDD Center & School.

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