
VIRTUAL SIMULATIONS & INFANTRY TRAINING



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WHUMP! The breaching charge did its job and put a man-sized hole in the side of the farm house, but Bravo Team, 2nd squad had sustained casualties in completing the breach. Only one man got back from laying the breaching charge. SGT Makuch was first out from the railroad ties as he led his fire team through the dark the last 20 meters to the farmhouse. SSG Hicks trailed Alpha team, ready to bring in Bravo Team as soon as they seized the foothold in the house. 1LT Miramontes had already called for smoke and shifted 2nd and 3rd squads' fire and was bringing up the Strykers led by SFC Dunn. 1LT Miramontes NVG's were comparatively limited, and the Strykers would be better able to identify and suppress enemy positions with their enhanced optics and firepower. He monitored his squad leaders' chatter as they adjusted their Soldiers' suppressive fires and got ready to follow first squad.

SGT Makuch brought his fire team straight into the breached room and shot an enemy Soldier as he turned to fire. SSG Hicks ordered Makuch to take the next room as Bravo Team made the leap across the open area. Bravo Team just made it into the initial room as an enemy grenade went off outside and Alpha started clearing the next room. PVT Kim from second squad saw the window the grenade came out of and promptly put an M203 round in the window. His team leader popped smoke in the open area to cover the team's bound as Kim told him what he saw and why he was shooting. Alpha Team's 1st squad stacked and tossed in a flash bang to the room on the left per platoon SOP and rushed into the room to find two dazed civilians. Bravo team followed the same procedure in the room to the right. SSG Hicks reported the farmhouse clear as SFC Dunn reported that the Strykers had caught the enemy fire team running out the back.

As 1LT Miramontes entered the farmhouse, an enemy automatic grenade launcher started pounding the building from down the street. It was masked by the surrounding buildings, and he had already learned that bringing in Strykers too early risked an RPG ambush. He requested help from his CO, who directed him to illuminate the building with a PAC4 and change radio frequencies to direct Spectre gunship fires. Three 105mm rounds later, the enemy 40mm fire ceased.

The lights came on and 1LT Miramontes came out of his simulator. "Much better Miramontes, and good shooting Kim, you probably saved your squad with that shot. Miramontes, let's get your platoon into the AAR room and talk distribution of fires."

"Sir, we cleared the building this time and..."

"And you lost a fire team, Miramontes., They say three is a charm, but let's see if there was something Bravo team or the support by fire squad could have done better. Remember, tomorrow we're going out to McKenna MOUT Site!"

The best training is live, realistic, challenging METL-supported training, executed to standard on terrain similar to where you will fight. Nothing replaces live training with live ammunition with the whole unit in the field. That is an honest and time proven truth. Unfortunately, in actuality resources — space, ammo, time — are scarce, and we are very challenged to do all our training in the field for a myriad of reasons. Training areas are busier (and also super eco-managed) and not as plentiful as in the past. Ball and tracer ammunition and grenades are scarce. Missiles are expensive, and small arms rounds' usual priority of issue is to support marksmanship. What about time, the second most important resource next to the troops themselves? How many iterations of that platoon attack can I get in before I have to clear the range? Would preliminary training before the live fire make more of a limited opportunity? How often do we get those opportunities with all those conflicting requirements and mandated training?

For those of you who visited a video arcade lately, don't you wonder why someone hasn't figured out how to link those realistic shoot or be shot games out there together and let the individual choose a route versus going down the same old hallway every time? The holodeck simulation from the Starship *Enterprise* is still decades away, but today we can train a whole platoon along the lines of the above vignette. The purpose of this article is to introduce you to the utility of a virtual simulation and energize you and the infantry community to pursue a dismounted Infantry focused virtual simulation.

Applying Virtual Simulations

The Modeling and Simulations (M&S) Handbook defines virtual simulations as...

digital representations of environments, organizations, systems, other entities, and processes with players operating virtual prototypes in a synthetic environment (i.e., real people operating simulated systems). Virtual M&S put the human in the loop (HITL) in a central role by exercising motor control skills (e.g., flying an airplane), decision skills (e.g., committing fire control resources to action), or communicating skills (e.g., as members of a command,

control, communication, computers, intelligence, surveillance, reconnaissance [C4ISR] team). Current state-of-the-art virtual M&S bring the system (or subsystem) and its operator together in a synthetic or simulated environment.

The aviation community has used virtual simulations for more than half a century. The armor community has had a virtual simulation tool since the late 80's (SIMNET and now Close Combat Tactical Trainer [CCTT] is a networked simulation consisting of numerous vehicle simulators). That is longer than some of today's Soldiers have walked the planet. What types of tasks lend themselves to virtual simulation?

According to the Modeling and Simulations (M&S) Handbook,

Virtual M&S provide understanding of human reactions and decision processes and human-machine interfaces. Output supports initial and early user evaluation. Virtual M&S provide a platform for crew training prior to live exercises and tests, or realistic mission rehearsal in preparation for actual combat operations. Linked to other simulators, the interaction of multiple weapon systems can be examined, leading to changes in tactics or engagement rules.

Our tankers and Bradley crews have used virtual simulations for years to great effect. Couldn't traditional infantry benefit from a virtual simulation, a simulation that starts at the individual level but — equally importantly — gets the whole unit interacting together in a virtual battlefield, operating in those environments and against those threats we are likely to face? A simulation is needed that gives the infantryman training value in offensive and defensive scenarios in the types of terrain we will fight in like MOUT, dense forest and jungle, and incorporates the combined arms team and its effects? Now there are some great simulations out there, each designed for a very specific skill or task set. Specifically, the Weaponeer, Engagement Skills Trainer (EST) and call for fire simulators do great jobs for their training niches. None of them make Soldiers (emphasis on the plural and implying units) take cover, return fire, report, communicate with other real Soldiers/units (above the

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squad level), integrate artillery fires and other combined arms simultaneously (as in combat). I'm talking about a full spectrum infantry centric networked multi-simulator simulation focused at training Infantry from squad to company with the effects and participation of the combined arms team. Let's call this simulation concept Full Spectrum Infantry & Leadership Enhanced Reality or FUSILIER. Two centuries ago, soldiers called fusiliers, who were armed with light flintlock muskets, fought on battlefields using tactics and formations trained on the parade field. I propose that today's Infantry use a simulated and much more challenging training ground than those of the past. In the past, there have been four primary obstacles that have hindered development of a full spectrum Infantry simulation. Today, we have learned how to overcome those obstacles.

Previous Obstacles to the Development of FUSILIER and Today's Solution

For one thing, virtual Infantry centric simulation was just technically too hard. Infantry is typically not employed on virtual flat and/or open terrain. When it is, realism and utility suffer. The Infantry fight is terrain intensive and while a tank can hide behind a hill, infantrymen seek cover behind a fallen tree, in a small culvert or even next to the curb of a road. Buildings are another can of technological worms called multi-elevated structures (MES). Portraying buildings — ones you can get inside and that have multiple floors, stairs, doorways, windows etc. — requires a lot of memory. Now challenge a simulator with the tasks of tracking 30-120 infantrymen — and however many OPFOR — moving across complicated terrain with

their changing lines of sight (versus 14 tanks in a less terrain intensive environment for tankers) and the processor speed/memory demon becomes obvious. Although I've simplified this problem considerably for this article, a book could easily be written to more fully address the challenges in portraying a realistic Infantry fight.

Recent computer advances in hardware and software have largely overcome the argument that simulations are technically too hard to accomplish. The problem of not having enough power to push a simulation is generally a thing of the past, with processors today operating at 2.8 gigabytes or faster. Advances in memory and video card technology make it possible to run complex simulations on desktop PCs. Software enhancements have made leaps and bounds by better using hardware capabilities to improve Graphic Interface Units (GUI or picture). Given a detailed terrain database at the one-meter posting, today's software can routinely construct terrain with features that infantrymen will encounter, such as tunnels, curbs, doorways, stairs, or the inside of a fully depicted building located on one common terrain. For instance, the Shugart-Gordon MOUT site at JRTC is available now in virtual form, and is exact in detail to the Shugart-Gordon MOUT site on the ground. Simulations that involve virtual-immersed simulators are available today for the individual soldier. Much like the CCTT tanks and Bradley simulators — where each vehicle is immersed in a common synthetic terrain base — there are simulators available today that place players from a Soldier up to a platoon in common synthetic terrain capable of interacting with each other, as well as with vehicle simulators and OPFOR. The most significant technical hurdle left is to put all the pieces in place and actually demonstrate a complete company fight with the requisite number of entities. Later, I will explain a proposed solution that is largely in place today at Fort Benning.

While the development of an Infantry virtual simulation has been less urgent in the past, today's base closures, training area restrictions, maneuver damage, host country regulations and ecological concerns have all impacted on training area availability. Real world deployment costs

have reduced the dollars available for live fire training. The need is obvious. Yesterday's Infantry deployed, trained, and fought. Tomorrow's force will train, deploy, and fight, requiring that Infantry be ready to execute as soon as they hit the ground. A simulation tool leveraging our limited live training resources, providing a training gate and including assets not readily available (MOUT, AC130, Apaches) would pay big dividends. Remember the vignette? We also need a mission rehearsal tool where we can train today where we will execute tomorrow. Finally, Land Warrior and FBCB2 are just around the corner. Those skills are highly perishable. Couple that with the training limitations listed previously and the need to develop basic proficiency before we go do live training becomes even more important. Virtual simulations are a potential answer.

Another obstacle has been a perception that Infantry tasks and skills were too simple to warrant the cost and effort of a multi-million dollar simulation. "What does it take to give a soldier a rifle, send him in the woods and go kill the enemy?" went the argument. In reality, anyone who has had to plan and execute a mission requiring an Infantry unit to conduct a movement, execute a mission, and then return to refit and rearm only to start the second iteration can fully understand the effort required to make this happen. The advent of Land Warrior, complete FBCB2 fielding and ongoing transformation will only make the task more complicated, further supporting the case for the development of an Infantry simulation to support these superb additions to our inventory. Now let me tell you what FUSILIER can do to improve our training, starting with what we expect it to do.

FUSILIER Required Capabilities

FUSILIER must provide us a tool to make more efficient use of the limited resources of training areas, ammo, troops, and time. It must be as realistic as possible and model the up close dismounted Infantry fight. Realism enhances training effectiveness. Realism is not limited to not limited to merely stimulating senses; it includes METL tasks in real world environments under challenging conditions, using your personal equipment.

Here is a conceptual list of capabilities.

- Models the up-close, dismounted Infantry fight, and specifically:
 - * Compartmentalized terrain (MOUT, dense forest, jungle, mountain);
 - * Direct fire engagements with supporting fires to suppress or kill the enemy;
 - * Supports small unit maneuver at realistic speed to model fire and maneuver tasks at squad through company;
 - * Models the close fight;
 - * The enemy is presented as a thinking, tactically sound opponent using all his capabilities.
- Realism
 - * Battlefield (sights, sounds, smells);
 - * Stress (see above, threat of death vs. don't let your buddy down, don't embarrass yourself, desire to win, obedience);
 - * Challenge (level of difficulty, fatigue, wounds);

- * Maximizes use of our unit's equipment that is accurately modeled;
- * Use unit's organic equipment especially technology (M4, M203, SAW, flash-bangs, frags, smoke grenades, star clusters, illumination, binoculars, thermals, NVG's, laser pointers, GPS, LRF and link into FBCB2).
 - Trains the whole unit (you don't develop a championship football team by focusing on the quarterback alone; you scrimmage with the whole TEAM).
 - LEADERSHIP
 - Integrates the combined arms team. At a minimum incorporates:
 - * Aviation (lift & attack),
 - * Mechanized vehicles (Infantry carrying)
 - * Armor
 - * Artillery
 - * CAS
 - Land Warrior and FBCB2 capable.
 - Includes the fog of war (civilians, intelligence, mistakes).

Technology available today in the Squad Synthetic Environment at Fort Benning

Two key concepts that are integral to the success of FUSILIER are integrating all of the unit's Soldiers and leadership. The bottom line is that building a simulation that only models key individuals and leaders develops a very high speed Training Exercise Without Troops (TEWT) machine and in the end reinforces a manager approach versus a leadership model. Infantry leaders are warriors who should be trained to **lead** Soldiers on the battlefield and not **manage** machine/robotics or information systems. You don't train teams (units) by just training leaders (TEWT). Omitting Soldiers from training with their leaders denies opportunities for Soldiers to learn from their leaders and leaders to learn from their subordinates. Scaling back the simulation to not include subordinates eliminates an opportunity to build team cohesion and reduces the training benefit for C2 tasks and SOP reinforcement. Including Soldiers into training conducted by their leaders inspires Soldier confidence in their leaders and esprit de corps at squad/platoon/company. Additionally, not including subordinates robs them of an opportunity to learn how to become leaders themselves and more practically, to take charge of the unit should the leader become incapacitated.

There are several arguments against taking the simulation down to the lowest level. They mainly revolve around individual tasks can be trained better in the field, the contention that technology can model subordinates well enough, and that the cost of expanding simulation to include lower echelons would be prohibitive. Obviously, individual tasks can be trained better in a live training environment, and indeed **all** training can be done better in a live training environment. Sure, the individual soldier gets some individual training benefit in virtual simulations but his major contribution to training is his presence. Leaders get trained by leading Soldiers, and this is particularly true of the Infantry. You can not train a unit without having the majority of its Soldiers



The Squad Synthetic Environment is comprised a fully immersed environment, which is also called stand up (at left) and desktop computer mode (right).

present and the majority of tasks in MTPs are not just leader tasks. Second, today's technology does not model individual Soldiers' behavior well enough, especially in compartmentalized terrain. Electronic soldiers bump into walls, each other and doors in MOUT environments or require significant guidance that leaders cannot give in the heat of battle. Even if technology could model Soldier behavior to the fidelity required, we shouldn't do it for the reasons already identified. That type of technology would make very significant contributions in robotics and is another essay. Finally about cost, fully immersed virtual simulators are not cheap and when you multiply that number by a 100 a FUSILIER site becomes prohibitively expensive. The solution is modeling subordinates in a less fully immersed environment, a desktop computer-joystick versus a special room and equipment to immerse each Soldier in the virtual environment.

Today's Potential Solution

Today at Fort Benning there is a virtual Infantry simulation called Squad Synthetic Environment (SSE). It is used to research and develop new concepts and technology to support tomorrow's Infantry and ongoing transformation. It has fielded up to a platoon of infantry with a couple of vehicles in a virtual battlefield. It also models effects of the combined arms team (artillery, aircraft, etc) and has even been tied to the AC130 virtual simulator at Hurlbert Field. A successful experiment was recently conducted where the AC130 simulator flew

into the virtual battlefield in SSE at Fort Benning where FSO's from the 3rd Ranger BN and ETACs at Fort Benning directed AC130 fire into the virtual battlefield and destroyed an enemy company.

The SSE is configured to support research and development. One squad of the platoon operates in a fully immersed environment (the focus of experiments) and two squads operate in the virtual battlefield through desktop computers (modeling flank units or OPFOR). The immersed environment (or stand up, SU as we call it) consists of a 10x10-foot blacked out room with the front wall being a screen where the soldier views and interacts with his virtual environment. A projector 20-foot behind the screen projects the virtual view onto the screen. A Soldier wears a sensor so the SU's sensors can determine his posture and render an appropriate view (i.e. a soldier in the prone can see much less of the are in front of him versus when he is standing up). The Soldier's M4 mockup has a thumb joystick on the left side of the weapon where he inputs major movement (running, walking, crawling) into the simulator. The SU's sensors pick up the Soldier's real movement (leaning, taking a step to the left/right) inside the SU giving the Soldier the ability to look around corners by moving in the SU. Just a few of the capabilities of the SU are reloading, grenades, flash bangs, smoke, flares, emplacing C-4, and NVG's. The SU's are networked to desktop Soldiers who have all of the capabilities of the fully immersed stand up environment but input their actions via a joystick. All of this is controlled and recorded at the station of the

Battlemaster, who also controls semi-autonomous forces (SAF) to model flank units, the OPFOR — the OPFOR could even be some additional desktop simulators to provide for the most realistic OPFOR actions — and additional battlefield effects (i.e. artillery if there is not an artillery cell). The exercise is observed here by the leader in charge of the study who selects key points, views and communications for discussion during the AAR. You can read more about SSE capabilities, methods and weapons at the Army Modeling and Simulation Office Web site at www.amso.mil and click on major simulation systems.

For training, SSE would be reorganized as portrayed below to become FUSILIER. Leaders, the focus of training, are placed in fully immersed environments with the members of fire teams manning low cost desktop stations so they can participate and observe the training exercise, respond to commands and take over for their leaders should their leaders become incapacitated. Fiber optic links could be used to bring in other simulators such as the AC 130 described earlier. Fielding to units should include an organic terrain database generating cell so units could generate their own terrain based on local training areas but also real world contingency areas so units can arrive on station with multiple mission rehearsals under their belt. Today, no Stryker simulator exists but as that is developed and fielded with FBCB2 it could also be linked to FUSILIER along with other systems and combat multipliers (artillery effects station). SSE served as the testbed for Land Warrior .6 and is

presently being tested as the trainer for Land Warrior (VICTER program). There is an ongoing effort to integrate it with Land Warrior 1.0. As that effort comes to fruition in the next year, the Army would have a virtual trainer very capable of carrying it into the Objective Force time frame.

Figure 1 portrays a simulation suite to support training of an Infantry company. The platoon suite of FUSILIER would be one-third of the company suite. The company suite also give the option of integrating battalion assets and combat multipliers to expand the collective training affect of the system. Mortar platoons can set up in nearby locations. Using digital fire commands sent from the forward observer in FUSILIER, the mortar platoon executes fire missions in direct support cleared by the BN FSO in the TOC monitoring the battle. FUSILIER operating Land Warrior software and Stryker simulators also would incorporate FBCB2 and exercise those skills at the company and battalion

level. Armor, close air, civil affairs, live training with sister companies using local training areas (or deployed to far away training areas) all are potential training exercises to be developed by the aggressive S-3 or commander.

FUSILIER, Infantry's Future Simulator

Scarce training resources, a changing and increasing threat, increased OPTEMPO and new explosive technology are driving the Infantry community to find innovative techniques to train. With the SBCT fielded, Land Warrior on the horizon, and Future Combat Systems heralding the Objective Force, traditional techniques of training will be hard pressed to keep infantrymen at the technical edge while maintaining their time tested and true Infantry skills. Virtual simulations are a potential solution to training resource

scarcity, integrating highly lethal and costly combat multipliers and developing the skills to use them. These virtual simulations could serve as an excellent training gate to gain a certain level of proficiency before units execute costly, rare and dangerous live training. These same virtual simulations make mission rehearsal for far flung or quickly developing contingency operations possible. Our aviators and tankers have already trained on virtual simulations for decades, and now it is time for Infantry to reap the benefits of 21st century technology as it trains to meet tomorrow's challenges.

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Figure 1

