Synthetic Training Environment (STE) White Paper

Combined Arms Center - Training (CAC-T)

Introduction

The Army's future training capability is the Synthetic Training Environment (STE). The Synthetic Training Environment will be a single, interconnected training system that provides a Common Synthetic Environment, in which units from squad through ASCC to train in the most appropriate domain - live, virtual, constructive, and gaming, or in all four simultaneously. This training capability will enable Army units and leaders to conduct realistic multi-echelon / multi-domain combined arms maneuver and mission command training, increasing proficiency through repetition. Units can then master collective training tasks in the live environment. This Synthetic Training Environment (STE) White Paper describes the future training vision grounded in the Army Operating Concept (AOC) and guides modernization and technology necessary to realize the STE.

The Synthetic Training Environment

Reduces:
- **Terrain databases**
- **Hardware and software engineering costs**
- **Contractor costs**
- **Fixed site training facilities and costs**
- **Time to plan, prepare, execute and assess training**

Utilizes:
- **The Army Enterprise Network**
- **The Common Operating Environment**
- **Operational Global Terrain**
- **Army Enterprise Database cloud**
- **All Mission Command Information Systems**
- **Relevant technology and adapts as it changes**

Increases Readiness:
- **Units train as they will fight, on the terrain the will fight on**
- **Available anywhere that Soldiers need to train**
- **Replicates current and future threats (Cyber, Space, Mega-Cities, EW)**
- **Multi-echelon, Combined Arms, Multi-domain, Joint, JIM**
- **Closes current future training gaps**

The Integrated Training Environment (ITE), the Army's current training environment, has made significant strides providing a training capability, but is a mix of different Non-Systems Training Devices (NSTDs) which were all developed separately over the last 35 years. They are connected together by the Live, Virtual, Constructive – Integrating Architecture (LVC-IA) that can only deliver a semi-integrated training environment. This partial integration of separate systems results in a very complex federation of capabilities. It is expensive and can't keep pace with technology, and thus can never fully train our formations to meet current and future threats.

Integrated Training Environment limitations hinder units from achieving maximum readiness. The ITE lacks sufficient realism, interoperability, affordability, reliability, adaptability and availability necessary to prevent, shape and win as a part of the joint force in the multi-domain operational environment. The ITE also cannot adequately replicate emerging threats and conditions such as; Electronic Warfare, Cyber, Space, Mega Cities, and simultaneous operations in a multi-domain battle environment. Many systems are tied to fixed, expensive facilities limiting where a commander can conduct training. Terrain and database development is extremely costly, and time consuming; currently taking up to 9-12 months for engineers to deliver new terrain. The ITE requires extensive lead times, up to 120 days, to plan, prepare

and execute a training exercise due to complex database set up and integration between environments. Finally, sustaining the ITE is cost prohibitive. Sustainment of current legacy ITE NSTDs combined with facilities maintenance, and contract personnel costs will continue to grow and eventually consume the training budget. The ITE simply cannot keep pace with changes to the operational environment and does not deliver the required capability Commanders require to ensure training readiness.

The Synthetic Training Environment the Army's Future Training Environment

The STE is an essential component for the Army to fully realize Objective - Training (OBJ-T) required levels of proficiency. The STE is the opposite of the ITE. Rather than patching costly, proprietary individually developed systems together, after-the-fact, the STE is deliberately envisioned, from the beginning, to incorporate the live, virtual, constructive, and gaming environments as one complete training capability. The STE must have the ability to change with technology allowing for the replication of current and future force structure, weapons effects, warfighting functions, JIM capabilities, human interaction, dense urban terrain, and near-peer threat capabilities. The STE will be capable of training units across the full range of Unified Land Operations in multiple domains (Air, Land, Sea, Cyber, and Space).

US Army Combined Arms Center
SOLDIERS AND LEADERS - OUR ASYMMETRIC ADVANTAGE

Mission, Principles, Characteristics & Requirements

Principles (Why)	Warfighting Requirements (Able To)	Characteristics of the Training Environment (Qualities and Attributes)	Technical Training Environment Requirements
Mission: The Army must fight and win wars against adversaries… 1st Principles: The Army's Synthetic Training Environment must enable: 1. Prepare/Train for War. Execute realistic, expeditionary, multi-echelon, cross war fighter function, Joint combined arms multi-domain battle in various complex operational environments training. (See notes 1, 2, 3, 4, 5, 6) 2. Conduct of War: Provide trained and ready units prepared for the execution of expeditionary, world-wide, Unified Land Operations (ULO) to shape, prevent, and win as a part of Unified Action in all domains and all environments	❑ Execute collective combined arms, multi-echelon training, across all warfighting functions ❑ Train Mission Command BN TF, BCT through ASCC ❑ Replicate the full complexity of the operational environment ❑ Provide a common training environment that spans the three training domains (Operational, Institutional, and Self-Development) ❑ Replicate current and future force structure, weapons and effects, warfighting functions, JIM capabilities and near peer capabilities	❑ Intuitive and easy to use. Maximize current commercial technology ❑ Customizable Global Terrain. Units can change to replicate operational conditions ❑ Available where we train. Home station, Armory, CTC, Deployed ❑ Improved exercise design and planning tools. Reduce planning, rapid task organization, repetition ❑ Interoperable with Joint and UA partners. Units train with the partners they will fight with ❑ Keeps pace with technology. Software centric, rapidly change the environment and introduce new capabilities (DUT, EW, CYBER, Near-Peer) ❑ Low Overhead. Soldier maintained and operated, reduced hardware and facilities	❑ **Reconfigurable Trainers**…*Squad through Battalion Combined Arms (Air & Ground) Virtual Trainers* ❑ **One-World Terrain**…*Common Global Data used by all training devices* ❑ **Common Synthetic Environment** … *Standard applications, integrated data, accurate OE replication across all environments (Live, Virtual, Constructive)* ❑ **Point of Need** … *Capable of providing tailorable, scalable training where Soldiers need it* ❑ **Cloud Based**.. *Simulation and Data stored on Army Enterprise Databases.* ❑ **Delivered over the Army Network…***Software updates, Classified and Unclassified, interacts with all MCIS* ❑ **Intelligent Tutors** … *Artificial Intelligence enabled training management, exercise design, and after action reviews* ❑ **Version 7**
Note 1: Expeditionary – Units train as they will fight on the terrain and in operational environment they will fight **Note 2: Multi-echelon, Cross WFF, Joint Combined Arms** – Fully enables combined arms maneuver, multi-domain battle in multiple environments to include DUT **Note 3: Multi- Domain Battle** – Replicates current and future threats (Cyber, Space, Mega Cities, EW) **Note 4: Execute Mission Command.** Fully integrated with Tactical Networks and Mission Command Information Systems	**Note 5. Joint and UA Partner Integration.** Fully integrates Joint and UA partners allowing commanders to train as they will fight in Unified Land Operations (ULO) **Note 6: Trains the Total Force.** Cloud based, software centric, network delivered to the point of need training environment supports training at, Home Stations, CTC, Deployed locations and Armories and Reserve Centers		

Architecture

STE modernization efforts are critically linked to the Army's Mission Command Network Strategy. Sub-Objective 6.2 requires the network to field Live, Virtual, and Constructive Components of the Synthetic

Training Environment. In addition, rather than being a closed training network, the STE will be an open architecture that capitalizes on other Army programs such as the Common Operating Environment, Operational Terrain Databases, and Army Enterprise Data Base cloud computing, thereby reducing investment and sustainment costs. At the heart of the STE will be a Training Simulation Software ensuring that all environments operate together from common authoritative data, collapsing three current programs of record.

Training Simulation Software

The Training Simulation Software will leverage emerging gaming and next generation Computer Generated Force (CGF) simulation that can represent a full range of operations, systems, unit behaviors, environmental conditions, and control processes. This software engine must also accurately represent specific activities of Combat Arms, Combat Support, and Combat Service Support. Operational (PMESII-PT) and mission (METT-TC) variables will be scalable and dynamic in the land, air, sea, space, and cyber domains. Terrain will be a Global Terrain representation of the world, from subterranean to the outer layers of the atmosphere leveraging Standard Shareable Geospatial Foundation (SSGF) storing, distributing and scaling terrain data models.

The Training Simulation Software will fully stimulate all Mission Command Information Systems (MCIS). The STE requires that all future NSTDs be a part of this one training capability working in concert with the Training Simulation Software. The goal is that all environments easily replicate the battlefield and function as one.

> Example: All terrain is common in all environments. A unit at Fort Riley, KS can use European terrain from their location simply by accessing the STE. They can also go one- step further locally manipulating the terrain to meet specific training objectives.

The early establishment of standards for both the STE open architecture and Training Simulation Software will allow us to begin reformatting existing training content for its use in the STE and provide the ability for the development, prototyping and testing of future capabilities.

Artificial Intelligence and Big Data capabilities must be organic to, and reside within the STE Architecture and the Training Simulation Software from the beginning. Artificial Intelligence used for Adaptive Tutoring will increase the rate of individual and unit skill and task acquisition by providing the ability to capture and rapidly learn from each repetition. Big Data techniques will be used improve training effectiveness, drawing from training data repositories and records of past individual and unit performance.

Virtual Collective Trainers

The STE must provide less costly virtual immersive and semi-immersive collective combined arms air-ground training capabilities. Our current virtual Air Collective Training capability AVCATT (Aviation Combined Arms Tactical Trainer), CCTT (Close Combat Tactical Trainer) and RVTT (Reconfigurable Vehicle Tactical Trainer) will be modernized to reconfigurable, transportable, immersive Synthetic Collective Trainers. The quality of simulation will provide an approximation of what the Soldier/Crew will experience in the Live Environment. These air and ground collective trainers will not completely replicate platform form, fit and function, but will replicate enough to provide realism and fidelity needed to execute squad through BN collective training. They will not be tied to fixed facilities and must

be upgradable, mirroring platform concurrency, through software updates and limited hardware changes, reducing costs and improving availability. This gives units the ability to collectively train in a complex operational environment at Home station, Armories, CTCs, Institution and deployed locations.

> Example: Aviation collective trainers use the same software updates that are used in the aircraft eliminating costly engineering costs to convert actual aircraft software updates into the training system. These trainers can be accesses locally and linked across the world.

Constructive

The modernization of our current large-scale constructive simulation training requires the greatest amount of technology maturation. The STE will advance the Army's constructive training capability by improving the Army's capability to train large scale BN/ Battalion Task Force through ASCC Mission Command Training. Large-scale constructive collective training will continue to be supported and delivered to and from Mission Training Complexes by our Global Simulation Capability. Migration into the STE must result in reduced database manipulation and reduced federation time. The STE will provide units with an improved Training Management Tool capability, streamlining the activities necessary to plan, prepare, execute (support staff perspective) and assess training events. The improved capability will reduce the amount of services manpower (contractor and/or government) required to plan, prepare, execute, and assess a training exercise by a minimum of forty percent. Artificial Intelligence will significantly reduce manpower requirements by providing an autonomous EXCON and AAR capability. This feature will provide the Commander and Exercise Directors recommendations based upon current performance and predictable analysis of future performance.

> Example: Instead of taking 120 plus days to produce all of the components necessary to execute an exercise the necessary elements are already in the system and easily manipulated locally using state of the art software reducing cost and time.

The integration of Artificial Intelligence into constructive and virtual simulations will advance current capabilities from semi-automated forces to future fully automated forces. With the fielding of future Army Live Training Aids, Devices, Simulators, and Simulation (TADSS), Artificial Intelligence, coupled with Augmented Reality, will deliver the level of fidelity in representing complex operational environments to integrate seamlessly with the next generation live training environment.

Live Training

The STE must bring forward the introduction of simulations into the live training environment as envisioned in the Army future enterprise engagement system. This future engagement systems will replace our current legacy live training environment capabilities to include home station and CTC instrumentation systems and complete suite of MILES-like capabilities. It will interface with the STE architecture providing the seamless exchange of content between live and simulated environments.

The application of Augmented Reality with Artificial Intelligence in the future live training environment will provide the Army ability to replicate cultural specific human behaviors as well as autonomous civilian and military equipment behaviors (robots, drones, droids etc.). This combination of capabilities will simulate large density human behavior "patterns of life" and crowd behaviors in dense urban environments. The ability to conduct live training ICW with gaming, constructive, and virtual is possible and will enable units all over the world to train together improving multi-echelon training exercises. The Army must develop the technology that allows live training systems, ranges, targets, and ammunition to be a part of the STE.

> Example: When an artillery round is shot on a range, it must accurately hit the ground at the exact same spot in each environment, while also providing realistic visual and auditory battlefield effects and training to all training audiences in all training environments.

Overarching Strategy to Achieve STE

In October 2016 and again in July 2017, STE proceeded through the Army Requirements Oversight Council (AROC) for approval by senior leaders of the concept, the gaps, and the requirement. The capability gap examined by the Army Capabilities Board (ACB) is that the Army has fallen behind in the realm of synthetic technology. Specifically, there is a gap in the ability to conduct and integrate multi-echelon and distributed synthetic (virtual, gaming, and constructive) training either as a stand-alone capability or integrated into the live training or real world mission rehearsals delivered at the Point of Need (PoN). The Army requires a converged Live, Virtual, Constructive, and Gaming common simulation environment that allows units to train as they will fight, with whom they will fight with, and where they will fight. It will provide units the repetitions required to achieve mastery of the diverse individual through collective tasks necessary to win decisively in Multi-Domain Battle.

As a result of the 27 July 2017, ACB it was determined that the Army required a new STE approach that keeps pace with commercial virtual, gaming and constructive simulation technologies, where we currently lag. The STE requires cost-effective synthetic training capabilities that make positive contributions towards assisting Commanders in preparing our Soldiers and formations to win in combat.

To execute this new approach to STE, a cross functional team (CFT), led by CAC-T, will be formed to develop approaches which accelerate the development of STE through industry collaboration and early user feedback. This CFT approach will allow for early prototyping, experimentation, and user feedback in order to better inform the STE requirement; allow for a better assessment of technology maturation (especially in Virtual and Gaming); and provide the opportunity to develop a better costing methodology for STE.

Our overarching strategy to develop STE will rely on an incremental capability development approach utilizing and Other Transactional Authorities (OTAs) to accelerate the development of prototypes to place in the hands of operational units in order to gain user feedback. The CFT will follow a developmental operations (DevOps) philosophy, which is defined as warfighters and developers working together to enable rapid and frequent delivery of capabilities to the warfighter to inform a potential program of record.

The initial incremental approach will focus on the development of prototypical capabilities for company level Combined Arms (CA) Transportable Reconfigurable Virtual Trainers, Global Terrain, and a Training Simulation Software engine, all delivered at the Point of Need. The intent is to have prototypes in the hands of operational units no later than July 2018 for user assessment and feedback.

Based on the outcomes of the July 2018 demonstration, follow on incremental efforts will focus on expanding CA Transportable Reconfigurable Virtual Trainers to BN/ BDE level; expansion of Point of Need capability; and Big Data (Intelligent Tutors, Artificial Intelligent-Intuitive Exercise Design and Training Management Tools). When thresholds of maturity are achieved, specific capabilities will be delivered to the operational force, as it is deemed acceptable, through the DevOps process.

Conclusion

TRADOC is currently developing STE requirements in conjunction with PEO-STRI, DAMO-TRS and industry and academia stakeholders with continuous input from MACOMs and Commanders in the field. The STE, by design, will keep pace with both technology and the complex operational environment. The preponderance of technologies necessary to begin fielding initial STE capabilities are projected to be mature as early as FY 20. Progression and prioritization of modernization efforts will take into account technology maturation and affordability. We will not assume risk to training readiness as new capabilities are developed and fielded.