Virtual Reality (VR) inclusion in Army Combined Arms Training Centers (CTCs)

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Preface

The US Army relies on the Combat Training Center (CTC) to train Army brigades and battalions in tactical and operational skills. The goal is to generate units who can operate in complex environments and to provide the most realistic training possible for soldiers.(cite) This is achieved by focusing on unified land operations and decisive action missions. CTCs are also what drives training throughout the Army and is where new innovations are tested. Throughout a rotation, soldiers could be part of operations that are offense, defense, stability, and defense support of civil authorities type missions.

With a limited and finite amount of resources, Army CTCs are tasked with training units to fight in asymmetrical warfare, as well as against near-peer competition. A conventional CTC relies heavily on a set training schedule, so that certain training objectives required for a unit's overall training goal are met. Battalions and brigades have individual and team level tasks sufficiently trained before arriving to conduct a rotation in a CTC. CTCs currently do not have the ability to train those skills, due to a lack of time and/or resources. Training collective Mission Essential Tasks (MET) for battalion and brigades within a set amount of time and allocated funds is the primary training value of CTCs.

Because of time and money constraints, Army CTCs would benefit with the addition and incorporation of Virtual Reality (VR) training. VR would reduce the time and resources needed and afford the opportunity for CTCs to retrain individual tasks and time to time collective tasks before units go to the field. A classroom full of VR systems can provide individualized experiences to soldiers, allowing to proceed at their own pace and retry failed procedures multiple times, which could further benefit units in the field. Additionally, VR training could be further incorporated throughout the unit's rotation to provide more comprehensive training. In a

constrained military resource environment, it is both practical and beneficial to incorporate VR training as part of the Army Combat Training Center (CTC) exercise model.

Abstract

There are three CTCs in the Army. The Joint Multinational Readiness Center (JMRC), a multinational CTC in Hohenfels and Grafenwoehr Germany. The National Training Center (NTC), a CTC in Fort Irwin, California, and the Joint Readiness Training Center (JRTC), a CTC in Fort Polk, Louisiana. Units training at the CTCs today face a complex hybrid threat, as to replicate the threat they are most likely to face in real combat. Units could face a near-peer opposing force and an insurgent force, along with a myriad of other dilemmas. All three CTCs incorporate a complex scenario design laden with social, ethical, and moral dilemmas; the goal of which is to develop leaders who are adaptable. There is also an emphasis

CTCs train Brigade Combat Team (BCTs) by conducting force-on-force and live-fire training in a joint scenario with partners across the range of conflicts using a Live Virtual Constructive (LVC) training model. (cite) The BCTs are opposed by a professional opposing force (OPFOR) and observed and controlled by an expert and experienced operations group (OPS GRP). (cite) Within the Army Force Generation (ARFORGEN) readiness model, CTCs will normally focus on collective training events supporting BCTs transitioning between the train/ready and available force pools.[1] However, CTCs may also be tasked to execute Mission Essential Task List (METL)-focused rotations in support of BCTs progression through the train/ready force pool when required by Army Force Generation (ARFORGEN) demands.

Utilizing advanced technologies, provided by current computerized VR technology, and with the existing network infrastructure, soldiers in a CTC will be afforded an even more extensive training opportunity. An LVC environment provides the ability for soldiers to practice Tactics, Techniques and Procedures (TTP)s before, during and after during training. The inclusion of the Synthetic Training Environment (STE), a common simulated environment that both VR and simulated systems can propagate support trial and error application, knowledge advancement, and integration across training centers. Leaders in the simulated environment could delegate orders to the lowest tactical level in a simulated environment and achieve strategic results within the simulated world. Instead of having to test innovative technology in real battles and war, soldiers can test new capabilities and equipment in a simulated war environment, and then further test them in the field.

Army's CTCs currently do not efficiently and effectively train for Multi-Domain Operations (MDO), driving the need for better training capabilities. Integrating VR into the LVC environment allows soldiers to train for multi-domain operations, supports trail and error applications, and saves money. The Army has improved training from the Vietnam era, where two-thirds of all small-unit combat deaths occurred during the first two months in combat. (digital dirt, pg. 25) The integration of advanced technologies across the domains offers the US Army new capabilities, but also offers our enemies those same new capabilities. The ability to win future conflicts will require the execution of seamless and continuous integration of technologies to enable command and control, so that the lessons we learned from Vietnam are not repeated. A training system needs to be dynamic and prepare soldiers for an ever changing MDO environment. It should not just mass-produce soldiers that train in a predictable environment.

Introduction

The need for realistic training that replicates the conditions of small arms and land combat in a multi-domain environment is becoming even more vital. Army forces currently need to be ready to fight a different type of war in the future. The US Army remains the most combat-experienced ground force in the world. Some mid to senior level officer and non-commissioned officers have had as many as four deployments in a combat zone. However, as US armed forces start drawing down from deployed environments there is going to be a gap in combat experience that pervades the Army. There is only so much time on the calendar and money in training budgets to replicate real combat, which threaten the ability to train for a new multi-domain type engagement in the future. The cutting-edge advantage afforded to the Army's land combat operations honed during a decade of war has the potential to be degraded by our enemies' new capabilities.

The emergence of a new Army, where soldiers get most of their experience in home station training or through CTC training rotations will be a different Army from the past fifteen years. Battalions and brigades will very soon consist of new soldiers that are unable to hone their skills as their predecessors before have. A new training paradigm is needed that further stretches training centers capabilities to replicate real combat. Once the infrastructure is in place to support VR training, exercises should be conducted to test boundaries of warfighting strategies and practice flexible command structure, while in a contested environment. Many of the technologies needed to produce a STE already exist. The DoD, in conjunction with the Army needs to establish an interoperable architecture supporting integrating current capabilities to support

Army training within the proposed schoolhouse and for simulated exercises with multiple participants.

Background and Significance

All three Army CTCs usually incorporate a fourteen-day training model. Units usually conduct RSOI for three days and move to the field where they conduct full-spectrum operations.[2] Currently, once units rotate into the field, training is conducted, which includes company, battalion, and brigade training. Once complete, the unit returns from the field and out-processes for another three to four days. This is supposed to replicate a deployment to another country and the kinetic operations and non-kinetic operations that soldiers would be a part of in combat. Training days can often include offense, defense, and stability operations and there missions fall across the full-spectrum of operations and seek to address all training requirements for the training audience.

Objective-T or Objective Task is the new method in which the Army now certifies brigades and battalions and ensures training standards are consistent across the force. Objective-T consists of four foundational components by which to assess training readiness: (1) weapons qualification at the individual, crew, and platform level (2) MET proficiency, (3) collective live-fire proficiency, and (4) training days required for a unit to attain T-1 readiness.[3] According to the latest manual on Objective-T "Objective-T also standardizes METLs down to the company level to establish a common baseline for like-unit assessments, as well as to ultimately produce better resourcing predictability." Objective-T provides a common language for leaders through employing detailed descriptions of what a unit should be capable of in combat, to include introducing or revising terminology which enables standardized and objective assessments. This standardization effort includes revising and defining MET evaluation in a T/P/U model.[4]

Essential Task (MET) proficiency uses a Trained (T), Practiced (P) or Untrained (U) scale.[5] While the Army has established standardized METs down to the brigade level by which units report, it has historically been less prescriptive for MET development at the battalion and company level. Commanders at those echelons develop METs which are nested with, and supportive of brigade level tasks. All commanders train their units to achieve proficiency in METs which are part of their enduring Decisive Action Mission Essential Task List (DA METL). Those commanders whose units are programmed for a specific mission within the force generation cycle train to MET proficiency in their DA METL plus their Assigned METL (A-METL) tasks specific to the anticipated mission set.[6] These essential tasks are trained at their duty station and/or in off post exercises, to include CTC rotations.

The defined full-spectrum operations each have associated mission types and subtasks to accomplish to achieve proficiency.[7] It is the ability to accomplish each of these tasks and subtasks that marks a brigade as proficient in full-spectrum operations. For the purpose of analysis, a brigade-sized unit must be proficient in those tasks articulated in the applicable doctrinal manuals for the brigade type that they have. Those doctrinal manuals include operations in offensive, defensive, and stability operations. However, the amount of time and resources needed to train individual and team level tactics in full spectrum operations is an additional burden for over constrained CTCs, when CTCs are already strapped for time and resources training battalions and brigades. As the CTCs are asked to do more with less, virtual reality can bridge the gap in the individual, crew, and squad level tasks to be trained.

By integrating the virtual element (a real person in a simulator) and the constructive one (computer-generated forces and environments) into live training assets, units need less ground to train on because they can expand their battlespace with a synthetic environment. This

ability can be leveraged to allow for units to train at a CTC before going to the field on weaknesses identified. The units can train multiple times on identified tasks in a synthetic environment that mimics the environment of the CTC the unit is training in. Currently at this stage in Virtual Reality (VR) development there is a real opportunity to incorporate VR training in small arms training, and in Enhanced Maneuver Training (EMT). Later, there is also possibilities to incorporate VR into offensive, defensive, and stability operations training.

A lot of this is possible with the inclusion of the Synthetic Training Environment (STE). With STE, an open-architecture digital simulated platform with units ranging in size from squad to division, battalions and brigades will be able to tap into a common synthetic environment simultaneously.[8] Soldiers can operate seamlessly in multiple domains with participants around the world. Individual soldiers from around the world can train virtually in the same environment at the same time. The opportunities for training in the STE are endless, as battlefields and scenarios can be replicated in precise high-fidelity resolution. Incrementally, the digital battlefield will become more realistic and more reliable, and there will be very little difference in training small arms tactics and squad level training in the STE and in a real environment. A revolution in training is possible, and the CTCs can be the testing ground of this innovation.

Inclusion of VR in CTCs can be planned and started incrementally. The first step in VR training in CTCs is to start planning the incorporation in a "rotation" during planning conferences. VR training can be included in the beginning of a unit's start in a CTC. A battalion or brigade would train Soldiers on simple tasks that are nested with their METL tasks at the individual or squad level. A trial run could be executed at one of the CTCs and a survey conducted afterwards on how it compared to live training and how effective it was. If effective,

the VR training in the STE could be further expanded to include more mission essential tasks until there is a limit reached on the capability of VR and the STE.

The issue of training Army battalions and brigades on asymmetrical warfare and a near peer threat is a very complex and dynamic issue. The solution will most likely be a tiered approach. Initial actions should be situated first to include virtual reality training as necessary to retrain soldiers on individual tasks that will be essential for the Soldiers in the CTC rotation. Later, VR training should be included to train squads, platoons and even battalions all at once. Once enacted, the amount of time and money saved should be significant. However, it will take time to incorporate VR training in CTCs on a skeptical audience, an audience that is more practiced in training in a live environment. The conventional CTC's reliance on physical land and traditional methods will be a hindrance at first in enacting VR training but could enhance training instead of undermining it.

Analysis

Any broad changes to the CTC training model will take time. VR training has limits to actual live training. Additionally, they are significant one-time costs in setting up and executing VR training. However, VR training in the Army CTC framework, once enacted at scale, could save significant amounts of time and money, while still providing efficient training. VR training can be leveraged to train targeted deficient tasks for soldiers during multiple iterations, without the need for land, vehicles, or weather considerations.

VR has the potential to add more dynamic training opportunities for soldiers in CTCs. VR provides a way to train more soldiers in a shorter time on mission critical training objectives, while also providing vast cost savings. There are multiple benefits of VR training in CTCs if enacted in a measured slow manner. It must be tested first and measured before full

implementation within the Army CTC framework, but the immense benefits completely outweigh the time and effort it would take.

The Army needs a method to train and reinforce traditional warfare skills. Junior officers and non-commissioned officers of today's Army are not training enough in their core competencies. The focus in the last ten plus years on combat in urban environments and counter-insurgency warfare results in a double loss of maneuver expertise and, eventually, maneuver training expertise. Multiplying the loss is the junior leader's lack of experience in their basic branch skill sets in a deployment setting.

The ability to win future conflicts will require the execution of seamless and continuous integration of technologies to enable command and control across domains. Furthermore, the use of advancing technologies provides the Army a warfighting advantage by fusing information from various platforms increasing speed, precision, and agility of assets to achieve the nation's objectives. Leaders can now maneuver and command in combat with a synchronization of technology that has only come to the forefront recently. Leaders in the Army will only gain the skills needed to take advantage of this technology through repetitive realistic training. Officers will struggle to gain the requisite experience to enable them to execute their basic war-fighting skills to standard if they are not allowed to constantly train on these skills in VR, in a simulated environment, and then lastly in the field.

Although VR is only in its infancy in technological capabilities, the technology is right now capable of training basic command and control tasks at the company and battalion level. Later on as the haptic technology becomes more adaptable and Advanced computer technologies such as Virtual Reality (VR), haptic gloves and pads, HOTAS systems are capable to provide even more enhanced training. Numerous equipment exists already on the commercial market that can

revolutionize military training. The US Air Force is experimenting application of VR in pilot training.[9] As the second batch of pilot candidates currently undergoing the project called Pilot Training Next, the first group of trainees already received their pilot wings in August 2018. The training took only four months, opposed to a typical pilot training which takes an entire year.[10] Current legacy simulator facilities are expensive, approximately $4.5 million, therefore only a few exist, usually one per a squadron. Since the VR simulator setup costs between $8-15,000, the Air Force can operate many of them, which can prevent the problem of a bottleneck. With multiple sets available for training, the candidates have unlimited time for practice which enhances and quickens their training process, ergo the Air Force can train pilots in a shorter time. The VR set only requires a few items and easy to operate, which demands less maintenance crew to operate it. It is so simple that the trainee himself can use them and "they can squeeze in a little more flight time back at the dorm rooms"[11] for after work hours practice. Currently simulating the cockpit interaction is under development, and haptic gloves will provide the solution for that soon. Besides the application of VR for pilot training, it is also usable for teaching maintenance crew through 3D modelling of aircraft, helicopters, and any other vehicles. All of these capabilities can be used in the Army as well.

As the commercial market has equipment with capabilities of enhancing military training, it is also true for available software. Many of these are already contributing to the training and development of US soldiers, airmen, sailors, and marines. The US Army is utilizing Virtual Battle Space Synthetic Training Environment[12] simulations in their Combined Arms Center Training for infantry training for more than a decade.[13] The Army stated, "Virtual battlefield represents future of training".[14] This software is able to provide training basically for any members of the Army's different branches as individuals, and it is also capable of collective training. The After-Action

Review (AAR) built in the software can provide detailed feedback, even down to an individual's field of view at any given time. With all the features available in this simulation, many branches can be incorporated into a war game and work toward the successful completion of the given task involving infantry, artillery, tanks, army aviation. New VR technology can be incorporated even further into this technology.

The US Air Force National Guard (US ANG) contracted Eagle Dynamics for the A-10 Desktop Simulator (DTS). [15] With prior approval, they released a downgraded commercial version of the A-10C. Their software - called Digital Combat Simulator (DCS) - beyond the A-10 currently features models of planes like F-5E, AV-8B, F/A-18C, and helicopters such as SA-324 Gazelle, UH-1H, KA-50, Mi-8. Besides these modules, they developed the possibility to command ground forces, act as a Joint Terminal Attack Controller (JTAC) and take an active role in simulating air defenses. The software has a capability to build any model one requires to the highest fidelity, where the accurate simulation is only depending on the available data. DCS provide one with the opportunity to create war scenarios utilizing any of the modules in single or collective mode. With the commanding module, it is possible to train ground commanders, the market offers strategy simulations as well, leading towards the Multi Domain Operations (MDO).

A French company named Eugene Systems has a long history developing wargaming simulations. These simulations are quite complex and feature more than 17 nations, 1400 entities such as ships, planes, helicopters, tanks, infantry fighting vehicles, artillery, and infantry units. Their software contains many modules on the Cold War, Naval Warfare, Air-Land Battle in Asia, Europe, and Pacific Ocean. Their database is editable, and one can program to the unit's needs, with unlimited variations of real and fictional scenarios can be produced. The software provides the opportunity to train current and future commanders, staffs to specific situations as well as test

campaign plans, set and evaluate strategies. Various assets, weapon systems involved in the scenarios are also enhancing the knowledge of the operational planners, and commanders. Doing so they are going to be familiar with many of them when it comes to real operations. Spectacular visuals are aiding the personnel to follow battles and take appropriate decisions. Battle force composition can be set to specific situations providing rehearsal possibility to help create the most efficient operational plan. Communication system can be established to simulate specific organizations, and practice decision-making processes. Advanced artificial intelligence in the future will also allow for a more adaptive and dynamic enemy to be utilized in the simulation and VR systems.

Recommendations for Use of VR in an ARMY CTC

Proposal

The Army should prioritize the development of more robust VR training, outlining fundamental capabilties, and TTPs to facilitate the establishment of VR best practices. After VR is incorporated more into CTCs and Army training, it will be incorporated into schoolhouses across the service, standardizing terminology, and concepts to be employed throughout the Army. To allow for preliminary and advanced training an integrated STE in the training centers need to be integrated. Additionally, VR training can span the DoD enhancing multi-domain knowledge throughout the different services and allow for joint training across different training centers.

The STE must present a mixed architecture integrating the computer, warfighter, and operational environment to ensure the best training possible.[23] The STE focuses on MDO training objectives by adapting and integrating emerging technologies. Integrating emerging technologies enhances the efficiency and effectiveness of training while maximizing the best

value, mitigating risk and optimizing learning efficiency.[24] Simulations create a low-risk environment, where the joint force can train simultaneously across multi-domains against adversaries that may be human or machines utilizing VR and AR. Simulations have many positives, but there are some challenges, which include complexity, portability, adaptability, and interoperability. Despite the challenges, using simulations for initial and follow-on training for MDO while integrating into joint exercises enable a multi-domain mindset to be practice across the Army.

Risk

If the Army does not prioritize VR training, the Army will continue to operate in a stove-pipe fashion. It will still cost a lot of money to go into the field and practice mission command and practice combat operations, where failure could mean injuries or broken equipment. Failure in a simulation or VR system just means you can try again multiple times until proficient in the objective task. To maximize the effectiveness of VR training, the personnel running the training needs an unbiased understanding of the spectrum and application of VR. This can be run by the Army simulation officers and civilians that are located at brigades, divisions, and training centers throughout the Army. The risk of maintaining the live training as it is now setup risks not incorporating innovative technology or incorporating MDO as it is possible to do in a virtual and simulated environment.

Cost

There are costs to this proposal both in funding and personnel. The Army would have to provide personnel for maintaining administrative control of VR systems. Additionally, with the personnel, it would benefit the Army to produce a doctrine that prescribes a certain standard for

what VR training constitutes across the service. The Army will also have to fund the new VR systems across all the training centers. The initiative to develop adaptive and dynamic leaders in the Army will require time, money, and resources, however, the risk of not supporting the development puts the Army in a disadvantageous warfighting state.

Conclusions

VR in the 21st century is offering high-level training possibilities; with the rapidly advancing technology and software development the opportunities are unlimited. The Army is already operating high fidelity simulations, but they are limited by being separated from their system level operations. In addition to utilizing advanced technology, the greatest breakthrough is networked operations of these facilities, which can create many segments of the simulated training environment.

VR within simulations are capable of training individuals, units, commanders, and staffs, enhancing their ability to conduct Multi Domain Operations. Although utilization of these simulations in their current state are not optimized enough for everything, the Army needs to train on, as it can still train a lot of individual and collective tasks. With recent simulation capabilities, VR training allows a soldier maintain currency on their core competencies, and to maximize and refine their knowledge. Currently, facilities are not able to accommodate large force employment, where 500 soldiers are participating, but larger facilities with current technology can be built. Huge networked simulation centers with VR technology could create the required MDO environment where the Army, along with the other services, could be introduced to cyber and space concepts throughout the operations, and work across space boundaries with advanced technology that will be important for future battles and wars.

In conclusion, the Army should prioritize the development of dynamic leaders by establishing training centers to include more VR training into the STE. This initiative does not need to too costly in both funding and personnel, however, the risk of not establishing the training infrastructure for Army leaders could prove devastating in a near-peer conflict. The 2017 NSS states the importance of multi-domain operations, which has been emphasized by many DoD senior leaders.[16] VR training can be leveraged to train targeted deficient tasks for soldiers during multiple iterations, without the need for land, vehicles, or weather considerations. VR has the potential to provide Army CTCs with a way to train more soldiers in a shorter time on mission critical training objectives, while also providing vast cost savings. Specialized training exploiting these opportunities will create better, more professional warfighters and commanders for the future.

[1] Cite from CTC article
[2] Cite from CTC article
[3] Cite from CTC article
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