

VALIDATING DISTRIBUTED MISSION SIMULATION IN A TACTICAL INTEGRATED TRAINING ENVIRONMENT

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ABSTRACT

According to the Commandant's Planning Guidance for 2015, FRAGO 01-2016, his intent is, "...for Marines to encounter their initial ethical and tactical dilemmas in a simulated battlefield vice actual combat." Suitability of simulation systems and their capability to deliver on this demand depends on accurate identification of capability gaps and affordances. Identification of these capability gaps and affordances have traditionally focused on simulators in standalone configurations. However, the shift toward Live, Virtual, Constructive (LVC) training conducted within Distributed Mission Training Environments and System-of-System (SoS) configurations demands new, standardized procedures to assess suitability and effectiveness.

This paper is the second of three assessments of a multi-phased effort led by TECOM in collaboration with Program Manager Training Systems, Marine Operational Test and Evaluation Squadron One, and Marine Aviation Weapons and Tactics Squadron One. Extending results from the first effort, and to support validation of a strategy for SoS accreditation, this paper presents results of an assessment of SoS capability within the framework of TALONEX 2-18. During TALONEX 2-18, the focus was on Marine Pilots and Joint Terminal Attack Controllers (JTACS) using Virtual Battlespace 3 simulation software training in conjunction with a Battalion Staff via high-fidelity flight simulators (UH-1Y and AH-1Z), as well as AV-8B weapons system trainers.

Outcomes of this SoS evaluation include a standardized evaluation methodology to support VV&A of SoS configurations, lessons learned for future integrated training, and identification of improvements for current training systems. Resource sponsors, developers, operational and support commanders, designers, users, and other stakeholders will benefit from these results as they develop and employ other LVC assets and evaluate capabilities of other SoS evolutions. Recommendations for optimizing training value by improving training design with performance metrics for elements such as communication and coordination, to objectively assess collective performance-oriented standards of tactical and technical competencies, are also provided.

Key Words: Training Systems Evaluation, Technology Capability Assessment, LVC, VV&A

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DEMAND SIGNAL

According to The Commandant's Planning Guidance for 2015, FRAGO 01-2016, it is his intent, "...for Marines to encounter their initial ethical and tactical dilemmas in a simulated battlefield vice actual combat." In answer to this demand signal, Marine Corps Synthetic Training Environment (MCSTE) contracted the Institute for Simulation and Training (IST) at the University of Central Florida (UCF) to develop and execute a validation framework that incorporates elements of the Systematic Team Assessment of Readiness Training (START; Sheehan, et. al, 2009) to evaluate the newly developed Marine Air Ground Task Force – Tactical Integrated Training Environment (MAGTF-TITE). This evaluation was conducted during TALONEX 2-18 and involved units from the Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, CA, Marine Corps Base Camp Pendleton, CA, and Marine Corps Air Station (MCAS) Yuma, AZ.

BACKGROUND

Following Large Scale Exercise 2014 (LSE-14), USMC Training and Education Command (TECOM) required STARTs to be conducted on training systems which were integral to the conduct of large scale exercises. START is a systematic, iterative, and replicable analysis methodology that assesses the capabilities of a training system to support the performance of mission essential tasks, tasks associated to training and readiness (T&R) events, and training objectives. START provides a data-driven evaluation methodology that assesses a training system's ability to enable and support the training of tasks (physical and/or cognitive, individual and collective actions) performed by warfighters in their operational mission or job. As part of this assessment, the START process identifies areas for improvement and upgrade to enhance trainee proficiency and optimize return on investment (Johnston, et al., 2015).

The objective of TECOM's requirement was to feed START results into the Live, Virtual, Constructive – Training Environment (LVC-TE) blueprint to combine LVC domains in a common battlespace so trainees can interact as they would in actual conditions. The LVC-TE enables the conduct of realistic, collaborative training and the performance of warfighting functions across the full range of military operations. This effort led to the development of the Live, Virtual, Constructive – Regional Capabilities START (LVC-RCS) initiative, which aligns the technological progress of tactically relevant and networked simulations with robust evaluation processes to ensure the cost-effective advancement of training systems in support of operational readiness. The LVC-RCS initiative is being conducted in three phases. The first phase, Initial Capabilities Operability, focused on the development and evaluation of LVC System of Systems (SoS) capabilities. The results of the first phase demonstrated the viability of LVC Distributed Mission Training (DMT) and validated the use of the START methodology for assessing SoS configurations (Dunne, et. al., 2017).

The second phase of the LVC-RCS initiative, Capabilities Expansion, seeks to fully integrate and assess virtual and constructive environments to implement a persistent, on demand, SoS home station training network capability. A recently developed training network, known as MAGTF-TITE, establishes this persistent capability to facilitate collective training in a distributed virtual and constructive environment and enhance integrated training across MAGTF elements. The capabilities of MAGTF-TITE were demonstrated during TALONEX 2-18, conducted in

March 2018, during battalion-level exercises that included Marine pilots, Joint Terminal Attack Controllers (JTACs), a Direct Air Support Center (DASC), a Fire Direction Center (FDC), and battalion combat operations center (COC) staff training together in a common Distributed Mission Training Environment (DMTE).

This paper presents the results of an assessment of MAGTF-TITE SoS capability conducted within the framework of TALONEX 2-18. Specifically, the assessment focuses on the collective training tasks performed by Joint Terminal Attack Controllers (JTACs) using Virtual Battlespace 3 (VBS3) simulation software interacting with Marine pilots operating UH-1Y and AH-1Z high-fidelity flight simulators and AV-8B weapons systems trainers, training in conjunction with battalion COC staff. Leveraging the recommendations and lessons learned from the first phase of the LVC-RCS initiative, this paper extends the START methodology to support validation of a process for SoS accreditation and presents the results of the evaluations conducted during the TALONEX 2-18 exercise.

METHODOLOGY

The MAGTF-TITE SoS capability was evaluated using a Technology Capability Assessment (TCA) approach which establishes a systematic, data-driven methodology to evaluate the systems and technologies that support training events. A hybrid of an established process from the Prodigy Lab, Institute for Simulation and Training at UCF, was extended to provide a methodology for documenting, assessing, and reporting training system capabilities. TCAs are performed in both stand-alone and distributed mission training environments, providing valuable assessments of training assets in both single system and system-of-systems configurations (Goodwin, et. al., 2018). This methodology addresses emerging TECOM requirements for persistent evaluations of Marine Corps DMTE such as MAGTF-TITE within LVC-TE.

Training Tasks

Tasks were the primary drivers of MAGTF-TITE assessment efforts. A task is defined as any activity conducted by an individual or a team in the actual performance environment that is necessary to accomplish a specific job or mission. A task may be knowledge-based or skill-based and, in the context of TALONEX 2-18, supported collective, integrated actions. The first step in preparing for a TCA is the development of a comprehensive list containing a set of mission essential and key tasks associated with specific operations or tactics. These tasks ultimately formed the basis for the overall TCA.

TALONEX 2-18, was a Battalion level Command Post Exercise (CPX) assessing the 1st Battalion, 4th Marine Regiment's (V14's) Combat Operations Center (COC) operating at Forward Operations Base (FOB) Laguna, Marine Corps Air Ground Combat Center (MCAGCC).

CPX 1, the first part of the TALONEX 2-18, was a series of COC battle drills based on the Marine Corps Tactics & Operations Group (MCTOG) battalion tactical networks (TAC) Standing Operating Procedures (SOP) flowcharts and Fire Support Coordination Center (FSCC) battle drills based on the Marine Corps Warfighting Publication (MCWP) 3-16, Fire Support Coordination in the Ground Combat Element (GCE). The purpose of CPX 1 was to provide the Battalion COC personnel the opportunity to develop/refine COC procedures, gain familiarity/expertise with digital Common Tactical Picture (CTP) systems and prepare for CPX 2.

CPX 2 Day 1 was planned as an offense to seize key terrain and establish a deliberate defense, while Day 2 defended the position against an enemy offense. The purpose of CPX 2 was the integration of lessons learned in CPX 1 in a complex scenario. CPX 2 of TALONEX 2-18 offered an operational environment supporting the concept described by the LVC-TE Concept of Operations (CONOPS). Additionally, it served as a means for a secondary training audience consisting of JTACS and Marine pilots to not only achieve value added training, but support the battalion scenario with more robust collaborations.

CPX 2 exhibits a viable MAGTF-TITE persistent capability, permitting collective training in a distributed virtual and constructive environment to enhance integrated training across MAGTF elements. Task list development involved an identification of the training requirements and objectives associated with the MAGTF-TITE training systems that were the subject of the assessment. Specific tasks are derived from the scenarios scheduled to be conducted during

TALONEX 2-18. The task list was validated and finalized in consultation with subject matter experts (SMEs) from relevant operational and training communities.

The Battalion Training Standards that were the focus of training task development included:

- INF-C2-7004 Conduct Combat Operations Center (COC) Operations (B)
- INF-C2-7010 Execute Command and Control (C2)
- INF-FSPT-7002 Conduct Fire Support Coordination

The developed and validated comprehensive T&R standards-based task lists for JTACs and AH-1Z, UH-1Y, and AV-8B pilots (TAC-SOAS-2000) are associated with the INF-FSPT-7002, Conduct Fire Support Coordination T&R Events. The actions of the MAGTF-TITE capable simulators also supported INF-C2-7004, Conduct COC Operations and INF-C2-7010, Execute C2 T&Rs.

Criticality Analysis

Criticality analysis builds upon the START process to identify if a training system provides the necessary level of sensory inputs (stimuli) to establish context and influence task performance aligned to specific training objectives. These stimuli are described as attributes. The starting point for this analysis is the development of a list of attributes provided by the evaluated environment that support task performance.

The validated attribute list used for the assessment of MAGTF-TITE during TALONEX 2-18 is contained in Table 1. The attribute analysis of MAGTF-TITE focused on the how critical each of the listed attributes were to the execution of individual training tasks contained on the validated task lists.

Table 1. MAGTF Attribute Listing

Attribute Category	Attribute	Attribute Definition
Physical Look and Feel	Appearance (A01)	Ability to convey an accurate and realistic representation of an object and its physical properties and/or distinguishing characteristics - such as shape, size, color, mass, or relative position with respect to other objects. Usually focuses on objects in the vicinity of the user. These objects (often systems, displays or instruments) are generally actual physical objects within one's reach - and are not generally reproduced via screen projections.
	Tactile (A02)	Ability to convey an accurate and realistic representation of the sensations produced by physical contact (i.e., physical feel) of an object, instrument, or natural element usually located in the immediate environment or vicinity.
	Environment (A03)	Ability to convey the touch sensations associated with variable environmental, atmospheric and/or climate conditions in the immediate area - such as wind breeze/gust, precipitation, fog, variable visibility, temperature, humidity, etc.
Functionality	Haptic (A04)	Ability to convey an accurate and realistic "response" sensation (feedback) when touching or interacting with the ground systems, instruments and controls, etc. This can include the relative weight (portability) of the system, object or piece of equipment (or pressure exerted) when pulling, pushing or lifting it.
	System Response (A05)	Ability of the system to provide a realistic and appropriate interaction - i.e., system reaction in response to user input, or where input or activity with one system (controls, instruments, etc.) influences the reaction, output or display of another system, control or instrument.

Attribute Category	Attribute	Attribute Definition
Auditory	Environmental (A06)	Ability to convey discernable and indiscernible sounds occurring in the environment - whether natural or man-made - including variable battle munition sounds.
	Sound Bearing (A07)	Ability to convey variable sound tone, volume, and source location to determine the direction and source of the sound.
	Audible Systems Sounds (A08)	Ability to convey realistic non-verbal audio sounds and tones where the tenor, frequency, tone, regularity, pitch and/or volume provide meaningful and specifically interpretable information, signals or alerts.
	Verbal Communication (A09)	Ability to convey and/or represent discernable voice communication and commands between and from ground personnel as well as aircraft aircrew and other relevant voice communication sources.
Visual	Static (A10)	Ability to convey accurate and realistic representations of stationary environmental objects, terrain, topography, and scenery. These objects and scenery are generally reproduced via screen projections and NOT actual objects within one's reach.
	Dynamic (A11)	Ability to convey accurate and realistic representations of moving objects in the environment (ground and sky) with an appropriate motion fidelity, motion speed, acceleration, and motion trajectory.
	Models (A12)	Ability to convey accurate and realistic models for airborne aircraft, objects (munitions, missiles, rockets, artillery, airborne threats, etc.), ground vehicles, and human actors. Model capabilities include speeds, trajectories, turns, dives, climbs, maneuvers, etc. for single and multiple entities.
	Resolution (A13)	Ability to convey accurate and realistic representations of visual images with the required level of detail, focus, and acuity in order to achieve a prescribed level of recognition
	Depth Perception (A14)	Ability to convey accurate and realistic representations of realistic distances or changing distances of objects in the environment (on the ground or in the air).
	Light Levels (A15)	Ability to convey accurate and realistic representations of variable light levels and conditions (day light, night, dawn, dusk, moon light, etc.), and lighting anomalies (glare, sun-in-eyes, reflection, etc.) - as well as accommodate light and/or night system aids (e.g., infrared, night vision goggles, thermals).
	Damage States (A16)	Ability to provide and receive standardized and correct visual depictions of damage states in response to ordnance or other physical conditions.
Motion	Awareness (A17)	Ability to sense oneself moving in an environment. Ability to sense the movement of the environment or other objects relative to self.
	System Movement (A18)	Ability to provide accurate and realistic replication and/or simulation of the movement and positioning as present in the tactical vehicle environment.
Field-of-View	Horizontal FOV (A19)	Ability to display the essential range of site on the horizontal (left-to-right) global plain for variable terrains.
	Vertical FOV (A20)	Ability to display the essential range of site on the vertical (top-to-bottom) global plain.

Capability Survey

A capability survey focused on the ability of the MAGTF-TITE SoS to support the execution of training tasks. Participant SMEs from the AH-1Z, UH-1Y, AV-8B, and JTAC communities assessed MAGTF-TITE collective training capabilities via an 8-item post-exercise questionnaire.

FINDINGS

Criticality Analysis Results

A DMTE Assessment Team consisting of members from the UCF Institute for Simulation and Training, PMTRASYS, and TECOM, conducted SME working groups with the SMEs from the JTAC, AH-1Z/UH-1Y, and AV-8B communities. During these working groups, the DMTE Assessment Team guided the SMEs in evaluating, task by task, how critical the presence of specific attributes are to the execution specific tasks. Each task/attribute combination was rated based on the five-point scale defined and described in Table 2.

Table 2. Criticality Ratings and Definitions

Rating	Attribute Criticality	Attribute Criticality to Task Performance
5	Absolutely Critical	Task cannot be executed without this attribute.
4	Critical	Attribute is critical, contributing to important cues to task execution.
3	Important	Attribute is important and contributes to task execution, but work-around is acceptable.
2	Nice but not important	Attribute is nice to have but peripheral and not essential to task execution.
1	Irrelevant	Attribute is irrelevant or not applicable and contributes nothing to task execution.

Each task-to-attribute criticality rating provided by the SMEs was averaged across all tasks to arrive at an overall criticality rating for each of the MAGTF attribute list (Table 3). Criticality ratings followed the scale and definitions listed in Table 3. These averages are presented in the following sections.

JTAC Criticality Analysis Results

The levels of criticality of the top training attributes for the JTAC indicate the vital importance of the MAGTF-TITE SoS to convey and/or represent the following (see Figure 1):

- Ability of the system to provide a realistic and appropriate interaction - i.e., system reaction in response to user input, or where input or activity with one system (controls, instruments, etc.) influences the reaction, output or display of another system, control or instrument (A05).
- Accurate and realistic representations of stationary environmental objects, terrain, topography, and scenery (objects and scenery that are generally reproduced via screen projections and NOT actual objects within one's reach) (A10).
- Accurate and realistic representations of moving objects in the environment (ground and sky) with an appropriate motion fidelity, motion speed, acceleration, and motion trajectory (A11).
- Ability to convey accurate and realistic models for airborne aircraft, objects (munitions, missiles, rockets, artillery, airborne threats, etc.), ground vehicles, and human actors. Model capabilities include speeds, trajectories, turns, dives, climbs, maneuvers, etc. for single and multiple entities (A12).
- Accurate and realistic representations of visual images with the required level of detail, focus, and acuity to achieve a prescribed level of recognizability (A13).
- Essential range of site on the horizontal (left-to-right) global plain for variable terrains and the vertical (top-to-bottom) global plain (A19).

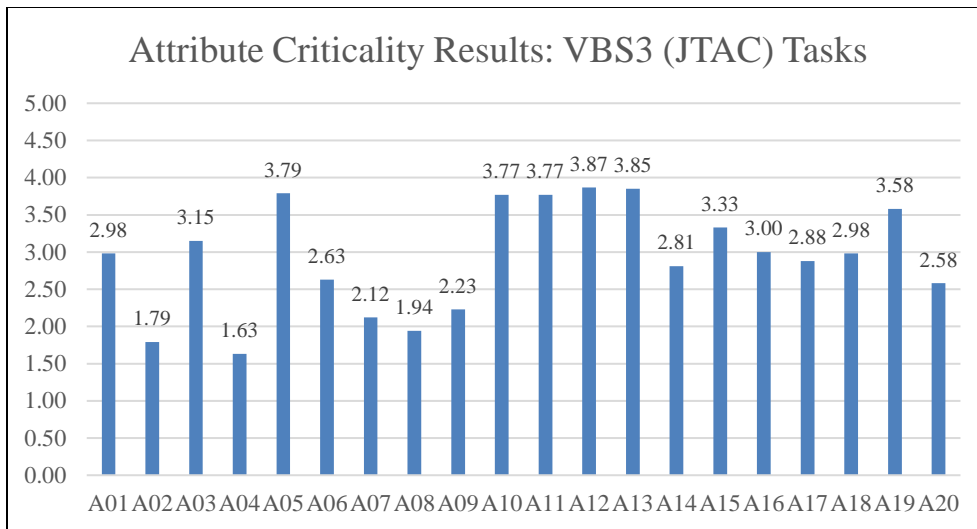


Figure 1. Attribute Criticality Results: VBS3 (JTAC) Tasks

AH-1Z/UH-1Y Criticality Analysis Results

The levels of criticality of the top three training attributes for the AH-1Z/UH-1Y indicate the vital importance of the MAGTF-TITE SoS to convey the following (see Figure 2):

- Ability of the environment to provide realistic and appropriate interactions - i.e., system reaction in response to user input, or where input or activity with one system (controls, instruments, etc.) influences the reaction, output or display of another system, control or instrument (A05).
- Ability of the environment to convey and/or represent discernable voice communication and commands between and from ground personnel as well as aircraft aircrew and other relevant voice communication sources (A09).
- Ability of the environment to display the essential range of site on the horizontal (left-to-right) global plain for variable terrains and the vertical (top-to-bottom) global plain (A19 & A20).

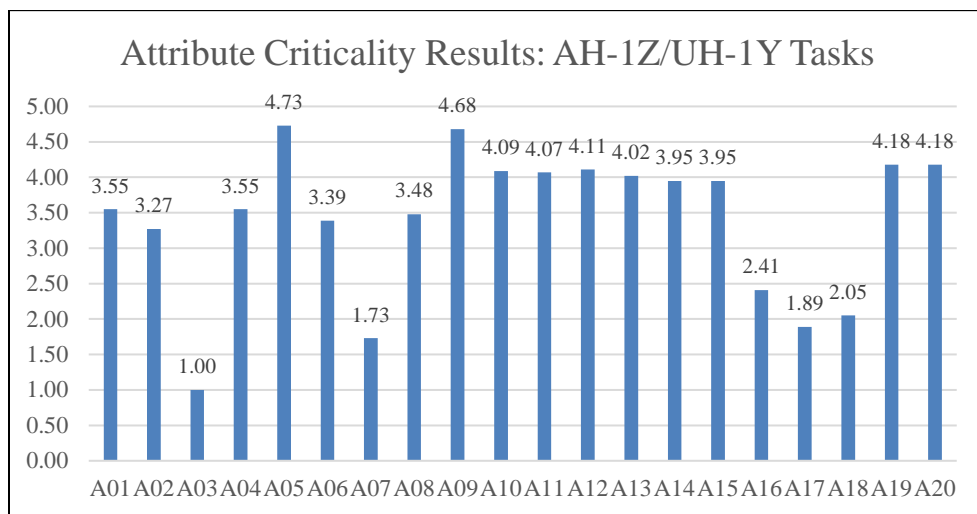


Figure 2. AH-1Z/UH-1Y Task-to-Attribute Criticality Results

AV-8B Criticality Analysis Results

The levels of criticality of the significant training attributes for the AV-8B indicate the vital importance of the MAGTF-TITE SoS to convey the following (see Figure 3):

- The levels of criticality of the top training attributes for the AV-8B indicate the vital importance of the MAGTF-TITE SoS to convey and/or represent the following:
- Discernable voice communication and commands between and from ground personnel as well as aircraft aircrew and other relevant voice communication sources (A09).
- Accurate and realistic representations of stationary environmental objects, terrain, topography, and scenery (objects and scenery that are generally reproduced via screen projections and NOT actual objects within one's reach) (A10).
- Accurate and realistic representations of moving objects in the environment (ground and sky) with an appropriate motion fidelity, speed, acceleration, and trajectory (A11).
- Accurate and realistic representations of visual images with the required level of detail, focus, and acuity to achieve a prescribed level of recognizability (A13).
- Accurate and realistic representations of variable light levels and conditions (day light, night, dawn, dusk, moon light, etc.), and lighting anomalies (glare, sun-in-eyes, reflection, etc.) - as well as accommodate light and/or night system aids (e.g., infrared, night vision goggles, thermals) (A15).
- Essential range of site on the horizontal (left-to-right) global plain for variable terrains and the vertical (top-to-bottom) global plain (A19 & A20).

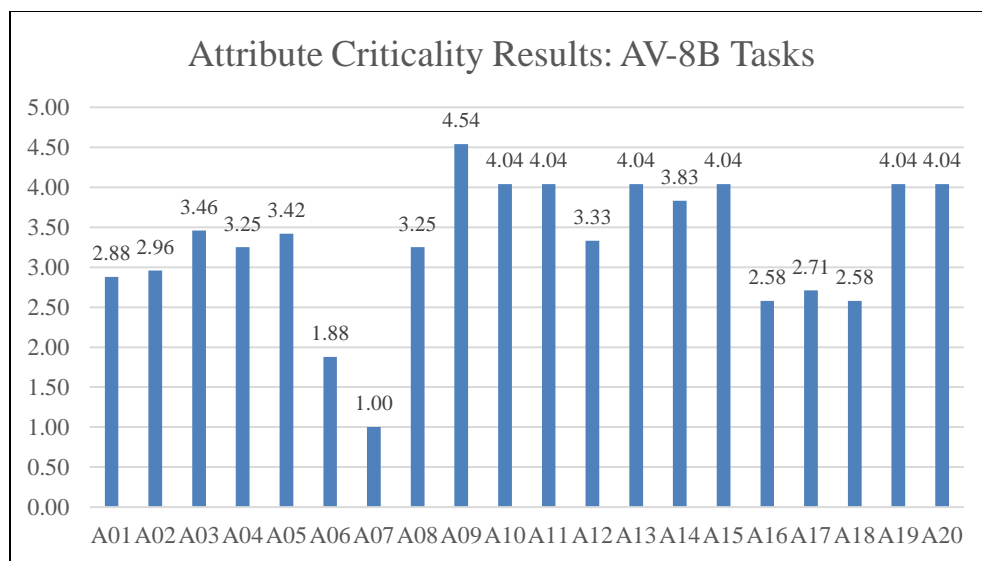


Figure 3. AV-8B Task-to-Attribute Criticality Results

Capability Survey Results

The DMTE Assessment Team used an 8-item post-exercise questionnaire to assess the reactions and experiences of participants to the collective training delivered through the MAGTF-TITE SoS configuration. A sampling of questionnaire responses from TALONEX 2-18 exercise participants from the AH-1Z/UH-1Y, AV-8B, and JTAC communities captured their perceptions of operating within MAGTF-TITE and are listed in Table 3.

Table 3. Sample Post-Exercise Questionnaire Responses

Post Exercise Questionnaire Responses	
Q1	How Effective Was Your Response Cell in Allowing You to Achieve the Training Objectives?
	Mainly due to the connection, we were unable to do as much support as we would be able to do in the aircraft. However, I can foresee this being a great training aid once the connection bridge is improved. Additionally improving the targets would help immensely. Being able to correlate on more realistic looking targets would greatly improve the usefulness as a training aid.
	To my knowledge, the local response cell was only involved in the first day of simulation for my specific role (JTAC) and effects on targets were painted via software and voice. The second day with simulation and communications working the response was relying on simulation effects that never occurred to my knowledge, elimination my effects on the battlefield.
	Once communication was established the response was as effective as would be in live training. The benefit to the simulation was the weapons release was replicated on visible targets which is done very seldom with [unreadable] in training with the actual aircraft. Having multiple players listening to act as a white cell to push through simulator constraints is a good practice as well.
	Would not have been able to fight as a section if flying in formation was not possible. Able to talk through the 12 Step Process (CAS) and use the sensors well (as a single).
Q2	How effective were your adjacent supporting elements in achieving the training objectives?
	Having the adjacent units there was very helpful to training. Being able to talk to an actual JTAC while he runs you and other assets in the simulator greatly helps to show the process and procedures we use in the CAS environment.
	To some extent, yes. Having actual Marine elements playing each role has increased our awareness of the coordination involved and provided integration training for those that have not been exposed previously. However, each element faced significant simulation/realism challenges that forced adaptation of standard procedures and tactics.
	Adjacent units were effective once linked. The issue is joining each individual simulator onto the virtual network. When one simulator goes down or falls off the network, resetting the network can cause errors or cause the entire scenario to drop off the link. Re-establishing the connection takes time and degrades training.
	Communications were biggest part of the training, communications were in and out but facilitated training when available
Q3	Do you see value in simulation training?
	I see huge value in simulator training. Being able to practice a full CAS mission with other people, all while everyone is getting their own good training, can do great things for the Marine Corps. Unfortunately, due to computer and programming issues, these simulators are not quite to that point, but they are quickly approaching it.
	I value simulation training up until the point that it detracts from Doctrine and standard operating procedures. I understand that simulation allows for larger and more complex scenarios but if the fidelity and limitations force me to adapt my procedures and behavior, it results in negative training value.
	Yes. You can simulate scenarios that you cannot accomplish in the aircraft. By creating the simulated tactical environment network and incorporating aviation and ground elements you can create a similar environment that would be found in an actual combat scenario. Simulation training can assist in filling holes in readiness shortfalls.
	Yes, mainly for the communications practice. Actually being able to have key players talk over the communications
Q4	Was the training realistic?
	No simulator training will ever be 100% realistic. However, that being said, the simulators are at least moving along on the right track. Once we actually got the bridge working, it was great to be able to see all the different units working together to get the rounds down range in support of the simulated [people] on the ground.
	In a very limited scope, yes. In the sense that all agencies were coordinating and talking (communication challenges aside). However, when conducting complex scenarios like this it requires all of our senses, available resources (equipment), and realistic effects to build appropriate situational awareness for effective decision-making.
	Somewhat. Simulators are important training aids, but realism is only partially accomplished.
	Yes. The biggest issue is maintaining the link and expanding the simulation models to prevent players from being dropped from the Ten.

Post Exercise Questionnaire Responses	
Q5	What was the most valuable aspect of simulation training?
	Simulation training will not ever be able to provide an exact representation of how the aircraft will fly and react when actually flying around or at least they will not in the near future. The most important part of the simulation training is the procedural and communication aspect of the exercise. Being able to talk to the JTAC, get correlated, and then conduct the attack on an agreed on target provides great training.
	Repetitions are always good, especially with this level and amount of actual role-players. At the end of the day we could scale down to the level of “[Hey] you, this is me” on the radio and work from there.
	Operating with other players with disparate backgrounds and varying degrees of proficiency.
	Integration with multiple agencies for communications flow and scenario based training.
Q6	Did you feel accountable for meeting mission objectives?
	I did feel that were accountable for meeting mission objectives. Connectivity issues did hinder that initially, but over the course of the exercise things improved.
	Yes. We were part of a larger mission and were working hard to meet our required tasking.
	Yes. Being able to work with other units improves responsibility and accountability.
	Yes, unless the training assets are otherwise usable to provide an environment for us to accomplish.
Q7	Did you sense cohesion with higher, supporting, or adjacent units?
	I did feel a sense of cohesion with the other units working with us in the simulator. Initially it was a feeling of joint frustration as we attempted to get the bridge working properly. Over the course of the exercise, that cohesion moved more towards getting the mission accomplished as we supported the simulated [people] on the ground.
	Yes, having actual roleplayers that are some level of subject matter experts makes buy-in higher. Having a simulator operator that is not current in tactics and capabilities playing one or several elements is often ineffective and negative training.
	In the sense that all players were trying to illustrate the current challenges to federated training –Yes. With respect to accomplishing a specific tactical mission, no
	Yes. The units worked together as they would during an actual time on station, albeit with difficulties rising from the sim connections.
Q8	What did you see as the most valuable aspect of federate training?
	Working through tactical problems with other units that have different backgrounds & capabilities. Getting exposure to problem solving within the group in real-time as the tactical environment changes.
	Working with a live JTAC in control of fires, which more accurately mirrors a real missions.
	Being able to talk to key players while trying to do our respective jobs and not having someone from the community act as FAC/JTAC or DASC or AirO.
	The most valuable aspect was the integration of multiple entities for a purposeful and objective-based communications flow/scenario based exercise.

Outcomes of this SoS evaluation include a standardized evaluation methodology to support VV&A of SoS configurations, lessons learned for future integrated training, and identification of improvements for current training systems. Resource sponsors, developers, operational and support commanders, designers, users, and other stakeholders will benefit from these results as they develop and employ other LVC assets and evaluate capabilities of other SoS evolutions. Optimizing training value by improving training design with embedding performance metrics for elements such as communication and coordination, to objectively assess collective performance-oriented standards of tactical and technical competencies, is also discussed.

RECOMMENDATIONS

Applying the MAGTF-TITE SoS concept to TALONEX 2-18 developed the following recommendations:

- Exercise design and scenario development should precede network design to meet training objectives of each platform and user community.
- Validated training scenario advances training value for each MAGTF element (Air, Ground and Logistics).
 - Applying MAGTF-TITE concept to current and future training events focuses on a broad spectrum of battalion/squadron and below training objectives and mission essential tasks (METs).

- Emphasizing MAGTF-TITE operational cohesion in a collective training environment increases realism and better prepares Marines for combat.
- Enabling MAGTF-TITE collaboration with adjacent/supporting agencies minimizes uncertainty, miscommunication, and errors while improving reliance on individual competency.
- Providing MAGTF-TITE opportunities increases potential for tactical decision making, critical thinking, experiencing non-standard events, and integration with external organizations.
- Comprehensive assessment efforts, such as those based on the TCA methodology, help drive the development and implementation of persistent training network capabilities.
 - Identifying specific deficiencies in environmental attributes that require improvement to support training tasks and actionable information.
 - Supporting capabilities of instructional interfaces, technologies, and environments facilitate performance of training tasks and requirements.
- Supporting DMTE Assessment Team configuration review ensures executable assessment design, documents required workarounds to SoS functionality, and accomplish training requirements.

CONCLUSIONS

The training enabled by the interoperability of these distributed systems defines the term “the whole is greater than the sum of its parts.” T&R events addressed by a standalone simulator often fall within the, this-is-what-you-do and this-is-how-you-do-it (declarative and procedural) levels of individual skills and learning (Dunne, et al, 2017). However, when simulators with differing training objectives are linked, multiple MOSs are working together in a shared environment, combining collective procedures and skills in high-fidelity experiential conditions that exercises higher-order thinking and decision-making abilities (e.g., application, conceptual understanding and rule integration) as the cognitive complexity increases. With higher level training comes higher-level lethality, survivability and value added training (Dunne, et al, 2017).

FUTURE WORK

The next phase of the LVC-RCS initiative, Capabilities Integration, will focus on increasing the interoperability of MAGTF-TITE and improving the distributed training network to expand across the MAGTF, joint services, and coalition partners. Participation in simulation experiments, demonstrations, and exercises will continue to be instrumental to this effort. The knowledge and experience gained by the simulations team through participation in these events will advance the use of simulations to support collective training in a distributed virtual and constructive environment and enhance integrated training across all MAGTF elements.

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