

LIVE, VIRTUAL, CONSTRUCTIVE DISTRIBUTED MISSIONS: RESULTS AND LESSONS LEARNED

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ABSTRACT

A Capabilities-Based Assessment chartered by the Commanding General, Training and Education Command identified the Live, Virtual, Constructive – Training Environment (LVC-TE) capabilities required by the United States Marine Corps (USMC). These capabilities enable the LVC-TE to create a common environment for units to train across LVC domains as though located in the same battlespace and, “provide the means to conduct realistic, collaborative training and exercise of warfighting functions” (Initial Capabilities Document, USMC, 2010).

Subsequently, Training and Education Command (TECOM) required assessments be conducted for simulation training systems used in an LVC-TE intended to address recommendations identified by Marine Requirements Oversight Council Decision Memorandum and developed further by an LVC-TE Working Group. Special Operations Command followed on these recommendations and consequently requested that Headquarters, Marine Corps include the Marine Corps Special Operations Command requirement for Special Operations Terminal Attack Controller training in this effort. Thus, through collaboration with Program Manager Training Systems (PM TRASYS), TECOM, Naval Air Warfare Center Training Systems Division (NAWCTSD), Marine Corps Tactics & Operations Group, Lockheed Martin (LM), and Instructional Systems and Engineering contracted support, a team was assembled to design, develop, implement and evaluate a unique and ambitious Distributed Mission Training Environment (DMTE).

This paper first describes the three currently fielded training devices whose capabilities to support training objectives (tasks associated to Training and Readiness events) were assessed to determine suitability for inclusion in the DMTE then the methodology of the DMTE evaluation. This paper then details the Systematic Team Assessment of Readiness Training (START) process that was employed to confirm and illustrate the capability of the training devices to provide value added training in the DMTE. Results, analysis and the most salient lessons learned are then presented. Finally, the projected movement forward of this DMTE effort is briefly described.

ABOUT THE AUTHORS

Dr. Robb Dunne holds a PhD in Instructional Technology from University of Central Florida (UCF) and is the Senior Instructional Systems Architect at Zenetex, LLC. Orlando, FL. For the past 6 years he has supported PM TRASYS, NAWCTSD, the Navy and Marines. He has conducted numerous training system evaluations including Front End Analyses, Verification and Validations, Training Effectiveness Evaluations, and START processes. Dr. Dunne enjoyed 2 years at the Institute for Simulation and Training (IST) where he began his work on computationally defining scenario complexity. He has published and presented two papers and a dissertation on the subject.

LtCol. Scott Harris retired after serving 28 years as an Active Duty Pilot in the USMC and is now a Faculty Research Associate at the IST at UCF in Orlando, FL. In 2010 Scott was assigned by Headquarters Marine Corps to serve as the Program Manager for all Marine Corps Aviation Training Systems at PMA-205. Prior to this, Scott

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Scott Tanner holds an M.A. in Instructional Systems Design from UCF and for the past three years supported Navy and Marine projects as a lead Instructional Systems Designer and Research Psychologist for NAWCTSD in Orlando, FL. He has conducted front end analyses, as well as training systems evaluations utilizing START process. Before NAWCTSD, he spent 14 years as an Instructional Systems Designer at the IST supporting U.S. and Florida Departments of Transportation, Florida Highway Patrol, Orange County Fire Rescue, Orange County Public Schools, and NASA.

Brett Vonsik is a principal system engineer with 20 years of experience in the modeling, simulation and training industry. Veteran of the United States Air Force as a Navigator/Electronic Warfare Officer he logged over 2,000 flight hours in Special Operations MC-130E/H Combat Talons and has 10 years of experience as a Subject Matter Expert in military schoolhouse training systems, simulations, and courseware. Brett currently runs the LM Innovation Demonstration Center in Orlando, Florida where he oversees technology demonstrations involving full mission simulators, part-task and desktop training systems, constructive simulations, Distributed Mission Training and Live, Virtual Constructive training systems.

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Shawn Muir is a senior system engineer for LM with 10 years of experience in the modeling, simulation and training industry. He holds an M.S. in Electrical and Computer Engineering, a B.S. in Electrical Engineering and a degree in Electronics/Computer Systems Technology. Shawn also has three years of experience in Radio Frequency Data Communication technology. He currently maintains and expands the operations of the LM Innovation Demonstration Center in Orlando, Florida in support of Advanced Programs, Research & Development, Business Development and other Engineering projects.

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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, the Training and Education Command (TECOM) is pursuing appropriate linkages among the Corps' existing simulations to provide robust and mission-oriented capabilities. Marine Corps Reference Publication (MCRP) 3-0B, How to Conduct Training, defines "mission-oriented" as individual and collective training that provides Marines with the knowledge, skills, and attitudes necessary to execute combat-related missions. TECOM is also examining networking requirements to link simulation systems with each other, with live domain capabilities, and to provide access to Joint and partner nation training and Modeling and Simulation (M&S) networks. Live, Virtual, Constructive (LVC) networks supporting Distributed Mission Training Environments (DMTE) between Marine Air-Ground Task Force (MAGTF) elements are necessary to enable large scale MAGTF exercises and follow the Commandant's guidance.

With the expansion of the LVC-Training Environment (LVC-TE) and increasing investment in technology to provide tactically relevant and networked simulations in support of training that produces operational readiness, a replicable, systematic evaluation process is essential to ensure cost-effective advancement of training M&S systems and provide evidence and research-based data for decision makers. As the LVC-TE matures to provide infrastructure for a "plug and play" System of Systems (SoS) capability, evaluations that determine LVC-TE configuration's affordances of value-added training¹ are vital.

OVERVIEW

To efficiently and effectively provide such an evaluation the Systematic Team Assessment Readiness Training (START) process, a non-proprietary, open-use method that employs a series of linked spreadsheets to determine the level of capability of training environments to train Warfighter Mission Essential Tasks (METs) (Sheehan et al., 2009), was used in an LVC DMTE. Initially intended for use on stand-alone systems, the dynamic training environment inherent to LVC DMTE required that START extend the validation and verification criteria (training criticality, device capability) from stand-alone systems to LVC configurations. As described in a previous IITSEC paper (Johnston et al, 2015) START results can inform decision makers of the suitability of upgrades to improve training by expanding the array of METs that can be effectively supported. Now, in the case of LVC DMTE, such results can extend that array from individual and collective to unit, company and above.

¹ Value-added Training is a concept used to guide the identification of potential LVC configurations focusing on the progression of a Marine's competency (knowledge, skills and attitudes). For instance, there is Value-added for an aviator and a Joint Terminal Attack Controller (JTAC) to train Close Air Support (CAS) objectives together; both trainee's accountable for mission objectives.

To support the LVC DMTE and address the research question, “does a DMTE enable value added training” START processes were used to evaluate the training affordances first of stand-alone training simulators then in a DMTE that combined three training domains (Battle Staff, Individual, Unit and Collective) across Military Occupational Specialty (MOS) and units to simulate the conditions of a Contemporary Operational Environment.

This paper reports on the methodology, the findings and results from the initial phase of a three phase LVC DMTE effort. The second and third phases are briefly described in the Moving Forward section. This initial phase developed a capabilities interoperability baseline modeled upon the guidelines from the First Marine Expeditionary Force Proof of Concept and Large Scale Exercise 2014. Using those guidelines, three systems were used in this LVC DMTE:

- Virtual Battlespace 3 (VBS3) is a Commercial Off-the-Shelf software program embedded in the Deployable Virtual Training Environment system used to train Marines from the individual to the battalion staff by using a self-contained network of laptop computers with reconfigurable workstations capable of presenting an array of virtual and constructive skills sustainment training scenarios.
- Combat Convoy Simulator (CCS) is a software based, immersive simulation program that places Marines in a realistic, simulated environment and trains basic and advanced combat convoy Tactics, Techniques, and Procedures, Command and Control, Improvised Explosive Device countermeasure skills, attack, and response with small arms and crew served weapons, and allows for repetition and remediation.
- Pilot Training Aid (PTA) uses a touchscreen monitor to display out-the-window view and touchscreen instrumentation (Main Forward Display). The PTA also fully replicates the F-35B Hands-On Throttle and Stick. The PTA is developed on Lockheed Martin (LM) Prepar3D software that is Distributed Interactive Simulation (DIS) network compatible and contains communication radios, constructive simulation and Virtual Reality capability, with an expandable library of 3D entities. Other characteristics of the PTA include: munitions effects and aural cues, simulation of visual conditions such as night and infrared and customized entities and assets that can send datalink messages to the PTA.

This DMTE START defined “value added training” as training that goes beyond individual or MOS-centric training. Training events addressed by a single simulator fall mostly within declarative and procedural levels of learning limited to a particular MOS. Coordinating multiple simulators in a DMTE allows collective and above training that enables Higher Order Thinking Skills for training objectives such as decision making, evaluation and synthesis. For determination of such value added training the LVC DMTE START was undertaken.

METHODOLOGY

This section first defines key terms then describes the limitations, assumptions and procedures of the DMTE effort and evaluation. Details of the analysis outputs instrument and outputs, basis of the results, are then presented.

Key Terms

The Department of Defense, Modeling and Simulation (M&S) Glossary, 2011 defines LVC as the following: “Live” as simulation that involves real people operating real systems, “Virtual” as simulation that involves real people operating simulated systems and “Constructive” as simulation that involves simulated people operating simulated systems.

LVC is an extension of Scenario Based Training that emphasizes learning by doing (Reigeluth, 1999) and employs real-world problems that focus on performance outcomes in the context of the real work environment (Kindley, 2002). “Train as you will fight,” is one of the fundamental principles upon which USMC training is based Marine Corps Reference Publication (MCRP) 3-0A (USMC, 1996). LVC is an ideal vehicle for training within the USMC as LVC links a single system, or training capability in a distributed manner to other training systems in larger, joint conditions that exceed the capabilities of that single system and enable value-added training with real-world problems like the pressures and “fog of war”.

A DMTE is an LVC that physically connects simulation devices to enable seamless integration and exchange of data. When joined together, these devices provide accurate, and consistent simulated conditions that adhere to the principles of fair fight, address mission objectives and enhance training proficiency beyond stand-alone devices.

Analyses processes are an integral part of the Instructional Systems Design process that includes Front End Analysis (FEA). Process outputs and the FEA provide input to the physical, functional, and instructional baseline requirements of training devices and are vital components of the training media analysis to optimize the mix of media and achieve identified learning objectives. Together with the FEA, these analyses provide specific data to support the transfer of knowledge, skills, and attitudes from training devices such as part-task trainers, desktop computer based training, and high-fidelity simulators to live events.

START is a systematic, replicable analysis process that assesses training device capabilities to support performance of tasks associated to Training and Readiness (T&R) events and thus training objectives. It is a data-driven evaluation of simulators and their ability to enable and support training of tasks associated to T&R events and identifying areas for improvement and potential upgrades to enhance trainee proficiency and optimize return on investment. The process is executed in several steps to collect data through Subject Matter Expert (SME) feedback. This data enables computational determination of task criticality and device capability scores.

Limitations and Assumptions

First, distributing simulations from a technical standpoint requires numerous permissions; Authority to Connect, Authority to Operate, etc. These are time consuming and of limited duration. Another time consuming process is ensuring the database (terrain and entities) is consistent throughout the federation. Due to lack of a centralized authority like the Marine Aviation Training Support Squadron, the nature of ground simulation systems fielding and the fragmented nature of local networks maintained by each base this LVC DMTE and similar efforts are local and short-lived. Stable, continuous and follow-on undertakings are notably limited.

Second, the following limitations to this DMTE affected the analysis results by reducing data collection opportunities or limiting analysis, although every effort was made to minimize the impact of these limitations:

- At the time of the DMTE event F-35B T&Rs were not finalized, therefore mapping of tasks to T&R events was not possible.
- CCS/VBS3 participants were USMC Reservists and not consistently practiced in use of CCS or VBS3 as it is not doctrine to use these systems to augment live training.
- The on-site LM CCS was not identical in configuration as those fielded.
- CCS and VBS3 communications were originated from the PTA LM Prepar3D software; an external system not inherent to fielded CCS or VBS3.
- The Phase 1 network architecture at the LM facility was not identical to USMC networks.
- The F-35B PTA used in the DMTE had received a software upgrade that provided new capabilities in distributed network exercising via DIS. The F-35B simulation was also modified to support specific Joint Terminal Attack Controller (JTAC) operations. Therefore reliable comparison to the stand-alone F-35B PTA, conducted without these upgrades and modifications, is impacted.
- The use of the PTA Prepar3D software for event Communications between simulation platforms and battle staff was not initially brought into the assessment as it was not a fielded requirement at the time.
- Schedule, personnel, budget and report requirements, limited Code Training Support (CTS) scores to the VBS3 (Ground) device; comparing two conditions from two different populations reduces reliability.

Finally, the following assumptions guided data collection and ensured successful completion of the evaluation:

- The SME participants possessed the expertise to provide accurate, consistent assessments for capability ratings.
- The criticality levels of the associated stand-alone analyses are equivalent to the criticality levels in the DMTE configuration.
- The VBS3 system was lacking flight simulation realism or F35 cockpit functionality before the beginning of the assessment however, this was a known factor and flight pilot SMEs process output analysts took this into consideration when providing and eliciting feedback.

Procedure

Laying the foundation for the DMTE START required first the determination and alignment of the T&R events to be used in the analyses processes and DMTE scenario. In order to align the tasks evaluated in the stand-alone and DMTE STARTs to doctrine, the tasks were aligned to their associated T&Rs based on four sources: T&R events identified by Simulation Assessment Working Group efforts as being supported by training simulators, the LVC-TE (Feb 2016) Working Integrated Product Team, community SMEs and appropriate T&R manuals.

Of the tasks and T&R events identified by these sources, 137 Collective tasks associated to 86 T&R events formed the basis of the Kinetic Stability Operations (KSTABOPS) scenario used in the DMTE. These tasks were conducted, as appropriate, across the three simulation systems supporting 21 to 40 tasks and three to 45 T&R events.

With tasks identified analysts conducted a series of data collection workshops to: 1) validate the specified tasks were complete and accurately associated to T&R events; 2) determine how critical each training device attribute was to the training of each task and, 3) evaluate how capable the training devices were to train each task.

The conduct of the DMTE and the analyses processes was as follows. On the first day, after CCS, VBS3 and PTA SMEs arrived at the LM site they were given pre-briefings and familiarization exercises on the training devices they were to use and provide input for. Following these exercises the first distributed exercises were conducted connecting the CCS, VBS3 and PTA. The VBS3 was used for both the JTAC and ground SMEs participants. During the following days, the full DMTE exercise was conducted with all systems connected during which analysts observed the participants and the system interactions and gathered data from both technical and operational SME input. An area for assessment overview was provided by LM in order for coordinators to centralize efforts and observe the simulation, SMEs and communications within the event. Upon completion of the DMTE exercise, analysts convened the applicable SMEs in dedicated rooms and collected data, comments and feedback. Afterwards, analyses were conducted to provide the outputs: Task Training Support (TTS) and CTS scores. DMTE START results were then compared to stand-alone results. SME comments, during formal and informal conversations were also collected and aggregated, however, due to space constraints are not reported here.

START Instrument and Outputs

START's algorithms combine task criticality and attribute capability ratings provided by SMEs during data collection workshops to illustrate the level of support the training device provides for tasks associated to T&R events. SMEs are asked to evaluate how critical, task by task, the presence of specific attributes (conditions and stimuli) are to execute those tasks. These attributes may be tailored to address specific system capabilities or requirements. Then SMEs are asked to evaluate how capable the training device is at providing those specific attributes, task by task. In this way analysis outputs illustrate the alignment of criticality levels to levels of capability. Examples of these attributes and definitions may be found in a previous IITSEC paper (Johnston et al., 2015).

Once criticality and capability data are collected analyses outputs provide two sets of scores: the TTS and CTS scores.

Task Training Support (TTS)

The TTS score is derived from SME's evaluation of the level to which a simulator's attributes enable training of tasks. Levels are averaged across all tasks and rated using the attribute capability description and ratings below.

Table 1: TTS Levels and Definitions

Level 3	Trained to Standard	Task can be trained to standard using the training device/simulator with insignificant attribute capability gaps
Level 2	Partially Trained	Task can be trained using the training device/simulator but not trained to standard due to notable attribute capability gaps and work-arounds
Level 1	Not Supported	Task cannot be trained using the training device/simulator due to significant attribute capability gaps

Code Training Support (CTS)

CTS scores are calculated by cross-referencing TTS scores to the task criticality evaluations and produces two types of CTS scores: CTS₁ and CTS₂. The CTS₁ score indicates the training device's capability with respect to tasks critical to successful completion of the associated T&R event and therefore critical for the training device to enable. Tasks deemed critical are weighted heavier than those simply deemed relevant. The CTS₂ calculation indicates the device's capability with respect to both non-critical and critical training tasks associated to a T&R event. The CTS scores are thus derived from the level of training support a device provides for execution of specific tasks associated to T&R events as defined in the applicable T&R Manual, and are expressed on a scale of one to five as shown below.

Table 2: CTS Levels and Definitions

5.00	<u>Full Training Capability</u> : T&R code can be <u>thoroughly and accurately trained</u> in the simulator with no compensation required for the individual to execute and accomplish the T&R code.
4.00	<u>High Training Capability</u> : T&R code can be <u>effectively trained</u> in the simulator with minor compensation required for the individual to execute and accomplish the T&R code.
3.00	<u>Moderate Training Capability</u> : T&R code can be <u>trained</u> in the simulator, but with considerable distractions requiring significant compensation for the individual to execute and accomplish the T&R code.
2.00	<u>Low Training Capability</u> : T&R code can be <u>addressed</u> in the simulator, but with severe distractions requiring extraordinary compensation to have a useful affect towards executing and accomplishing the T&R code.
1.00	<u>No Training Capability</u> : T&R code <u>cannot be trained</u> in the simulator, and no amount of compensation allows the individual to effectively execute and accomplish the T&R code in the simulator.

RESULTS

As mentioned earlier, CTS₁ and CTS₂ scores were derived only from the VBS3 (ground) stand-alone and DMTE STARTs. The CTS₁ score indicates training capability with respect to tasks critical to successful completion of the associated T&R event and therefore critical for the training device to enable. There were 68 tasks associated to T&R events that were deemed critical by the SMEs that participated in the DMTE, therefore during the CTS₁ analysis phase of the DMTE START only those 68 events were compared to the CTS₁ scores of the identical events from the stand-alone START. The table below shows only those scores that deviated by more than two points between the VBS3 (Ground) standalone and VBS3 DMTE (Ground) for both the derived CTS₁ scores.

Table 3: Significant VBS3 (Ground) Stand-alone and DMTE CTS1 Comparisons

#	T&R Event	Event Description	Stand-alone	DMTE
4	0369-OPS-2002	Lead a unit during relief in place	5.00	2.50
5	0369-OPS-2003	Lead a unit during passage of lines	5.00	2.50
6	INF-MAN-3201	Conduct a passage of lines	5.00	2.50
8	INF-MAN-4202	Conduct a passage of lines	5.00	2.50
12	INF-MGUN-4002	Conduct motorized operations of a machinegun unit	5.00	0
13	INF-MGUN-5002	Provide defensive fires	5.00	0
14	INF-MGUN-5004	Conduct motorized operations	5.00	2.50
15	INF-MORT-4002	Provide indirect 60mm mortar fires	5.00	0
16	INF-MORT-4003	Provide indirect 81mm mortar fires	5.00	0
17	INF-MORT-5001	Provide indirect fires	5.00	0
22	INF-MAN-6207	Conduct a link up	4.17	1.67
23	0311-OFF-2006	Direct the employment of 60mm mortars in support of offensive operations	3.75	1.25
24	0369-OFF-2003	Employ mortars in support of an attack	3.75	1.25
26	INF-MAN-6214	Conduct a screen	3.75	1.25

Table 4: Significant VBS3 (Ground) Stand-alone and DMTE CTS1 Comparisons (Cont.)

32	0300-COMM-2007	Communicate using squad wireless communications	2.50	0
35	0300-TVEH-2015	Communicate using organic tactical vehicle radio communications equipment	2.50	0
38	0369-FSPT-2502	Develop a target list	2.50	5.00
41	INF-0317-3003	Execute immediate action drills	2.50	5.00
53	INF-MAN-4004	Clear a Fortified Position	2.50	0
58	INF-MAN-6216	Conduct a cordon and search	2.50	0
63	0300-PAT-2007	Lead a unit in reaction to a detonated Improvised Explosive Device	2.50	0

The CTS₂ score indicates the training devices' capability to train both critical and non-critical tasks for successful completion of the associated T&R event. There were 114 tasks associated to T&R events that were deemed critical and non-critical by the SMEs that participated in the DMTE, therefore during the CTS₂ analysis phase of the DMTE START only those 114 events were compared to the CTS₂ scores of the identical events from the stand-alone START. The table below shows only those scores that deviated by more than two points between the VBS3 (Ground) standalone and VBS3 DMTE (Ground) for both the derived CTS₂ scores.

Table 5: VBS3 (Ground) CTS2 Scores Compared

#	T&R Event	Event Description	Stand-alone	DMTE
5	INF-MAN-5208	React to a meeting engagement	5.00	2.50
16	INF-FP-5002	Operate in a Chemical, Biological, Radiological, Nuclear threat environment	4.17	1.67
46	0369-OPS-2002	Lead a unit during relief in place	3.64	1.82
47	0369-OPS-2003	Lead a unit during passage of lines	3.64	1.82
48	INF-MAN-3201	Conduct a passage of lines	3.64	1.82
49	INF-MAN-4202	Conduct a passage of lines	3.64	1.82
60	INF-MAN-4004	Clear a Fortified Position	3.57	1.61
81	0311-DEF-2002	Lead a squad sized unit in defensive operations	3.33	1.25
97	INF-FP-6004	Conduct Chemical, Biological, Radiological, Nuclear (CBRN) operations	3.00	1.00
101	0300-COMM-2007	Communicate using squad wireless communications	2.50	0
104	0369-FSPT-2502	Develop a target list	2.50	5.00
105	0300-MOBL-2001	Lead a team/squad in convoy/motorized operations	2.50	0
106	0300-PAT-2007	Lead a unit in reaction to a detonated Improvised Explosive Device	2.50	0

Table 6: VBS3 (ground) CTS₁ and CTS₂ Comparison

Level	CTS ₁ Stand-alone		CTS ₁ DMTE		CTS ₂ Stand-alone		CTS ₂ DMTE	
	Total	%	Total	%	Total	%	Total	%
Level 5	17	25	9	13.23	5	4.38	4	3.5
Level 4	5	7.35	0	0	16	14.03	1	.87
Level 3	8	11.76	8	11.76	76	66.66	22	19.29
Level 2	33	48.52	31	45.58	13	11.4	60	52.63
Level 1 or Below	5	7.35	20	29.41	4	3.5	27	23.68
Total	68	99.98	68	99.98	114	99.97	114	99.97

TTS scores were derived from the assessments made by the SMEs of all the training devices used in the DMTE and they indicate the capability of a device to support performance of a particular task. Due to space constraints only the aggregation of the scores are presented here.² There was no stand-alone START conducted on the VBS3 (JTAC).

Table 7: Stand-alone to DMTE TTS Comparisons

Level	CCS Stand-alone		CCS DMTE		PTA Stand-alone		PTA DMTE		VBS3 (JTAC) DMTE		VBS3 (Ground) Stand-alone		VBS3 (Ground) DMTE	
	Tot.	%	Tot.	%	Tot.	%	Tot.	%	Tot.	%	Tot.	%	Tot.	%
3	6	31.5	0	0	0	0	4	23.5	12	30.7	16	64	14	56
2	11	57.9	3	15.7	4	23.5	13	76.5	8	20.5	9	36	11	44
1	2	10.6	16	84.3	13	76.5	0	0	19	48.7	0	0	0	0
Tot.	19	100	19	100	17	100	17	100	39	99.9	25	100	25	100

ANALYSIS

As indicated by CTS₁ results, the overall diminishing of the capabilities of the VBS3 (ground) device to train critical tasks in the DMTE raises two questions; 1) did the KSTABOPS scenario allow action of those tasks and, 2) what technical interoperability issues impacted the DMTE? CTS₂ results indicate non-critical tasks associated to T&R event such as *INF-FP-5002: Operate in a Chemical, Biological, Radiological, Nuclear threat environment* could be addressed but the DMTE scenario did not allow sufficient action of the critical tasks.

It can be seen that some T&R events associated to tasks support the supposition of value added training in this DMTE. For example, T&R events *0369-FSPT-2502: Develop a target list* and *INF-0317-3003: Execute immediate action drills* provide a clear example by increasing from a CTS₁ 2.5 rating in stand-alone to the maximum rating of 5 in the DMTE. In the case of CTS₂ T&R event *0369-FSPT-2502: Develop a target list* provides another example by increasing from 2.5 in stand-alone to the maximum 5 and 4 respectively.

In regards to the CCS findings, two tasks were evaluated at TTS Level 1 in stand-alone while in the DMTE 16 tasks were evaluated at Level 1. This indicates that in the DMTE the CCS was evaluated as incapable of supporting training for almost 75% more of the evaluated tasks. TTS Level 2 tasks indicates that the simulator or training device can provide some level of training, but it is not adequate to support full qualification. In the DMTE environment, the CCS may enable effective task familiarization or practice of three tasks. In the DMTE, there were no TTS Level 3 tasks. This finding shows that the CCS did not support the performance of these tasks sufficiently. However, in detailed analysis it was found that the same tasks received Level 3 evaluations in the standalone environment. This result may be an indication of the impact of technical issues. For example, the *Establish convoy communication* task was given Level 1 because, according to SME comments, “Marines would not use this [system] in country.” Even though the CCS had considerable technical issues during the DMTE comments like, “The CCS was good, very realistic. Communicating with the actual elements created a real life situation. I see the training going far” give evidence of value added training.

All PTA tasks increased from stand-alone to DMTE. Level 2 tasks that provided some level of training but not adequately support in stand-alone became Level 3 tasks where the PTA is capable of supporting performance of the tasks sufficiently enough to allow satisfactory performance of the task.

Due to time constraints collecting detailed input from the SMEs was not possible. Although additional input would have been optimal, value added training characteristics are supported by the ratings. SME comments such as: “You can’t do Close Air Support if you’re not federated...the federation is amazing” and “The ideal situation is to have the program of record simulations (e.g., Full Mission Simulator) federated,” lend evidence to value added training.

² To request full report, results, qualitative assessments and analyses contact co-author Alex Arrieta.

In the DMTE the VBS3 (JTAC) device is capable of supporting operator performance of the task sufficiently (Level 3) in the case of 12 tasks. In the cases of Level 1 designations, the causes were, according to SME comments, “(It’s) not the real piece of equipment,” acknowledging the absence of a Laser Range Finder and Portable Laser Designator Rangefinder.

Three VBS3 (Ground) TTS Levels dropped but increases in other tasks equalizes the overall capability of the VBS3 (Ground) simulator. Respectively, in the standalone and DMTE, 16 and 14 tasks were evaluated for VBS3 (Ground) at TTS Level 3 and nine and 11 tasks at TTS Level 2. No tasks were rated at Level 1. This illustrates that in both the standalone and DMTE the VBS3 (Ground) simulators were capable of supporting training for all evaluated tasks.

LESSONS LEARNED

First, the most important and valuable, and most immediately applicable lesson learned alleviates a major concern: the linking of classified to non-classified simulators in an LVC-TE or DMTE. The takeaway is this: LVC-TE or DMTE can achieve interoperability between classified and unclassified platforms without compromising protocol. The integration of data packages from one simulator to another, and the manner in which it was made possible, leads to the conclusion that classified data packages can be maintained within the classified configuration without dissemination to non-classified configurations. Thus it is possible for an LVC-TE or DMTE that incorporates classified information or data to not breach protocol.

Second, VBS3 was demonstrated to be a potential single engine to drive multiple simulation platforms using a plug and play concept. A single engine solution surpassed the usage of a single DIS database in the population of completely accurate and correct avatars, physics, and all other enumerations with no additional man hours devoted to de-conflicting database errors. Although current simulations can be better federated by fixing the DIS version control issues, complete accuracy of enumeration in the future must be achieved by using means such as a scalable single graphics engine.

Third, although all of the simulations that were federated used the DIS enumeration table, the standard for the coded definition of avatars, weapons, and physical effects, each of the systems used different versions. If a folder containing the raw data for Database, Models and Enumerations had been available from the beginning it would have drastically cut down on the man hours. For example, 12 avatars multiplied by three simulation engineers and further by eight conversion hours = 288 man hours. VBS3, Scalable Advanced Graphics Engine and Prepar3D have thousands of models; instead of trying to find out which model matched between the systems the effort could have pulled a dozen raw models and had each simulator integrate them. As the scenarios were not known until the week of the event matching models could not be done prior.

Finally, demonstration of value added training was clear. Although the primary training audience for the assessment was the infantry on VBS3 value added training was achieved through the DMTE and experienced by the other participants as well. The DMTE allowed all units to interact with others from the actual supporting agencies. Because of the high level of interaction between elements in support of the Ground Combat Element (GCE), the realistic communication increased the attentiveness and cohesiveness of the training audience. DMTE participants gave feedback and self-assessments that support the supposition of value added training.

MOVING FORWARD

This DMTE leads the way for the following two phases. The objective of Phase II *Capabilities Expansion*: is to improve training effectiveness by fully integrating the Virtual and Constructive environments. This will be done based on recommendations and lessons learned during this DMTE and accompanied by technology upgrades and systems improvements to the current portfolio. The focus of Phase III *Capabilities Integration* is on resolving “fair fight” issues, increasing interoperability of the Live portion of the LVC-TE and improving the distributed training network to expand across the MAGTF, Joint services and Coalition partners.

CONCLUSION

This DMTE showed that existing simulations, employing both non-classified and classified data, have the ability to interconnect given the proper infrastructure. It also provided insight into the federation methods used by the private

industry companies that produce the simulations for more effective and stable federation. Mapping of entities between systems create unique challenges; multiple unit entities and multiple munition types must capably bridge the network. This DMTE allowed three different domains (Forward Observer, Quick Reaction Force, and infantry ground maneuver force) to integrate across distributed systems to support each other's collective tasks with training systems originally designed to support individual MOS tasks.

The analysis processes used to determine if value added training was achieved provided illustration of the function of tasks that require the capabilities of simulators or training systems to interact. During this DMTE, because of its unique technical requirements and innovative solutions, gaps were exposed, but these did not, however, impede or diminish the value added training, merely demonstrated the importance of cutting-edge technical affordances keeping pace with training objectives. Interoperability of the systems was achieved under less-than-desired conditions but value added training was still delivered because of the opportunity to exercise inter-competency, realistic collective tasks.

The DMTE START also validated the potential of synergistic training with a replicable, systematic process and showed that by linking different simulators together the term "the whole is greater than the sum of its parts" is defined. The value of training using the simulators apart is exceeded by the value added training delivered when using them together. T&R events addressed by a single simulator, for example CCS, fall within the, this-is-what-you-do and this-is-how-you-do-it (declarative and procedural) levels of learning. However, when simulators with differing training objectives are linked, for example CCS with VBS3, three conditions are supported that produce value added training. First, because multiple MOSs are working together in a shared environment, the increase in fidelity furthers the "train as you fight" doctrine. Second, integration of procedures and skills across MOSs identifies gaps for mitigation and areas of opportunity for optimization. Third, the nexus of procedures and skills in high-fidelity experiential conditions requires a level of training that exercises higher-order thinking and decision making abilities (application, conceptual understanding and rule integration) as the cognitive complexity increases. In short, with higher level value added training comes higher level Warfighter lethality and survivability.

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