

Enhanced Training for a 21st-Century Military

A convergence of new technologies and advanced learning techniques will help the military meet its growing training requirements, despite budget constraints



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Executive Summary

Military Live, Virtual and Constructive (LVC) training is poised for a transformational shift that will significantly improve training effectiveness while reducing its costs. This shift is driven by a combination of new technologies and emerging trends in learning, including the widespread use of social media, Service-Oriented Architecture (SOA), cloud computing, data analytics, and ever increasing improvements in gaming and simulation technologies. These converging forces will enable greater use of integrated LVC solutions in training exercises, greater flexibility in adapting systems to new threats and requirements, and an increased ability to tailor training programs to the specific needs of military personnel wherever they are stationed.

Many of these technologies and learning trends are familiar to people in the military training community, who have already begun incorporating elements into training programs and systems. But with the services facing constrained budgets, rising costs for live training, and increased demands for training resources at home stations, the need for more efficient and effective training is growing urgent. This paper examines how the services can capitalize on the new technologies and learning environment to strengthen LVC training and meet their training requirements.

The Training Challenge

The military services face multiple challenges in meeting the high levels of training required for operational excellence and mission success. Over the next several years, the Department of Defense is slated for deep funding cuts that will certainly constrain training budgets. Unfortunately, these cuts are coming just as demands on home-station training resources are set to rise. The troops being withdrawn from Iraq, Afghanistan, and other overseas locations will require training to remain combat proficient in today's operational environment after they return

home. In addition, today's warfighters must train across all warfare phases for a variety of diverse missions, including counter-terrorism, asymmetric threats, traditional threats, reconstruction, and humanitarian assistance missions, each requiring its own set of competencies. Similarly, the services must train for operations with multiple partners and allies, including the other services in joint operations. However, the opportunities to conduct live training, particularly large-scale live exercises, are dwindling due to such factors as the high costs of fuel and ammunition, environmental constraints at training ranges, and the need to minimize the wear and tear on weapons platforms and equipment, which have been stressed by repeated deployments. The rapid rate of technological advancements in recent years, which is often accompanied by changes in doctrine and tactics, has also made it difficult for training systems and programs to keep pace. A new training system can become obsolete almost before it is built and fielded for use.

The services are addressing these issues through a variety of new programs and approaches, such as improving integration of LVC solutions and adopting new training methods. These efforts will help streamline and improve training, and provide the services with more flexibility to train for diverse missions. However, new technological developments now offer the services even greater opportunities to tailor training for the specific needs of individuals and units, and scale training to larger numbers of distributed training participants—quickly and at low costs. This enhanced training environment combines:

- New Approaches to Learning
- Flexible Training Systems Design
- Improved Training Feedback from Advanced Analytics
- Tailored Training Programs

Enhanced training does not require the services to embark on radically new programs but rather to build on current training investments with proven learning techniques and technologies.

New Approaches to Learning

Over the past decade, digital technologies and social media have transformed how people learn, including where they go to gain knowledge and skills. The essence of these changes is captured in the book, “A New Culture of Learning: Cultivating the Imagination for a World of Constant Change,” which describes a new style of learning characterized by self-discovery and creative, collaborative interaction among teachers and students.¹ In contrast to the traditional style of learning with a stable classroom environment, a single teacher, and a standardized set of lessons, the new culture of learning features constantly changing lessons and a variety of teachers, instructors, and classroom settings.

The new models for training embraced by the services reflect the new culture of learning in our broader society, where learning has become dynamic, interactive, and continuous.

In this dynamic environment, students learn from peers and mentors, and use their imaginations to seek out information from multiple sources. Students use social media, mobile devices, and other electronic avenues to broaden their reach into the connected world, accessing information and experts who can provide them with the knowledge and insight they need, often to address specific questions and problems. Students are not only active and engaged participants in their own learning, but they often contribute to the “collective wisdom” and an ever-increasing body of knowledge.

We are seeing this same cultural shift in military education and training. For example, the Army recently launched the “U.S. Army Learning Concept



for 2015,” a new learning model that Army leaders said will shift training from an instructor-centric to a learner-centric paradigm, providing soldiers with more relevant, tailored, and engaging learning experiences that can be accessed wherever they are needed.² The Air Force has emphasized similar training principles. “From their first day in the Air Force, Airmen will have unprecedented access to knowledge delivered via the internet to hand-held, mobile devices and organized by advanced knowledge management systems,” according to an Air Force white paper on training. “Instructional systems will allow students to increase the utility of the network by adding information and ideas that can be utilized by instructors. Reverse mentorship may become possible and real-time changes to tactics, techniques, and procedures will become both necessary and commonplace.”³ The new models for training embraced by the services reflect the new culture of learning in our broader society, where learning has become dynamic, interactive, and continuous.

Flexible Training Systems Design

The services are also improving training by combining separate Live, Virtual, and Constructive training systems in single events that create a realistic training experience while minimizing costs. Advances

¹ Douglas Thomas and John Seely Brown (2011).

² “U.S. Army launches Army Learning Concept 2015,” June 28, 2011, at www.army.mil.

³ “On Learning: The Future of Air Force Education and Training,” Air Education and Training Command, January 30, 2008, p. 14.



in simulation, gaming and other technologies have increased significantly the value of integrated LVC exercises, both large-scale events and smaller, every-day training activities that may combine only virtual and constructive systems. However, complete interoperability among systems is difficult to achieve; as a result, the capabilities of individual Live, Virtual, and Constructive systems are often diminished when they are integrated for a training event because not all functions or information are effectively transmitted. To address this problem, each of the services has launched programs to improve LVC integration, including the Army's LVC-Integrating Architecture (LVC-IA), the Air Force's Enterprise Architecture for LVC Environment (EA-LVCE), and the Navy's Integrated Live-Virtual-Constructive (LVC) Architecture. These programs are creating middleware that collects and exchanges data among live instrumentation, virtual simulators, constructive simulations, and joint and service command and control systems. This requires the creation of an architecture that provides for common protocols, specifications, standards and interfaces to help standardize common LVC components and tools for interoperable LVC components. Among the common LVC components and tools that can be standardized and made reusable are enterprise after-action reporting, adaptors for command and control/

intelligence, surveillance and reconnaissance systems, terrain databases, and security requirements. The ability to integrate across the LVC spectrum more effectively will enable the services to create a more operationally-realistic environment while relying less on costly live training exercises.

These programs integrating LVC are an important step—but only the *first* step—to creating more flexible training system designs, because the middleware will enhance only the simulators and ranges that are encompassed within these programs. As training needs change over time, additional training aids and devices will also need to be integrated into the LVC environment. However, using middleware to translate between systems will create increasingly complex integration challenges as each new device or system is added. To achieve even more flexibility in adapting LVC solutions and training to changing requirements, the services should build on LVC integration with Service-Oriented Architecture (SOA).

SOA is a set of principles for designing common functionalities within multiple systems as interoperable services. Each of these services is built to a common architectural standard, which allows them to be modified or upgraded to meet new performance requirements. Incorporating SOA into the design of



LVC components would enable LVC solutions to share common services, such as environmental services and databases (containing elements such as the terrain, sea, air, social infrastructure); user interfaces; simulation engines; translators (or adaptors) for Command, Control, Communications, Computers, and Intelligence (C4I) systems, battle command systems, other simulators, combat platforms, radios, etc.; network communications; data collection, storage and analysis; and report generation. This commonality



among reusable components could be built across a limitless number of LVC solutions to significantly increase flexibility in delivering robust, meaningful training. LVC components could be modified or updated quickly—for example, to reflect new tactics, emerging threats, or improved representation of terrain—without having to build entirely new systems.

A shift to cloud computing and Simulation as a Service (SaaS) would enhance this flexibility by enabling the services to scale training programs—that is, adjust the number of training participants and training devices—at much lower costs than is currently possible. With cloud computing, simulation applications would be services that reside within the data center of the cloud host. When the applications are needed for a training exercise, all of the necessary computing devices could be quickly provisioned via a network connection. Consequently, there would be no need to purchase or individually provision numerous computing devices for exercises that are held only once or twice a year, saving hardware and provisioning costs. Regional simulation centers could be created to consolidate SaaS delivery, further reducing the redundant expenditures of decentralized training delivery. In addition, cloud computing and virtualization technologies would allow personnel to access

simulation applications and other training software from many different locations through just about any kind of device, expanding mobile and e-learning while saving on travel costs. As an example, one Defense organization created costs savings of an estimated 12 percent to as much as 50 percent over five years by migrating its training environment to a private cloud.

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These efforts will present technical, policy, and governance challenges, such as reducing latency, standardizing architectures, ensuring security, and managing information sharing at multiple classification levels. Nevertheless, the benefits of SOA and cloud computing are compelling, particularly as budget constraints force the services to look for ways to reduce training costs without compromising readiness. Consequently, the Army Program Executive Office for Simulation, Training and Instrumentation (PEO-STRI) has already begun examining how virtualization and cloud technologies might be used to enable large, distributed exercises in which the service could download training scenarios and events, rather than having to ship the training equipment to the event locations. SOA and cloud computing will enhance not only large training events but also smaller, low-overhead exercises and programs, where the majority of training is conducted. This would significantly increase the Army's ability to deliver training to large groups participating remotely at their home stations, saving enormously on travel costs and providing greater flexibility and efficiency in training.

Improved Training Feedback from Advanced Analytics

Advanced analytics provide the services with an opportunity to conduct powerful analysis of training data to improve after-action reporting and create more



efficient training packages specifically targeted to the individual warfighter's needs. Training participants and systems today are wired (or instrumented) to gather performance data. Of course, the services are already gathering training data to both guide tactics and improve training. But modern analytical techniques offer more rigorous analyses that go deep into the data to uncover meaningful insights into the training experience—for both individuals and larger groups. For example, the application of measurement and analytics capabilities would allow the services to create more personalized training through “Reality Mining” of LVC performance data, which would enable them to determine the types of learning (including content, delivery and overall environment) that are most effective for different types of people. With these analyses, the services could shift learning from high-cost to lower-cost approaches that prove to be equally effective for a person or group of people. Similarly, the analyses would enable the services to eliminate learning and training techniques that are not adding value for specific types of personnel or missions. One US government organization assisted by Booz Allen used predictive modeling to identify “Classes of Excellence,” enabling the organization to shift resources from low performing to more efficient training programs.



Tailored Training Programs

Each of these three converging elements—the new approaches to learning; new technologies that support a more flexible design of LVC solutions; and data analytics that strengthen the lessons learned from training exercises—enhances the services’ ability to tailor training packages and exercises to the specific needs of their personnel. For example, the services can install SOA-based environment packages into LVC solutions to match the terrain at a location where a particular division may soon be deployed; or they can conduct training exercises geared to the specific level of expertise or learning preferences of the personnel being trained. Tailored training programs will significantly expand the number (or types) of training experiences for military personnel, putting users and user requirements at the center of the training experience. Combined with cloud computing, this flexibility will make tailored training and education available to personnel stationed throughout the world—at the home station, in a training center, in an aircraft, ship or vehicle, and on a desktop or mobile device.

We are already seeing how innovative training solutions can enable the services to sharpen and tailor training to address specific requirement. For example:

The Air Force Air National Guard Distributed Training Operations Center (DTOC).

Booz Allen developed for DTOC a low-cost, reliable capability that connects constructive mission training scenarios with advanced simulators, simulations, and real-world systems that are networked together to form a distributed synthetic battlespace. With this capability, DTOC can create tactical-level distributed mission operations (DMO) training events that are tailored to the specific needs of Air Force units stationed throughout the world. Pilots and aircrew using virtual simulators to train on Air Force aircraft can plug into DTOC’s constructive environment—which can simulate any terrain—to practice missions in Afghanistan, Iraq, and other places.

For example, A-10 aircraft pilots preparing for deployment to Afghanistan can fly simulated missions over the same geography they will encounter in the field, while also being guided or coached in their simulated flights by pilots who previously flew the same missions in those precise locations. Simulators for training on other Air Force aircraft, including the F-16, E-3, and B-1, also take advantage of DTOC’s constructive environment. Not only does this reduce costs and minimize wear and tear on aircraft, but it also provides a much safer environment to practice difficult maneuvers. The development of the low-cost



capability has enabled DTOC to increase the number of DMO training events from four to six events each week to 10 to 15 events each day.

Army Forces Command (FORSCOM). FORSCOM was running out of physical space for many live training exercises and wanted to use more simulation, particularly for Fire Support Mission Training and Collective Training with Anti-Tank Missile systems. Because the Virtual Battlespace 2 (VBS2) Battlefield Simulation System already had a large following within the Army, Booz Allen integrated the VBS2 gaming system with the TOW Anti-Tank Missile Trainer using middleware developed by the Army Aviation and Missile Research Development and Engineering Center. In addition, we integrated VBS2 with the Javelin Basic Skills Trainer using middleware developed by an original equipment manufacturer. Not only was VBS2 highly interoperable with these simulators, but it also accurately represented the terrain, communications, and fire effects, including fragmentation, property damage, explosive waves, and collateral damage, of a live range.

Integrating VBS2 with other simulators provided FORSCOM with greater flexibility and efficiency in training Army units. For example, soldiers can now train for the full spectrum of operations and dress

rehearsals before going to a live range. Moreover, incorporating VBS2 in simulators enabled FORSCOM to leverage its investments in simulators by providing low-cost, realistic, and easily customized software for use in the simulators.

Naval Education and Training Security Assistance and Field Activity (NETSAFA). Charged with training international military personnel, NETSAFA takes advantage of social media to facilitate communication with its students after they return to their home countries. For NETSAFA's courses on International Anti-Terrorism and Piracy and International Professional Enlisted Leadership, which thus far have attracted students from 14 nations, NETSAFA has established a Facebook page that instructors use to push new information and instructions to students, and that students use to provide feedback and ask questions about what they learned. In addition, NETSAFA gives each of the students a NOOK e-reader that not only has course material but also provides students with access to Facebook.



Next Steps

The chief obstacles to implementing innovative training solutions are primarily cultural rather than technical. This is not unexpected. Major program changes often encounter questions and resistance in the private sector as well as among civilian and military agencies. In addition, virtual and constructive training is still viewed skeptically by many in the military; they recognize that it is less costly than live training, but they are not persuaded that it is sufficiently effective. Similarly, gaming software is often dismissed as being subpar and of a different class than simulation or virtual technologies. Nevertheless, resistance is receding in the face of observable successes. For example, the Air Force has reduced the number of required live training flights for E-3 Airborne Early Warning and Control System (AWACS) surveillance aircraft because DTOC's simulated flight training has proved extremely effective in teaching some of the required capabilities. And the Army is starting to recognize that gaming software is essentially the same as other virtual software and so should be judged by the same standard: How well does it help us achieve our training mission? Barriers will continue to fall, spurred on, no doubt, by fiscal concerns.

Moving forward, the military services can build on current programs and initiatives to generate additional training efficiencies by:

- **Migrating existing training systems** to SOA and cloud infrastructure. This will decrease current operating costs and avoid future costs for complex engineering to modernize and integrate Live, Virtual, and Constructive systems. The challenge will be managing the transition while some systems are modernized and others lag behind.
- **Shifting additional costs** from live training (on ranges or in instructor-led environments) to technology-enabled learning, such as virtual and gaming worlds, simulation-based training, and virtual instructor-led training. The services can maintain the effectiveness of technology-led training by incorporating the insights and techniques that characterize the new culture of learning.
- **Integrating Learning Management Systems** with all types of training systems (virtual environment, instrumented range, etc.) to measure learning performance across all methods of training (live, virtual, constructive, and gaming).
- **Using advanced analytics** to mine training performance data to systematically look for ways to accelerate learning and eliminate ineffective training delivery methods at the individual and team level.

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Conclusion

The US military services have at their disposal a wide range of highly sophisticated training technologies to enhance training effectiveness and efficiency, including new gaming technology, virtual worlds, learning management systems, continual evolution of virtual trainers, better instrumented ranges, and more capable constructive simulation. The challenge is leveraging these capabilities to create the best possible training and testing environment for geographically dispersed forces. The services can achieve this goal by embracing the new approaches to learning now emerging in the military and, simultaneously, aggressively adopting digital technologies that provide greater flexibility and scalability in training systems. Solutions such as SOA, cloud computing, and data analytics will enable the services to create flexible LVC solutions that can be updated with new information and capabilities to support dynamic, interactive learning. These converging forces provide a foundation for transforming LVC training and achieving the training efficiencies needed for the 21st-century military.

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The firm’s management consulting heritage is the basis for its unique collaborative culture and operating model, enabling Booz Allen to anticipate needs and opportunities, rapidly deploy talent and

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