Leading, Integrating, and Leveraging M&S for the Warfighter

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Refocused in 2000, the Department of Defense's modeling and simulation (M&S) efforts have gained direction and magnitude. The Defense Modeling and Simulation Office (DMSO) is leading the implementation of an ambitious set of goals to support the warfighter that has buy-in from the commanders in chief, the services, and the joint staff. The DMSO's bottom line: Lead, integrate and leverage M&S for the warfighter.

The Defense Modeling and Simulation Office (DMSO) is a Department of Defense (DoD) policy and standards office that does not build simulations or, as a rule, develop software. Through a process of collaboration and consensus, the DMSO develops policies, standards, and architectures that allow organizations to build interoperable models and simulations without telling the organizations how to build their products.

Since it was established in 1991 to provide a full-time focal point for DoD modeling and simulation (M&S) activities, the DMSO has been a leader in guiding the community away from the costly practice of building proprietary, *stovepipe* simulations. Until then simulations were not necessarily built to work or communicate with other simulations or systems, nor share or reuse components.

To encourage unity, the DMSO's Focus Call program funded selected M&S projects that could benefit the entire community. Though a step in the right direction, it did not have the desired impact. So in 1994 the DMSO implemented a top-down, strategy-driven investment program aimed at fostering interoperability and reuse through a common technical framework of standards and architectures, and also a set of DoD-provided common M&S services, including help desks, an education program, resource repositories, and supporting software and tools.

The DMSO works for the director, Defense Research and Engineering (DDR&E), in the office of the under secretary of Defense (USD) for Acquisition, Technology and Logistics (AT&L). The deputy DDR&E chairs the DoD Executive Council on Modeling and Simulation (EXCIMS), a general officer-level board of directors.

A New Vector of Direction and Magnitude

In March 2000, the EXCIMS asked the DMSO to look for opportunities to better serve the M&S community. Given the maturity of DoD M&S today and the speed at which technology is advancing, it was time for us to reexamine how we do business, and how we support the warfighter.

Our reexamination was a community effort that spanned several months. We could not have done it without the input of the services, and joint and DoD M&S organizations who are our partners in supporting the warfighter. The EXCIMS approved our plans in August 2000 for moving forward on our new vector. Since then it has evolved and gained direction and magnitude and we—the M&S community collectively—are enthusiastically implementing it.

The DMSO has been talking to the warfighting commanders in chief, and I think it is having a positive effect—they are telling us what they need, what we are doing that is helping, and what we are doing that has not added much value. One of the good things we are hearing from the warfighters, our service counterparts, and other DoD leaders and staffs is that they feel we are on the right track. All the comments above encompass feedback we need to be effective.

We used that feedback to build our plans and budget for fiscal year 2001. A vision emerged in reexamining our role that defines what we think we need to do. That vision is "to lead and integrate the DoD M&S community and leverage M&S science and technology (S&T) advances to ensure that the warfighters of today and tomorrow have superior and affordable M&S tools, products and capabilities to support their missions, and to give them revolutionary war-winning capabilities."

Put more simply, "to lead, integrate, and leverage M&S for the warfighter."

Col. Steve Collier, deputy director of the Army M&S office, said in a discussion leading to our new vector, "You don't know what you don't know, but sometimes you don't know what you *do* know either." Not having a handle on what we, as a community, do know can be expensive. The DoD cannot afford to have organizations investing unnecessarily in redundant capabilities. And the warfighter does not have the time or resources to look any farther into the future than his focus on near- and mid-term operations and planning.

There are things that the warfighter does not know he needs. Once he gets them, he will wonder how he lived without them. For example, in 1975 I did not know I needed a computer in my home. I paid my bills, balanced my checkbook, wrote letters, kept my calendar, played with my investments and did my taxes by hand on paper. Now I do not know what I would do without my computer to do all those things. If you took it away, it would mean a major readjustment for me.

That same thing is true for the warfighter. There are technologies percolating out there that have great potential. The DMSO is well suited to discovering them. We are the warfighter's eyes and ears across the spectrum of time for science and technology developments that have M&S potential—from the present to five or more years in the future. But we need to know what his M&S requirements are to guide our search.

We are task organized to do that, as well as to continue providing the M&S community with those DoD-furnished services and resources that are part of the common technical framework. There is a circular flow in the process of identifying near- (present to three years), mid- (three to five years), and long-term (beyond five years) requirements and finding the scientific and technological solutions for each time frame. The process is continuous. M&S capabilities identified and capitalized on in the mid- and long-term will eventually move into the near-term as time passes, and they reach maturity.

Warfighter experience with those once future, but now present, solutions will likely contribute to new mid- and long-term requirements. At the same time, the common services that the DMSO provides to the community overlap the three time frames. This continuity allows the collective M&S community to share information throughout the life cycle of a product or capability from concept to fielding.

The DMSO's Warfighter Requirements Division, which is responsible for Command, Control, Communications, Computers, and Intelligence (C4I)-to-simulation cognizance; joint activities and programs; service coordination; and verification, validation and accreditation focuses on M&S needs and efforts from the present to three years out.

The Enterprise Division—composed of current DMSO programs like data standards and functional descriptions of the mission space (previously conceptual models of the mission space), integrated natural environment, human behavior representation programs, and the high level architecture for simulation—focuses on M&S needs and efforts three to five years out.

The S&T Division concentrates on finding promising M&S tools, products, and capabilities that are on the drawing boards five or more years out.

The Concepts Application Division provides resources such as the M&S Information Analysis Center, the M&S Resource Repository (MSRR), the M&S education program, and proactive outreach programs that provide a conduit for the M&S community to share information throughout the life cycle of a tool, product, or capability from concept to fielding. The division also serves as the DMSO's liaison with the simulation-based acquisition community.

The DoD Approach to M&S

DoD M&S efforts are mainly focused in three functional areas—training, analysis and acquisition—with more and more attention being paid to experimentation. The EXCIMS oversees three subordinate functional area councils that respectively work function-specific issues with the services and DoD components. The DoD is developing major joint simulations to support users in each area—the Joint Simulation System for training, the Joint Warfare System for analysis, and the Joint M&S System for acquisition.

Training improves performance.
Military forces deployed worldwide in support of U.S. security interests are under increasing pressure to protect the environment, reduce cost, and increase safety. While our new weapons systems are becoming more complex and lethal, our range facilities and live training opportunities are diminishing. Increased use of simulations and simulators is essential to maintaining force readiness. Despite the fact the United States is at peace, the number of simulation-supported training events is steadily growing. Twenty-two simulation-driven joint training exercises were conducted last fiscal year. These exercises train combatant command, joint task force, and service component staffs, many of which participate in more than one exercise each year. It is cheaper, safer, and reduces environmental impact to move electrons, rather than troops, around the globe.

Analysis improves decision-making.
Analysis simulations are workhorses. We have used them for force structure analysis to work the force cap in Bosnia. We use them for course-of-action analysis for operations plan development in real-world actions like Kosovo, and war plans at the commander in chief (CINC) and component command level. We use them for analysis of alternatives in weapon system(s) and organizational development. And we use them for mobilization, deployment, logistics, and sustainment planning. Finally, we are looking at how we can use analysis simulations to support small-scale contingencies and operations other than war, like the de-mining effort in Bosnia-Herzegovenia and resettlement of displaced persons, refugees, and evacuees.

Acquisition improves system(s) design.
The DoD Simulation-Based Acquisition program promotes the use of simulations throughout the life cycle of every weapon system and among all weapon system development programs. There are tremendous time and dollar savings to be had, and perhaps zero environmental impact and safety worries if we can wring out systems and certify their performance using M&S before we ever bend metal in production. The Army's Crusader, a revolutionary cannon artillery system of systems, is using more than 150 simulations. None of them were developed specifically for Crusader, which is an excellent example of how simulation reuse can save time and reduce costs. The program's integrated data environment, which makes extensive use of simulations, allowed the Crusader team to re-baseline the system in a matter of weeks when they had to trim more than 40 percent of its weight in order to preserve its role in the Army's future lighter force structure.

Experimentation helps us explore, develop concepts.
The U.S. Joint Forces Command (JFCOM) was formed in October 1999 with a charter to conduct joint experimentation. This experimentation will help put meat on the bones of the concepts outlined in the joint chiefs' of staff far-looking Joint Vision (JV) 2010, and more recent JV 2020. The Air Force's Joint Expeditionary Force Experiment (JEFX) in September 2000 was its third annual large-scale experiment combining live aircraft, M&S, and technology insertion to explore and evaluate new processes in the development of operational concepts and doctrine for the new Air Expeditionary Forces. Air Force Col. Kevin Dunleavy, JEFX 2000 director, summed it up well when he said, "[Air Force experimentation] provides a means to assess new technologies and operational concepts, allows warfighter involvement early in the acquisition process, and produces better informed investment decisions." JEFX 2000 served as the Air Force portion of Millennium Challenge 2000, the JFCOM's first major joint experiment.

International Activities

U.S. warfighters have to be able to operate in multinational coalitions as well as jointly. So it behooves us to work with our allies to make our M&S systems interoperable. As world events become more complicated, it is essential that we work and train together without the necessity of actually being in the same location—moving troops and materiel costs money; training and mainte-

nance monies often compete with real-world operations costs.

The DMSO helped NATO produce an M&S Master Plan (MSMP) for the alliance. We helped to establish a DMSO-equivalent NATO M&S group and a subordinate M&S Coordination Office to work on alliance M&S issues. NATO has adopted the high level architecture (HLA) as its simulation architecture, and we have assisted in a number of demonstrations and exercises for further understanding of the standard. We also assisted in the development of a NATO M&S education course for staff officers.

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The DMSO has provided M&S education, training, and technical exchanges with our defense counterparts in Australia and Korea. Our foreign outreach efforts include participation in simulation and training conferences in Europe, Australia, and South Korea, where we have had the opportunity to inform military and industry representatives about our programs.

Where Are We Headed in 2001?

Our fiscal year 2001 program was developed with feedback from the CINCs, the services, and the joint staff. It was approved by the EXCIMS. Here is our program for fiscal 2001:

- **Begin HLA technology transition.** The HLA is a general-purpose architecture for simulation. It is the cornerstone of the common technical framework. It supports reuse and interoperability across the large numbers of different types of simulations developed and maintained by the DoD. Besides being the DoD, and now NATO, standard, it has been accepted by the Object Management Group, an international standards organization. In September 2000, it was accepted by another international standards organization, the Institute of Electronic and Electrical Engineers (IEEE). We have begun to transition the HLA to a sustainment phase in 2001. Reducing HLA support costs allows the DMSO to redirect dollars to other activities. We continue to do bug fixes (and performance enhancement as required) types of support, but we are not developing any new tools. However, we still have some work to do to ensure the DoD M&S community's needs are met now that the HLA is an IEEE standard.
- **Improve M&S service to the warfighter.** The M&S needs and priorities of every warfighting CINC have been incorporated into a Web-based, interactive database with keyword search capability. If someone in the Pacific Command wants to know about verification, validation, and authentication (VV&A), the search turns up VV&A efforts across the M&S community. Unlike the MSRR, which is more content or product oriented, this database is requirements based. Having the CINCs' prioritized requirements will be a big help as we revise the DoD M&S Master Plan[1] (MSMP) in 2001.
- **Expand the S&T Initiatives Program.** Thirteen S&T projects were selected and funded in fiscal year 2000 by the DMSO and the service and joint M&S offices. At press time the prospects for fiscal 2001 look even better. We received submissions from more than 50 academic, industry, and government organizations in response to our request for

information on advanced M&S technologies. We used that information to lay out the fiscal 2001 M&S S&T Initiatives Program and issue a request for proposals in October 2000.

- **Address challenges and coordinate Integration Task Force (ITF) results.** One of our tasks from the EXCIMS is to develop an integrated M&S strategy for the DoD. Because part of determining what needs to be done is knowing what we have and have not accomplished, we are also assessing how successful we have been at meeting the objectives prescribed in the current DoD MSMP (published in 1995). This task, which falls to an Integration Task Force composed of DMSO, DoD, joint, and service representatives, will provide the foundation for the MSMP revision.
- **Continue investments based upon warfighter needs, ITF results, and S&T initiatives.** One of the things we hear about from CINCs is the void in simulation support for operations other than war. We are already looking at how we can support this requirement in 2001. We are also looking at federating joint simulation systems (JSIMS) and joint warfare simulations (JWARS) to enable CINCs to use JWARS as a course-of-analysis tool with real-world data piped through JSIMS C4I interfaces. The S&T division will look at next-generation simulations that are agent-based vice algorithmic. Agent-based simulations use environment to constrain behavior whereas algorithms do that job in our current simulations.
- **Continue to upgrade M&S education, and mature service academy education partnerships.** We recognize the need to start laying a foundation of M&S knowledge in the officer corps at the earliest opportunity and are working with the services and respective academies to promote M&S education in each school. In 2001 we will implement an M&S intern program for cadets; present a number of M&S courses at all three academies; take a look at how we can sponsor visiting M&S professors at each academy; and lastly, expand the over all effort to the services' ROTC programs in fiscal 2002.

Future Challenges

Looking beyond 2001 I think limited resources and keeping up with technology are two challenges that will continue. But I do not think they will thwart our continued use of an entrenched, value-added tool like M&S.

M&S is a combat multiplier. Our use of it is only going to increase. Our U.S. leaders know the value of M&S in maintaining readiness, and their support is evident in the continued funding provided for programs across the DoD components and for big-ticket systems like JSIMS. Further, as stewards of the taxpayer's dollars; the military will always be driven by the need to find a cheaper, better, safer, and environmentally sounder way of doing things. M&S lets us do that.

Rapid technological advances figure heavily in the challenges facing the warfighter. The array of issues facing our forces continues to expand while the time they have to prepare and respond is shrinking. Information availability for both sides of a conflict is increasing exponentially. The common denominator in all of this

is human capacity.

The gap between what we can do and what we have to do is widening. We cannot wait for the latest and greatest technology to emerge before we start building our M&S tools. The warfighter will go to war with the training and equipment he has now, not what is on the drawing board. We have to put a stake in the ground and start building, incorporating newer and improved technology as resources and time permit.

As the DMSO implements its vision in 2001 and beyond, we hope not only to anticipate selected technology leaps, but also to shorten the maturation time of M&S technologies so the DoD can incorporate them into planning and acquisition cycles for current or future programs.

Your Feedback

I invite CROSSTALK readers to visit our Web site at www.dmso.mil for more information about our programs and progress to date. The warfighters' return on investment in our efforts will be measured in how well we pursue our goals and implement our programs. If you have comments or an idea that will help us better serve the warfighter let us know. Contact information and the DMSO staff's e-mail addresses are available on our Web site. If you do not know whom to contact, send a note to ask@dmso.mil —we will sort it out and get back to you. Give us your input.◆

Note

1. Department of Defense, DoD 5000.59-P, *Modeling and Simulation (M&S) Master Plan*, October 1995.

Additional Reading

Department of Defense Directive 5000.59, Subject: DoD Modeling and Simulation (M&S) Management, January 4, 1994.

Department of Defense, DoD 5000.59-M, DoD Modeling and Simulation (M&S) Glossary, January 1998.

About the Author

Colonel Wm. Forrest Crain assumed directorship of the Defense Modeling and Simulation Office in March 2000. He received his commission from the United States Military Academy in 1975. He is currently pursuing a doctorate in information technology at George Mason University. He has served in a variety of combat arms positions throughout his career. Before joining the DMSO he served as chief of Strategic Plans for the Multi National Division (North) in Bosnia.

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Coming Events

February 7-9
Network and Distributed System Security Symposium
www.isoc.org/ndss01/call-for-papers.html

February 12-16
Software Management Conference
www.sqe.com/sm

February 12-16
Applications of Software Measurement Conference
www.sqe.com/asm

March 5-8
Software Testing Analysis and Review
www.sqe.com/stareast

March 5-8
Mensch and Computer 2001
http://mc2001.informatik.uni-hamburg.de

March 12-15
Software Engineering Process Group Conference
www.sei.cmu.edu/products/events/sepg

March 31-April 5
Conference on Human Factors in Computing Systems
www.acm.org/sigs/sigchi/chi2001

April 22-26
Twentieth Annual Joint Conference of the IEEE Computer and Communications Societies
www.ieee-infocom.org/2001

April 29-May 3
Software Technology Conference (STC 2001)
www.stc-online.org

May 1-3
2001 IEEE Radar Conference
www.atlaessgrss.org/radarcon2001

May 12-19
23rd International Conference on Software Engineering, and *International Workshop on Program Comprehension*
www.csr.uvic.ca/icse2001

June 11-13
E-Business Quality Applications Conference
http://qaiusa.com/conferences/june2001/index.html

June 18-22
ACM/IEEE Design Automation Conference
www.dac.com

June 25-27
2001 American Control Conference
www.ece.cmu.edu/~acc2001

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