Proceedings of the 1998 Winter Simulation Conference
D.J. Medeiros, E.F. Watson, J.S. Carson and M.S. Manivannan, eds.

PANEL: THE FUTURE OF MILITARY SIMULATION

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ABSTRACT

The U.S. Department of Defense (DoD) has a large investment in modeling and simulation (M&S). There are several ways to categorize M&S including engineering models, analysis models and training models. Tremendous savings in manpower and financial resources are realized through the use of M&S. There are a tremendous number of challenges and opportunities that confront and confound those in positions to make decisions relative to where to invest the time and money to support current M&S, and future development. Herein we present a panel of knowledgeable individuals who are filling those decision-making roles. We hope they will provide us some insight into this morass of algorithms and requirements.

1 INTRODUCTION

Modeling and simulation (M&S) within and outside the DoD has take on a life of its own. Semi-automated forces, the virtual battlefield and star wars could not have come into being without some level of M&S. The importance of this area in analysis, training and systems evaluation is immense. Of equal immensity is the challenge of creating systems that can efficiently exchange data (where that makes sense), and to manage budgets to minimize duplicate efforts. In the past individual services and agencies allocated resources to create independent, "stovepipe," stand-alone simulations. Today's environment requires a much greater degree of coordination and commonality than ever before. The members of this panel are well aware of the development and integration problems with military M&S, from the operational to the political levels. They will try to provide you with background on the issues and present what they see as the future for M&S within the DoD.

2 POSED QUESTIONS

Question 1
Briefly describe your background in M&S, and the depth and breadth of M&S with which you and your organization are engaged.

Question 2
What do you perceive as the goals and objectives of your involvement in M&S? E.g. Who are your sponsors and your clients, and what are their requirements.

Question 3
Do you plan to incorporate the HLA into your M&S strategies? If yes, how and if no, why not.

Question 4
What major problems do you see in the current state of M&S development and use?

Question 5
What are today's major M&S opportunities and challenges?

3 RESPONSES TO THE QUESTIONS

3.1 Response of Dr. Michael R. Macedonia

Question 1
A graduate of West Point, Dr. Macedonia served as an infantry officer in a number of United States and overseas assignments. During Desert Storm he was a member of Operation Proven Force supporting Electronic Warfare operations. Following his military service, Macedonia became the Vice-president of the non-profit Fraunhofer Center for Research in Computer Graphics, Inc. (CRCG) in Providence, Rhode Island. Macedonia then joined the Institute for Defense Analyses in Alexandria, Virginia.

Macedonia is the author of numerous publications and has worked extensively with the networking and computer graphics communities. He is the co-editor of Projects in VR for IEEE Computer Graphics. He also contributed to the National Academy of Sciences report entitled "Virtual Reality: Scientific and Technological Challenges," detailing the further networking and communications research needed to continue the development of virtual reality systems.

As the Chief Scientist and Technical Director for the US Army's Simulation, Training, and Instrumentation Command (STRICOM), Macedonia is responsible for the technology strategy that provides the full spectrum of commercial and defense technology support for an $800 Million per year enterprise with over 200 products. He also provides outreach to the civilian research and development community to identify and integrate new technology such as commercial software, tools and communications protocols into STRICOM's technical strategy.

Question 2
STRICOM develops and maintains affordable M&S products that support both the modernization and readiness of U.S. forces. Our ultimate goal is to ensure that the best soldiers in the world are the best trained. STRICOM provides over 200 products relating to training and instrumentation to the U.S. Army.

I develop science and technology strategic strategy. Furthermore, I am in charge of outreach to the civilian research and development community to identify and integrate new technology such as commercial software, tools and protocols into STRICOM's technical strategy.

Question 3
HLA is being incorporated into all our major simulation products to include WARSIM, OneSAF, and the Close Combat Tactical Training.

Question 4
The M&S community faces rising expectations from our customers who are exposed to commercial entertainment simulations such as Armored Fist and Longbow Apache. Our simulation technology will become obsolete while commercial games take advantage of Moore's Law and the rapid advance of the World Wide Web, graphics, and computer science. We need:

1. to understand that M&S will be an essential element for training, analysis, planning and research in all aspects of business, government, and the military as problems become more complex;

2. the ability to exploit commercial as well as military standards and eliminate the proprietary aspects of legacy systems;

3. to develop standard products that can evolve with the advance of technology;

4. to provide the same quality look and feel as commercial software;

5. to take advantage of the WWW to build communities of users ; and

6. to look globally for solutions – M&S is not just an U.S. phenomena.

At STRICOM, we are trying to emulate the commercial software world. STRICOM is in the midst of the information revolution. 80% of our development costs involve software. Moreover, we are very aware that we must deliver reliable, affordable, and relevant products that can be used by the widest possible customer base and not a patchwork of one-time prototypes. We are

1. establishing close customer relationships (e.g. we have LNO's at Ft Hood, and another at the National Simulation Center (NSC). The NSC also has representatives located at the WARSIM contractor facility in Orlando as well as at Ft. Hood.);

2. building for a mass market by using standard commercial technology where possible (Windows NT, Pentium II PC's and Sun UNIX Servers) and innovating with Java, VRML, and the World-Wide Web;
3. incorporating the best commercial practices such as programming languages and tools. WARSIM is in C++. Our SNE development tools are now being developed in C++. We also will likely provide Java interfaces to explore new uses and capabilities for WARSIM;

4. building our base of talent. For example, we are training a new breed of simulation software engineer through our collaboration with the University of Central Florida and we are bringing on-board more staff with industry software development backgrounds who understand the customer;

5. building a value-chain. SEDRIS and our policies on SNE will enable future products for such efforts as SBA and reduce our costs

6. expanding our R&D program to minimize competitive surprises and slip-stream new capabilities when mature and warranted;

7. innovating logistics through the use of a government-owned, contractor-supported system. The government will own necessary hardware, have all proprietary rights to the developmental hardware and software components, and full license rights to the non-developmental software components of WARSIM. Contracted logistical support will provide for the full gamut of maintenance of government-owned computer hardware and software; and

8. bringing best-value to the customers -- the soldiers and officers that we depend on to keep coming back for more.

Question 5
By applying the right structure, doctrine, and methodology to simulations and simulators, the second training revolution will provide commanders with choices and opportunities that they do not currently have. It will take the Army to a new level of combat proficiency, another quantum leap forward in warfighting capability. For additional insight, refer to BG James M. Dubik, USA, Director of Training, DCSOPS in Armed Forces Journal, December 1997

The STRICOM WARSIM program is an example of the challenges and promises of the 2nd Training Revolution. WARSIM will replicate the functional representations of the legacy systems (Corps Battle Simulation (CBS), Brigade/Battalion Battle Simulation (BBS), Battle Command Training Program (BCTP) Intelligence Collection Model (BICM), Tactical Simulation (TACSIM), and Combat Service Support Training Simulation System (CSSTSS).

Fielding of new capabilities, whether they be functional representations or technological enhancements, will be either practically transparent to the user or be accompanied by training, so the user can understand and receive the benefit of the new capabilities.

The acquisition strategy allows for regular user involvement in the development process. User evaluations and requirements will serve as a primary source for identifying changes to the system.

Another key reason for close user involvement is the rapid modernization of the Army command and control technology and subsequent changes in doctrine and organization. Moreover, the primary interface to the training audience for WARSIM is the Army Battlefield Command and Control System (ABCS). This is a dramatic departure from previous constructive simulations. Therefore, this demands that WARSIM must work closely with PEO C3S to enable a transparent interface between the simulation and the C4I systems.

Finally, WARSIM, as the Land component to JSIMS, is dependent on JSIMS and the other service components to deliver key technology and models to provide a common simulation environment. This is a major milestone in joint program development and for constructive simulation. However, it requires close collaboration among numerous contractor and Department of Defense teams.

3.2 Response of Dr. Jim Metzger

Question 1
Jim Metzger has been involved directly in M&S development and application since 1975, initially in simulating individual weapon systems and later in simulating force-on-force combat. The OSD Office of the Director, Program Analysis and Evaluation, which is responsible for developing the Joint Warfare System (JWARS), itself applies M&S in force structure and weapon system effectiveness analyses.

Question 2
The mission of the JWARS Office is to develop a state-of-the-art, closed-form simulation of joint, campaign-level warfare for analysis. It must represent uniquely joint functions and processes, and Services' warfare operations; be based on joint doctrine; and be capable of representing future warfare. It must support four types of applications: planning and execution, force assessment, system effectiveness and trade off analysis, and concept and doctrine development and assessment. Users will include the Joint Staff, Services, CINCs, OSD, Joint Task Forces, other DoD organizations, and industry. Requirements have been developed by a Requirements Integrated Product Team with members representing the future users.

Question 3
JWARS is being designed to be HLA compliant. The JWARS Office will demonstrate compliance. Currently the Office is coordinating with the HLA RTI developer, and is ensuring that the RTI is incorporated into the VisualAge Smalltalk Virtual Machine being employed for JWARS development and implementation.

Question 4
I see no problems (lest I be asked to suggest solutions).

Question 5
The major challenge is obtaining operational data for model validation.

3.3 Response of Col. John Andrew

Question 1
The Air Force Agency for Modeling and Simulation (AFAMS) is a relatively new organization (established in June 1996). The agency is primarily involved with coordinating and integrating the use of M&S to support training and operations.

Question 2
The Air Force vision for M&S is "a Joint Synthetic Battlespace supporting better decisions and warfighting skills to build the world's most respected air and space forces for the Joint Force Commander." This vision will be realized by developing interoperable M&S systems that provide warfighters and decision-makers the tools to ensure readiness across the full spectrum of conflict. The AFAMS mission flows directly from the AF vision: "Support Implementation and Use of the Joint Synthetic Battlespace." AFAMS has four mission areas:

1. Implement AF/joint/DoD M&S policy and standards
2. Coordinate and manage major M&S programs and initiatives
3. Support corporate AF M&S operations
4. Promote M&S technology improvement and innovation

AFAMS is a field operating agency of the Director of Command and Control, Headquarters USAF (AF/XOC).

Question 3
Yes, AFAMS has the lead on tracking HLA transition activities across the Air Force. All new M&S programs will adhere to DoD guidance relative to HLA.

Question 4
Major problems are controlling scope creep, managing expectations and keeping up with technology.

Question 5

Some of the areas that present M&S opportunities and challenges are listed below:

1. Technology development strategies for synthetic environments
2. Intelligent simulation
3. Voice interfaces
4. Sensor processing
5. Networked communications
6. Display technology
7. Tracking technology
8. Real-time 3D graphics
9. Real-time 3D sound
10. Database management
11. Distributed component technologies

3.4 Response of Lt. Col. J. O. Miller

Question 1
My operational analyst time includes a tour at what is now STRATCOM (formerly HQ SAC/JSTPS) from 1987-1990. During this time, I served in the Missile Employment division where I was responsible for the development and use of two strategic nuclear engagement simulation models (OASIS and FTPRNT) used in developing missile tactics and in generating AF reentry-vehicle fratricide regions for use in SIOP timing. Since December of 1996, I have been an Associate Professor in the Operational Sciences Department at the AFIT Engineering School. I teach the core simulation course to 30 – 40 masters students each year in our Graduate Programs in Operational Analysis (GOA) and Operations Research (GOR). Also I taught simulation electives as well as a Combat Modeling course and advise 3-4 master's students a year on their research.

Our department offers the two 18 month masters level programs mentioned above, GOA and GOR, to 30 – 40 students (mostly AF officers with a few Army and foreign officers) each year. They receive a broad exposure to modeling, simulation, and analysis techniques during their first 9 months and then concentrate on specialty coursework and their thesis for the rest of the program. Our student thesis efforts are our core research mechanism and are excellent for prototype/proof of concept type studies. Most thesis efforts are directed at real world DoD/AF problems. We also have an excellent OR Ph.D. program with 7 students currently enrolled.

Question 2
Our goal is to support the AF mission by providing highly trained and motivated analysts, proficient in M&S, but more importantly able to attack and solve real problems. Besides meeting the AF need for "blue suit" analysts, our objectives include providing our thesis sponsors with quality research that answers the mail. Recent sponsors from the DoD/AF/civilian communities include C-17 SPO/18th Airborne, AFSAA, ACC, DOE, AFRL, U.S. Army Recruiting Command, General Motors, and PepsiCo. Of particular note is our recent interaction with all six AF Battlelabs in providing research in support of their initiatives.

Question 3
We discuss HLA briefly in our combat modeling courses. In addition, we do use various legacy models (e.g., THUNDER and Brawler) on a limited basis in these courses and in dissertation and thesis efforts.

Questions 4 and 5
The major problem we see as an educational institution is the move toward "analytical free modeling." In other words, looking for our models to provide the final solutions, rather than as tools to be used by trained analysts in quantitatively evaluating problems. Clearly the rapid acceptance of the World Wide Web and distributive simulations (incorporating not only constructive models but man-in-the loop and real time data from deployed systems), present technical challenges, as well as opportunities, to provide more accurate and easily accessible models. Object-oriented tools, such as Java, provide a powerful framework for constructing standard libraries of classes/objects that can be readily reused in models developed by sister services, and contractors. The caveat is that these libraries of objects must be very clearly documented and organized in a meaningful and easily used fashion.

AUTHORS BIOGRAPHIES

Dr. RONALD J. ROLAND is the co-founder, president, and administrative head of ROLANDS & ASSOCIATES Corporation (R&A), Monterey, Ca. He holds a Ph.D. in Management (Information Systems emphasis), from the University of Nebraska, a MS in Computer Science from the University of Hawaii, and a BS in Mathematics from Colorado State University. R&A has been in business over 17 years and concentrates in mathematical modeling and simulation. Dr. Roland was Program Manager of a recent (1997) ACT II award, *Research for Integration of the IDEEAS and JTLS Combat Models Using DIS/HLA Protocol*. He is Project Manager of the Academic and Research support contract for Naval Postgraduate School and a support contract for the CINCPACFLT Wargaming Division. Dr. Roland is also the Program Manger for the continued development, maintenance and delivery of the Joint Theater Level Simulation (JTLS) which is under the management of the Joint Warfighting Center, Fort Monroe, VA. JTLS us used, worldwide, for U. S. and U. S. – Joint International computer assisted training exercises.

DR. MICHAEL R. MACEDONIA, Chief Scientist and Technical Director of the US Army STRICOM, is a West Point graduate. Dr. Macedonia is the author of numerous publications, working extensively with the networking and computer graphics communities. He is co-editor of Projects in VR for IEEE Computer Graphics. As Chief Scientist and Technical Director for the US Army's Simulation, Training, and Instrumentation Command (STRICOM), Macedonia is responsible for the technology strategy that provides the full spectrum of commercial and defense technology support for STRICOM.

DR. JIM METZGER received a doctorate in mathematics from the University of Michigan in 1970. He has worked for the Department of Defense since 1975, and for the U.S. Army Material Systems Analysis Activity, U.S. Army Concepts Analysis Agency, Headquarters Department of the Army, and OSD Director for Program Analysis and Evaluation. Herein he developed warfare simulations and applied them in analysis. Currently, he is the Director of the Joint Warfare System (JWARS) Office, which is developing the next generation theater-level simulation of joint warfare for use in analysis.

COLONEL JOHN ANDREW is the deputy commander, Air Force Agency for Modeling and Simulation (AFAMS), Orlando, Florida. AFAMS is charged with coordinating and integrating the use of computer simulations to support training, analysis, acquisition, and operations. Colonel Andrew entered the Air Force in 1976 as a distinguished graduate of the Air Force Academy. He was the outstanding graduate in operations research. Colonel Andrew has held a variety of scientific analysis jobs during his career, as well as serving as a research fellow at the RAND Corporation and a member of the staff group of the Secretary of the Air Force. He taught in the Department of Mathematical Sciences at the Air Force Academy. Colonel Andrew holds a Ph.D. from Harvard University, and he is a graduate of the Air War College. In 1996, he was awarded the Koopman Prize for the outstanding publication in military operations research.

LIEUTENANT COLONEL J. O. MILLER is an Assistant Professor in the Department of Operational Sciences at the Air Force Institute of Technology (AFIT). He serves as deputy director of the Center for Modeling, Simulation and Analysis. A 1980 graduate of the U.S. Air Force Academy, Lt. Col. Miller received his M.S. in Operations Research from AFIT in 1987 and his Ph.D. in Industrial Engineering from Ohio State University in 1997. His research interests include simulation, nonparametric statistics, and ranking and selection.