Analytic Wargaming on the Rise

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"A reinvigorated wargaming effort will develop and test alternative ways of achieving our strategic objectives and help us think more clearly about the future security environment."

—SecDef Defense Innovation Initiative memo, November 15, 2014

"The first and most important thing is our people. The second thing is what we want to do to reinvigorate wargaming."

—Deputy Defense Secretary Bob Work, on the Defense Innovation Initiative, Defense News interview, November 24, 2014

From its inception, military operations research has been inexorably linked to wargaming; the relationship is symbiotic and has benefited practitioners in both disciplines. Indeed, the overlap in a Venn diagram of the disciplines of military OR and wargaming is so large it is hard to find examples where wargaming will not benefit from OR, and where military OR will not benefit from wargaming.

Analytic wargames are designed to collect and analyze information from wargame play, and these results either feed directly into a decision, or are used to develop other analytic products. Outputs of analytic wargames such as concepts of operation (CONOPS), courses of action (COAs), and operations plans (OPLANs) are commonly used to "feed" other analytic activities or serve as the operational foundation for computer-based combat simulation analysis.[a]

Analytic wargames are particularly useful in scenarios where uncertainty is high. Instead of simply "red" and "blue," there may be many players, all with unique objectives. This includes operations where major cultural differences make understanding potential actions and reactions to unfolding events tremendously difficult or operations against new, unfamiliar threats in new regions, and operations that current doctrine doesn't adequately address.

Wargaming and History

Analytic wargaming has had a long and colorful history of success. The US Naval War College (NWC) began wargaming Plan Orange, operations against the Japanese in 1919, and created a rich body of analytic wargaming results

divided into three distinctly different phases (Vlahos, 1986):

- 1919–1927: The US Navy sails off to single-handedly destroy the Imperial Japanese Navy and relieve the Philippines just weeks after a declaration of war.
- 1928–1934: The US Navy realizes such a war may last longer and will require a phased approach necessitating large-scale amphibious operations with significant US ground forces.
- 1935–1941: The US Navy realizes that, in addition to the US Army and US Marine Corps, US forces will need help from regional partners.

The knowledge garnered in more than two decades of NWC wargaming Plan Orange led Fleet Admiral Chester Nimitz to famously say, "The war with Japan had been enacted in the game rooms at the War College by so many people and in so many different ways that nothing that happened during the war was a surprise—absolutely nothing except the kamikaze tactics toward the end of the war. We had not visualized these."[b] An even more telling tribute to Plan Orange wargaming came early in 1942 when Nimitz sent two young lieutenant commanders back to the Naval War College in Newport to gather previous wargaming results. Because NWC had changed Japanese strengths and weaknesses in each year's student-led wargame, Nimitz knew that NWC had wargaming results from one of its annual wargames that resembled the actual Japanese status that naval intelligence was reporting to him (Caffrey, 2000).

A more recent analytic wargaming success was the Desert Crossing wargame conducted in 1999 when Marine General Anthony Zinni commanded the US Central Command. He tasked his staff with conducting wargames to assess what could happen if regime change occurred in Iraq, deposing Saddam Hussein. The results were an eerie prediction of the post-"Shock and Awe" sectarian violence and regional power struggles that did in fact occur after the end of major combat operations in Iraq in 2004 (US Central Command, 1999). The wargame would have been tremendously successful had the National Command Authority given the game's results any credence as they planned for Operation Iraqi Freedom.

Computer-Based Combat Simulations Sideline Analytic Wargaming

Toward the latter part of the 20th century, the use of computerized combat simulations combined with other factors to relegate wargaming to a little-used tool for analysis. The dominant scenario that the United States DoD used to underpin acquisition decisions was the NATO-Warsaw Pact battle for Europe. This battle had been analyzed continually for decades and both sides' intelligence had been so well developed that, by the 1980s, nearly the entire world understood how the battle on the north German plain would unfold: attack corridors, force compositions, and equipment, even opposing commanders were all known. Tom Clancy's novel *Red Storm Rising* (Putnam, 1986) provided a realistic description of what that encounter would have looked like, and demonstrated the amount of information commonly available about that potential conflict. The dominant school of thought at the time seemed to be that there was no need to develop new courses of action or get fresh subject matter expertise on the battle to be fought; all that was left was the fight itself.

Computers started to impact military thought in the 1970s, changing the wargaming landscape forever. At first, computers were used to help with the bookkeeping of wargames, accounting for the physical phenomena such as adjudicating the outcome of engagements, tracking unit and vehicle movements, and accounting for logistics expenditures. The wargame Battle Analyzer and Tactical Trainer for Local Engagements (BATTLE) utilized a Wang 2200 computer to do what computers do best:

"The software was therefore designed to provide players complete freedom of action with respect to tactics employed and decisions made during the course of an exercise. Its function is to free players and controllers from the burden of complex, time-consuming computation, recording, and exercise management requirements and thereby permit the maximum possible involvement of exercise participants in the tactical decision-making process" (TRADOC, n.d.).

At some point, the allure of developing a computer-based combat simulation that was entirely automated and could replicate a major campaign was realized, and "closed-loop" combat simulations started to become a staple of operations research. Several of the major combatant commands adopted the Joint Staff's combat simulation Tactical Warfare Model (TACWAR) to assess courses of action and otherwise augment their planning processes.

These closed-loop computer-based combat simulations fall into two basic categories.

The first are theater- or strategic-level, lower-resolution combat simulations that represent forces in an aggregate manner, and often use some adaptation of heterogeneous Lanchester equations to adjudicate combat engagements (Taylor, 1983). Human

decision making in these simulations is rudimentary at best, such as, "attack when you have a 3:1 advantage," "defend when your opposition has a 3:1 advantage," and "skirmish when neither of the sides can muster a 3:1 or better force ratio." Many of these simulations are deterministic.

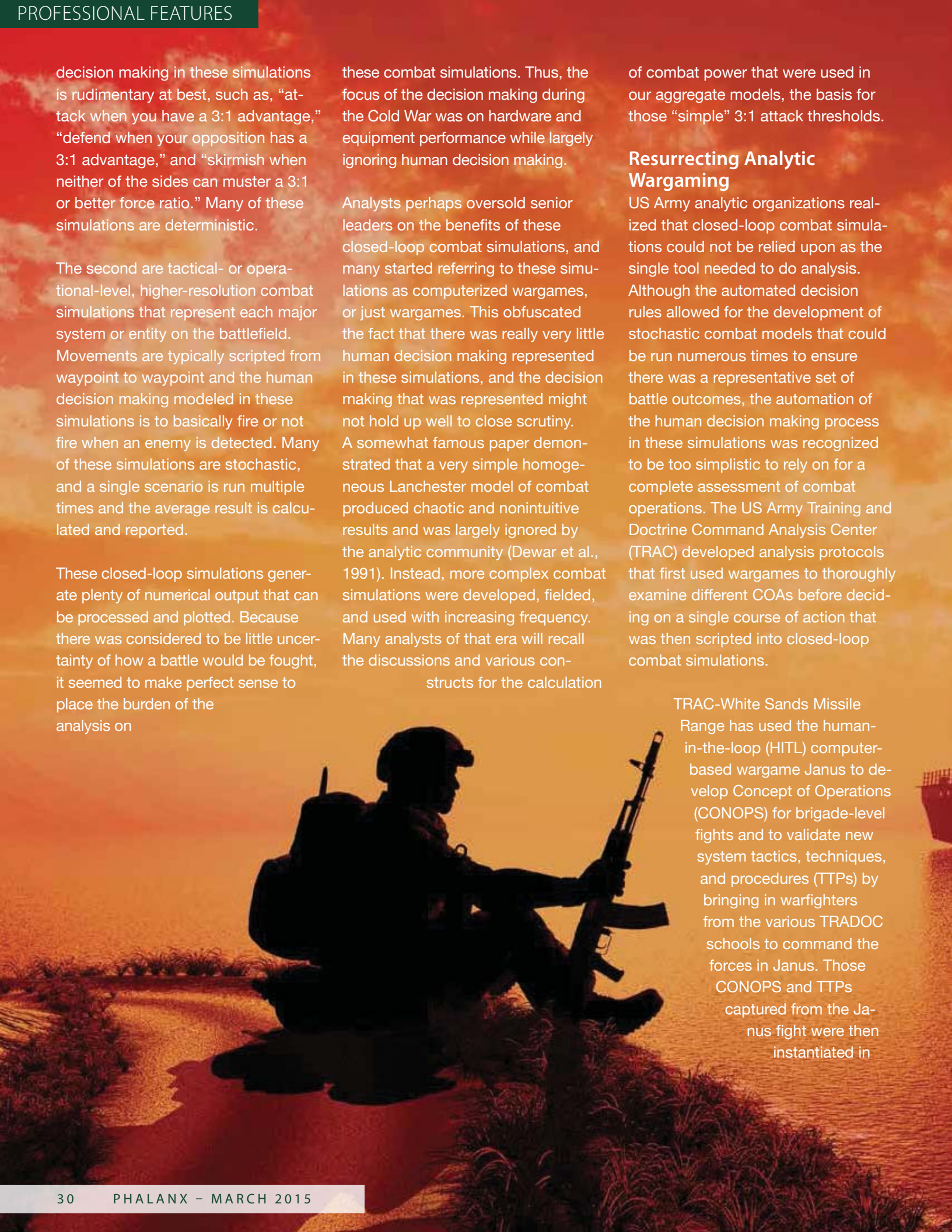
The second are tactical- or operational-level, higher-resolution combat simulations that represent each major system or entity on the battlefield. Movements are typically scripted from waypoint to waypoint and the human decision making modeled in these simulations is to basically fire or not fire when an enemy is detected. Many of these simulations are stochastic, and a single scenario is run multiple times and the average result is calculated and reported.

These closed-loop simulations generate plenty of numerical output that can be processed and plotted. Because there was considered to be little uncertainty of how a battle would be fought, it seemed to make perfect sense to place the burden of the analysis on these combat simulations. Thus, the focus of the decision making during the Cold War was on hardware and equipment performance while largely ignoring human decision making.

Analysts perhaps oversold senior leaders on the benefits of these closed-loop combat simulations, and many started referring to these simulations as computerized wargames, or just wargames. This obfuscated the fact that there was really very little human decision making represented in these simulations, and the decision making that was represented might not hold up well to close scrutiny. A somewhat famous paper demonstrated that a very simple homogeneous Lanchester model of combat produced chaotic and nonintuitive results and was largely ignored by the analytic community (Dewar et al., 1991). Instead, more complex combat simulations were developed, fielded, and used with increasing frequency. Many analysts of that era will recall the discussions and various constructs for the calculation of combat power that were used in our aggregate models, the basis for those "simple" 3:1 attack thresholds.

Resurrecting Analytic Wargaming

US Army analytic organizations realized that closed-loop combat simulations could not be relied upon as the single tool needed to do analysis. Although the automated decision rules allowed for the development of stochastic combat models that could be run numerous times to ensure there was a representative set of battle outcomes, the automation of the human decision making process in these simulations was recognized to be too simplistic to rely on for a complete assessment of combat operations. The US Army Training and Doctrine Command Analysis Center (TRAC) developed analysis protocols that first used wargames to thoroughly examine different COAs before deciding on a single course of action that was then scripted into closed-loop combat simulations.



TRAC-White Sands Missile Range has used the human-in-the-loop (HITL) computer-based wargame Janus to develop Concept of Operations (CONOPS) for brigade-level fights and to validate new system tactics, techniques, and procedures (TTPs) by bringing in warfighters from the various TRADOC schools to command the forces in Janus. Those CONOPS and TTPs captured from the Janus fight were then instantiated in

the closed-loop simulation Combined Arms and Support Task Force Evaluation Model (CASTFOREM), which provided a robust look at how well our forces performed with warfighter-developed maneuver. Similarly at TRAC-Fort Leavenworth, "orders drills" were conducted by warfighters to develop the division and corps-level CONOPS, which was then integrated into the Vector-in-Command (VIC) model. The Center for Naval Analyses used Marine Corps officers to develop its tactical decision rules when preparing the amphibious warfare model for the amphibious assault vehicle analysis of alternatives in the early 1990s (Akst, 1995). More recently, TRAC has leveraged "expert elicitation" techniques by interviewing serving or former brigade commanders to obtain their warfighting perspective on various brigade combat team (BCT) formations. The results of those interviews were used to integrate human decision making into analysis that underpinned the Army's recent brigade combat team transition to three-battalion BCTs (Salmeron and Appleget, 2014). Today the US Army Center for Army Analysis (CAA) wargaming capability provides the organization with a true end-to-end campaign analysis capability as they integrate COA developed through wargaming into their Joint Integrated Contingency Model (JICM) combat simulation.[c]

One of the significant by-products of recent engagements in Iraq and Afghanistan has been the experience analysts have gotten as they have been integrated into joint and multinational headquarters. The close partnership formed between analysts and planners provides a template for more relevant, comprehensive, and collaborative analytic products in the future. In particular, planners have never forgotten the usefulness of wargaming, and wargaming plays a prominent role in US and many of our allies' operational planning processes. The United Kingdom's Defence Science and Technology Laboratory (Dstl) created a computer-based wargame called the Peace Support Operations Model (PSOM), which was used in Afghanistan to wargame the International Security Assistance Force (ISAF) campaign plan in the spring of 2011.

CAA responded to commanders in Iraq and Afghanistan and created a wargaming capability that allowed them quick-turn analysis responding to the forward deployed analysts in Multi-National Force–Iraq (MNF-I) and ISAF. Today CAA is building a strong reputation for wargaming excellence recognized by COCOMs by supporting PACOM and USARPAC with wargaming expertise.

Conclusions

As the demand grows and more wargaming is sought, it is clear that the skills needed to design, develop, conduct, and analyze wargames are not well known, or if known, not well implemented. There are still many "wargames" being conducted that are little more than BOGGSATs (bunch of guys and gals sitting around a table), as evidenced by the lack of useful wargaming results from many of DoD's higher level wargaming events. Other organizations are trying to recreate our combat-simulation-heavy pre-9/11 wargaming capability by collecting and federating existing combat simulations for analysis. They seem unaware of the scenario and data challenges today's uncertain world presents.

COCOM planning organizations should partner more closely with analysts from their own headquarters and from other analytic organizations. Plans should be dusted off, reexamined, and updated, and then wargamed periodically, with planners and analysts teaming to produce rigorous, well documented and viable plans.

Peter Perla's *The Art of Wargaming* (US Naval Institute, 1990) is a great reference that sets the foundation for modern military wargaming, but the book is nearly a quarter of a century old. Since then, much has been learned about wargaming that needs to be collected, triaged, documented, and published. MORS began a presequester initiative led by Scott Simpkins of the Johns Hopkins Applied Physics Laboratory to capture what we've learned about wargaming that should be reinvigorated.

Finally, wargaming education needs to be embraced. Although US doctrine mandates that our planners wargame, details on how to conduct useful wargames are scarce in our doctrinal literature. Our war colleges and staff colleges need to devote more time to wargaming, to include having students build libraries of useful wargaming results of potential future conflicts, like NWC did with Plan Orange. All analysts, including civilian analysts, should take a course in wargaming. As part of the MORS initiative to provide professional development to OR practitioners, a component should be included that offers the skills necessary to design, develop, conduct, and analyze professional wargames.

Notes

[a] We have purposely included planning wargames under the heading of "analytic wargames" because planning wargames are wargames that are designed to produce output that feed into operational decisions.

[b] Remarks by Dr. Donald C. Winter, Secretary of Navy, Current Strategy Forum, Naval War College, Newport, Rhode Island, June 13, 2006.

[c] Personal communication with Dr. David Knudson, CAA.

References

Akst, G. 1995. Use of the Amphibious Warfare Model to Evaluate the Cost Effectiveness of Alternative Marine Corps Amphibious Assault Vehicles, *Naval Research Logistics,* Vol 42, 671–690.

Caffrey, M. 2000. Toward a History Based Doctrine for Wargaming, *Aerospace Power Journal,* Fall, 43–45.

Dewar, J. A., Gillogly, J. J., and Juncosa, M. L. 1991. Non-Monotonicity, *Chaos, and Combat Models,* RAND R-3995-RC, Santa Monica, California.

Salmeron, J., and Appleget J. 2014. Reshaping the U.S. Army: Brigade Combat Team Optimization, *Military Operations Research,* Vol 19, No 3, 51–65.

Taylor, J. G. 1983. *Lanchester Models of Warfare,* volumes I & II. Operations Research Society of America.

TRADOC Systems Analysis Activity. n.d. Battle Analyzer and Tactical Trainer for Local Engagements, White Sands Missile Range, New Mexico (development was initiated in August 1976).

US Central Command. 1999. *Desert Crossing Seminar after Action Report,* June 28–30; declassified and redacted version available at http://www2.gwu.edu/~nsarchiv/NSAEBB/NSAEBB207.

Vlahos, M. 1986. Wargaming, an Enforcer of Strategic Realism: 1919–1942, *Naval War College Review,* March–April, 7–22.

About the Authors

When Jeff Appleget joined the Naval Postgraduate School Operations Research Department in 2009 and was asked to update the Wargaming Applications course, he first read Peter Perla's book The Art of Wargaming and then called Fred Cameron (then an analyst with the Centre for Operational Research and Analysis (CORA) of the Canadian Department of National Defence) to see if he would help design a seminar wargaming week for the course. Five years later, they have fielded requests for wargaming support from PACOM, CENTCOM, AFRICOM, and others; mentored students developing wargames for DoD analytic organizations, COCOMs, and industry partners; co-authored and taught wargaming short courses for the Canadian Forces Aerospace Warfare Centre, STRATCOM, and Lockheed Martin; and integrated wargaming into peacekeeping and counterterrorism modeling courses delivered in Kazakhstan, Kyrgyzstan, and Tajikistan.