Future imperfect

U.S. Army struggles to model irregular warfare scenarios

By Michael Peck

T he future of warfare is irregular. But the U.S. military does not have the computer models to simulate it.

That could be a problem, because as the Pentagon shifts from fighting conventional wars to irregular warfare (IW), the quality and availability of models will affect everything from weapons procurement to first-person-shooter training simulations.

"I think we're at least five years behind where we should be," said Michael Bauman, director of the Army's Training and Doctrine Command Analysis Center (TRAC) at Fort Leavenworth, Kan., which creates analytical models for the Army.

The simple problem is that human beings are anything but simple. Irregular warfare is a vast, amorphous concept seething with human psychology and mob behavior. It encompasses politics, economics, psychology, sociology and most anything else you can think of. Model the physics of an armor-piercing shell fired at a tank two miles away? No problem for the Pentagon. But what about the impact on Afghan public opinion of a Predator strike or information operations? How will nonlethal beam weapons affect a mass demonstration in Baghdad? Is it even possible to create sophisticated software that will allow commanders to accurately forecast the consequences of firing a Hellfire missile versus building a school?

The prognosis is not good. Some defense modeling and simulation (M&S) experts are dismayed at the prospect of mathematically capturing human behavior. Commanders may also have to become accustomed to support from a new type of M&S that doesn't provide precise data — such as X percent chance of a missile destroying a tank — but

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rather illustrates relationships, such as how patrolling a town might influence the loyalties of the local population. "I think the metrics will be very different, and so will the insights," said James Bexfield, director of the Study and Analytical Support Division in the Office of the Secretary of Defense.

Compounding the problem is that the U.S. military is starting from scratch, because for too long it focused its resources on modeling Cold War-era conventional combat. The Army's new M&S strategy, released in July 2008, shows how deeply concerned the Army leadership is about the gap between Cold War-era models and the new world of irregular warfare. "As changes to the Army and the operating environment gained traction, much of our M&S functionality could not keep up, making much of our M&S less relevant to their intended usage over time, particularly in analytical models," said the

USC INSTITUTE FOR CREATIVE TECHNOLOGIES

UrbanSim is an effort to model the human terrain and teach commanders how to manage operations on a citywide scale.

document's foreword, which was signed by former Army vice chief of staff Gen. Richard Cody.

Cody laid part of the blame on the Defense Department, which "launched large and costly programs to develop new simulations." The programs weren't specified, but almost certainly they included the infamous JSIMS (Joint Simulations System), an over-ambitious federation of simulations that was canceled in 2002.

OLD-FASHIONED TOOLS

For now, the military can only model irregular warfare through old-fashioned tools such as seminar games (the so-called BOGSAT, or Bunch of Guys Sitting Around a Table). But TRAC has begun formulating a plan to develop IW models.

"We have an initiative to build a robust set of tools to support tactical level wargaming of IW and counterinsurgency [COIN] operations," Bauman said. Partners in the project

include the Marine Corp's Operations Analysis Directorate as well as the Naval Postgraduate School and the Army's Human Terrain System program.

Bauman, widely respected as a guru of defense analytical modeling, envisions approaching IW through a series of tactical models. The new models would cover raids, patrols, engaging key local leaders, cordon and search, and traffic control points by friendly forces. Insurgent activities would be covered through models of IED attacks, coercing of the local population, recruitment, sabotage and assassination. The models themselves could be computerized, or might be as simple as a spreadsheet. Bauman also foresees a "very efficient board game that lets us cycle through months of COIN operations very rapidly."

Why focus models on the tactical level? Bauman said he believes there has been too much focus on the strategic level. "The epiphany that everyone had was that irregular warfare was about engaging at the national and strategic levels: bringing in aid, establishing stability and the rule of law," he said. "What was missing was the notion that IW is what happens between soldiers and people at the tactical level."

Bauman predicts that devising these models will take at least three to five years. One roadblock is that there are no reliable social science models for human behavior. Current theories tend to have a Western bias, and as is common in social science, theories rarely agree with one another, Bauman said. "We have challenges in causality, challenges in nonlinearity, challenges in transference. But we're going to tackle those things."

The Defense Department has also responded to the IW challenge with the human, social and culture behavior (HSCB) modeling program. HSCB was created last year to develop a science base and associated technologies for modeling IW, especially in terms of human behavior. The goal is to create tools for analysts and planners that will enable forecasting for "sociocultural 'human terrain' responses at the strategic, operational and tactical levels," according to a program overview.

Navy Cmdr. Dylan Schmorrow, the HSCB program director, said he doesn't expect every facet of IW can be accurately modeled. "Give me 300,000 years, and maybe I'll get to 100 percent. I'd be happy right now if it was better than chance," he said.

Over the next five years, Schmorrow said, he expects IW modeling to help planners focus on specific questions by computing the range of likely possibilities in a given situation. "You're not saying that there's going to be a coup next week in Sweden, but you might be able to say that there's a high chance of political instability in Norway," he said. "Not answer a specific question, but providing the areas you should be paying attention to."

Eventually, analysts will be able to use computer models to help commanders at the strategic level assess likely outcomes. "You would put in all the assumptions that we have, and then the outcome we're trying to impact," Schmorrow said. "You could then say, 'Sir, our model says that if we use a Predator to drop a missile, it will cause this percentage of casualties, and those casualties will have a statistical likelihood of impacting the outcome we want.'"

HOW TO DRINK TEA

At the tactical level, models of human behavior will enable training simulations to better teach cultural gestures such as when to drink tea with an Iraqi official or how not to begin a conversation with an Afghan elder.
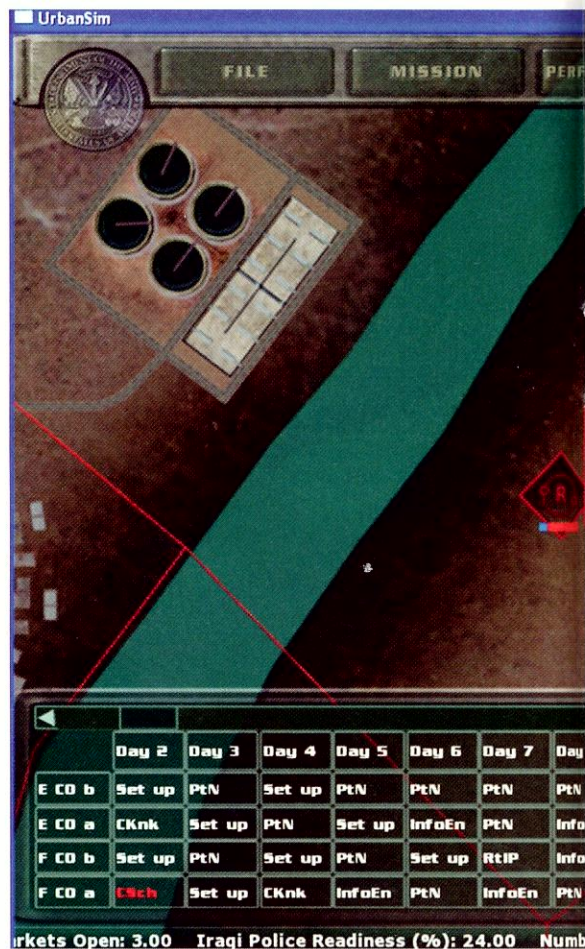

Besides human behavior, another facet of IW is nonlethal weapons. U.S. Joint Forces Command, which does a lot of modeling and simulation, admits that it's just begun assessing how to model irregular warfare, command spokesman Lt. Cmdr. Robert Lyon said. But the command has tested a nonlethal-weapons model created by Raytheon to market its crowd-control energy weapons. The nonlethal model was loaded onto OneSAF, the Army's general
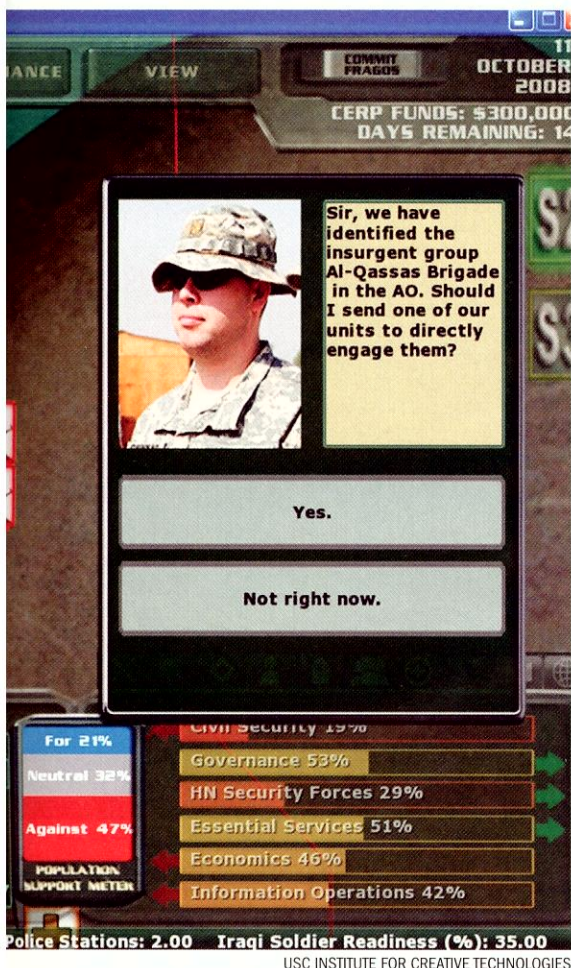
In UrbanSim, commanders must consider the broader and unintended effects their actions might have on stability operations.

purpose constructive simulation, for operations at the fire team to company level. Once OneSAF had the database and algorithms for nonlethal weapons, it was connected to the Joint Crowd Federate (JCF), a crowd behavior model from Virginia-based Werner Anderson.

"Through OneSAF, the weapon is fired. It hits people in the crowd, and then JCF will calculate the effects," said Steve Hansen, experimentation lead for Raytheon's Netcentric Integration and Experimentation Center in Suffolk, Va.

The project, known as the Non-Lethal Effects and Crowd Behavior M&S Test Bed, modeled Raytheon's Active Denial System and Silent Guardian energy weapons, which shoot millimeter-wave beams. Also modeled were the M1012 Rubber Fin Stabilizer Shotgun Round and M1006 40-millimeter Sponge Round kinetic weapons.

That proved challenging, Hansen said. "It's a beam as opposed to a bullet, and beams have different characteristics." Another issue was modeling multiple detonations, because a beam can hit multiple targets with one shot.

But as the saying goes: garbage in, garbage out. A computer model is only as good as the data it digests, and Bauman argues that the U.S. military's data collection efforts are in need of serious reform.

"Data collection is a cottage industry. We really don't have a coherent program for gathering data in-theater, which, in my opinion, is missing a tremendous opportunity," he said.

"There are a lot of people out there who believe that the data is out there, and all we have to do is analyze it," Bauman added. "That's not true. The data is incomplete in many instances, in terms of the context in which the data was collected, or what the consequences were."

Accurate models are only one requirement for successful irregular warfare. Another is high-fidelity training simulations. To some extent, training simulations depend on models to create accurate algorithms, so that civilian avatars in the Army and Marine Corps Virtual Battlespace 2 tactical shooter behave realistically. However, training simulations don't have to be quite as mathematically precise.

For higher echelons, the Army's School for Command Preparation at Fort Leavenworth wanted a simulation to train battalion commanders in counterinsurgency and stabilization operations for the Tactical Commanders' Development Course. The Army's Research, Development and Engineering Command (RDECOM) responded by creating UrbanSim. Designed by the Institute for Creative Technologies at the University of Southern California, and currently in the late beta stage, UrbanSim is a 2-D constructive simulation set in an Iraqi city. The player receives an operations plan from brigade headquarters, studies information on the city's economic, political and social networks, then conducts lethal and nonlethal operations to achieve his objectives.

"You're dealing with upwards of a hundred different entities that are being controlled by the social simulation operating under the hood," said Tim Wansbury, a research associate at RDECOM's Simulation and Training Technology Center. "We're trying to take the essence of the [Field Manual] 3-24 Counterinsurgency and 3-07 Stability Operations manuals, and boil that down into a two-hour training session that somebody can go through at their own pace."

Bexfield said he expects gradual improvement in irregular warfare modeling and simulation.
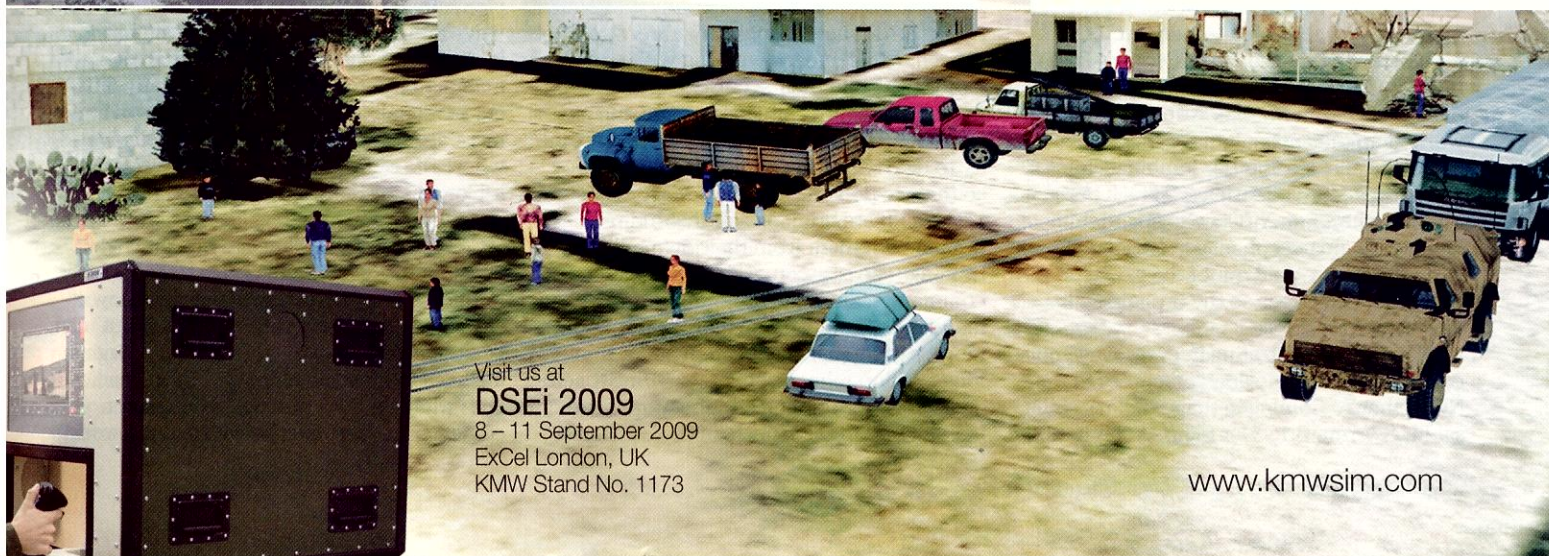
"I think we provide a little bit of insight now," he said. "Let's say we're at the 10 percent level, and that's just a guess. In five years, we may be at the 40 or 50 percent level, and maybe in 10 years, we'll be up to the 80 percent level, about where we are at conventional warfare." ■