The *right* connections

Consultant Bob Lemmon, a retired U.S. Air Force colonel, demonstrates one of the full-mission trainers destined for the F-15E Mission Training Center at Mountain Home Air Force Base, Idaho, to show how the fidelity level gives aircrews a visceral sense of combat-mission rehearsal.

RON BOOKOUT PHOTO

Boeing provides USAF with a cutting-edge network for training

By Doug Cantwell

In St. Louis or Seattle, it's tough to find Boeing employees who work on the U.S. Air Force's Distributed Mission Operations training network who aren't truly excited about it.

"DMO is on the cutting edge of network-centric operations in the aircrew training world," said Darrell Smith, project manager for F-22 DMO in St Louis, "whether you're talking communication standards, interoperability, security issues or road-mapping the future."

DMO is a simulated training environment in which pilots use network-connected, high-fidelity trainers around the world to "fly" a mission. There's no fuel burned, no ordnance fired, and no wear and tear on the aircraft—which drastically reduces the cost without compromising the quality of training. Pilots can fly over hostile "territory" without going into harm's way and can review their missions almost immediately in a comprehensive debrief.

With several milestones on tap for 2008, Boeing is accelerating its activities in developing and delivering the cutting-edge DMO training network. The St. Louis team activated the second DMO-enabled F-15E Mission Training Center last December at Seymour Johnson Air Force Base, N.C. They had stood up the first MTC for the E at Mountain Home AFB, Idaho, in October. RAF Lakenheath in the United Kingdom will be the next F-15E site; then Mountain Home and Seymour Johnson will each receive a second MTC later this year.

At the same time, the F-22 group is working to integrate the first Raptor MTC at Langley AFB, Va., into the DMO network by May 2009. They're also installing the second Raptor MTC at Elmendorf AFB, Alaska, which will be the first site that is fully DMO-enabled from the start. Boeing has delivered and currently operates five F-15C MTCs around the globe, including Kadena Air Base, Japan; RAF Lakenheath; Eglin AFB, Fla.; Elmendorf; and Langley. In addition, the company operates three F-16 MTCs at Shaw AFB; Misawa Air Base, Japan; and Spangdahlem Air Base in Germany.

3 FIGHTERS, 3 CHALLENGES

Smith recalls the different hurdles the team has faced in integrating the three platforms into DMO. With the F-15C, which came first, it was mostly a case of raising the bar of fidelity and shifting to a rhythm of continual updating.

"What DMO brings to the table," he said, "is daily, on-demand training capability." In other words, the network doesn't simply wire together remote locations; it allows those facilities to link up at will, generate an air tasking order (ATO) on fairly short notice, divide up the ATO into mission fragments, or "frags," assigned to the respective players, and execute the mission.

Before DMO, Smith recalled, training sessions were planned and staged "something like county fairs." Planning would start six months in advance; all the players would have to coordinate their frags to make sure all were on the same page; then everyone would converge on a few temporarily connected sites, execute the mission, hold a debrief after a lengthy collection of data, then pack it all up and go home for six months.

"When DMO came along, it was not just an advance in training capability. It represented a paradigm shift," said Greg Coady, F-15C program manager. "They were used to stand-alone, one-on-one trainers that involved a single pilot and instructor."

DMO first introduced a local area network that allowed the training centers to wire together a "four-ship" of simulators. This was a major leap, because it enabled the first level of mission training: coordinating with your wingmen to divide up a sortie into fragments. Next came the wide-area network that allowed F-15C pilots to receive an ATO and related data from a simulated AWACS command/control center at Tinker AFB, Okla.

"Now you're approaching full-up mission rehearsal," Coady said, "using databases that cover most of the hot spots in the world. Before you send guys to Iraq or Afghanistan, you can have them go practice missions you think they'll actually be flying."

With the F-15E coming on board, it was the versatility of the Strike Eagle's all-weather, air-to-air and ground-attack capabilities that created most of the challenges for the DMO team. Not only was there the densely featured ground environment to emulate, but also a much messier electromagnetic ambience with the addition of terrain-following and ground-based integrated air defense systems.

Besides that, the E's air/ground weapons suite includes various combinations of more than 30 individual armaments, each with its own set of mission tactics. By comparison, the C carries only three different air-intercept missiles.

SWEATY PILOTS

In the mid-1990s, Gen. Richard Hawley, then chief of the Air Force's Air Combat Command, laid out his vision of a distributed mission training capability and set the acquisition wheels in motion. Jumper wanted "sweaty pilots" to emerge from the simulators. In other words, the fidelity of combat simulation should engage them at a visceral level, give them the sense that they were truly airborne and engaging the enemy—but also acclimate them to flying and fighting as one of a four-ship formation as well as a joint force made up of diverse aircraft.

"In those days, there was a lot of doubt that the technology—especially the network throughput and bandwidth—would be there to support this vision," recalled Geoff Waldron, lead engineer for Air Force training systems in St. Louis. "We were still trying to figure out how we'd get to the level of fidelity desired by the Air Force—never mind the DMO connectivity."

Hawley also foresaw the transformational need to work up multiplatform mission tactics. He wanted his wing commanders to be able to "play" in a distributed environment so they could learn how a mix of fourth- and fifth-generation fighters might work together to best advantage. The latter—the F-22, for example, with its stealth characteristics and advanced avionics—could be more effective if used in an air dominance role to "kick down the door" and secure a corridor of airspace from any threat of opposing aircraft.

The fourth-generation strike fighters such as the F-16C could then use that corridor to suppress adversarial air defense systems. Once they had locked down the air defenses, the F-15Es could follow them in to execute their ground attack against high-value targets without fear of either airborne interceptors or ground-based missile or artillery attack.

"DMO gives pilots an environment where they can try new mission tactics—and weed out the failed missions—without putting themselves in harm's way or wasting expensive live-flying hours," said Joe Hendrickson, deputy director of F-22 Mission Systems and Software and DMO program manager in Seattle.

One of the key features of the Distributed Mission Operations–enabled Mission Training Centers is the debrief station, which allows players at all locations to review the mission they've just flown together—what went wrong and what went right—as soon as it's concluded.

RON BOOKOUT PHOTO

Distributed Mission Operations–enabled Mission Training Centers will help aircrews realize the U.S. Air Force's transformational goal of multiplatform missions that make the most effective use of fourth- and fifth-generation fighters such as the F-15C (right) and F-22, shown here during an exercise over North Carolina.

U.S. AIR FORCE PHOTO BY TECH. SGT. BEN BLOKER

A TALE OF TWO CITIES

Members of the F-22 pilot training team in Seattle knew they had their work cut out for them. They also recognized, as Scott Milton, DMO project manager for F-22 in Seattle, observed, "The right way to do it was to bring St. Louis and their experience into it."

It's often been noted that one of the pitfalls of working at a massive, sprawling aerospace firm is the stovepipe effect. Specifically, individual programs tend to drive the development of technologies—often along tightly focused trajectories that don't take into account their larger possibilities or potential applications.

Yet with DMO, knowledge-sharing was not only mutually beneficial to the Boeing F-15C, E and F-22 training units, it was critical to the customer's needs. A key objective of the Air Force's distributed mission training need was to enable different platforms with different performance parameters and weapon systems to work together as efficiently as possible—not only to improve their tactical effectiveness but to enhance their survivability.

This brought into play a longstanding Boeing concept. "Design anywhere, build anywhere—and also support anywhere—is at the heart of this program," Hendrickson said. Seattle had the F-22 platform systems-design talent as well as most of the software-design and integration/test capability it needed for the task, but it lacked the direct experience with DMO and with designing user/instructor interfaces, both of which St. Louis' engineering Integrated Process Team could provide.

F-22: TRAINING FORCE MULTIPLIER

"When the F-22 is in the fight, all joint force aircraft perform more effectively," said Pam Valdez, director of F-22 Sustainment. "By the same token, inserting the Raptor into the DMO network will act as a training force multiplier."

The task of adding F-22 to the mix is complicated by the Raptor's sophisticated technology more than by its mission versatility. That's especially the case for the near-term assignment, which is to focus on the aircraft's kick-down-the-door mission of securing air dominance during the first hours of a conflict. Adding the aircraft's ground-attack mission will come later.

The F-22's advanced, fully integrated avionics, low observability and electronic warfare capabilities require higher-fidelity simulation from all DMO participants. "If I'm an F-16," Smith explained, "I need to provide data to ensure that higher-fidelity avionics systems such as the Raptor's will definitely read me as an F-16."

In the old days of lower-fidelity training, simulators would simply throw an F-16 symbol onto the radar screen rather than actually challenge the identification-friend-or-foe capability of the avionics' mission systems to ID the approaching aircraft.

ADDING SECURITY TO THE MIX

Aside from raising fidelity to the standards required by its advanced avionics, the F-22 has brought security issues to the DMO table. While the objective is to link all of the Air Force's tactical fighters and command/control platforms together in order to simulate complex missions, it won't involve bringing all aircrews up to the security level required to operate the F-22. That wouldn't be prudent or practical from a security standpoint.

The solution: Integrate the fifth-gen fighter's characteristics into the system and distribute them to the other MTCs—while shielding the actual performance parameters from the fourth-gen players.

KEVIN FLYNN PHOTO

When it came to integrating the F-15E's air intercept/ground attack all-weather mission versatility into the Distributed Mission Operations network, Boeing engineers found the E's weapons suite—of more than 30 armaments used in various combinations—made their job a lot more difficult. Here, an E at RAF Lakenheath, U.K., the base next in line for a Mission Training Center, takes on a brace of AIM-120C missiles.

Building this multilevel security into the DMO system has been one of the major challenges in adding the F-22 to the mix. It's part of what Smith calls "roadmapping the future" of the distributed training experience. "We know that we want to reach a particular level of training fidelity across the entire network by the end of 2009," he said. "What do we have to do to get all the players up to speed by then?"

Providing effective aircrew training is arguably the Air Force's most critical mission. The Boeing employees who support this effort would also claim that it's one of their most challenging. Nor is it getting any easier, what with the Air Force's transformational mandate to combine forces with the Army, Navy and Marine Corps as well as fight in coalition with allied forces.

"Creating a high-fidelity training system is as challenging as building the actual airplane," Coady said, "except that you don't get to spend years on the research and development like the airplane guys do."

Developing DMO—and raising the bar of training fidelity to meet the Air Force's network-centric needs—has reinforced awareness of how critical the individual human being is in the training loop. "We could easily build a system that meets all the technical requirements, yet still fail to give the operators the capability to do their jobs," said Barry Cossel, F-22 training manager in Seattle. "Every pilot has individual needs, but good solid software requirements take this into account and enable the system to adapt to the human beings who use it." ■

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LOCKHEED MARTIN PHOTO BY JOHN ROSSINO

Part of the challenge in making high-fidelity network-enabled trainers effective has been to create agile user-interface software that adapts to the individual—both trainee and operator. F-22 pilots are shown at Elmendorf Air Force Base, Alaska, during the base's August 2007 opening as the F-22's second operational base. In 2009, Elmendorf will receive the first Mission Training Center that's fully DMO-enabled at installation.