Wargaming the Enemy Unmanned Aircraft System (UAS) Threat*

Colonel D. Matthew Neuenswander, USAF- Retired

A RQ-7 Shadow 200 unmanned aerial vehicle takes off for a night mission. The 4th Squadron, 6th Cavalry maintains 24-hour surveillance over the skies of Mosul. (Photo Courtesy of Combat Aviation Brigade, 1st Infantry Division)

*Source: *FIRES,* Noviembre – Diciembre 2012, http://sill-www.army.mil/firesbulletin

The downing of two Hezbollah Ababil UAS over Israel during the 2006 Lebanon War served as a "benchmark tactical event" in that war.[1] Although the US military had been looking at ways to defend against enemy UAS prior to 2006, it is safe to say that Hezbollah's use of UAS served as a wakeup call for the entire Department of Defense. This prompted Joint Forces Command's Joint UAS Center of Excellence and Joint Staff J8, Joint Integrated Air and Missile Defense Organization (JIAMDO) to conduct a series of UAS defense events. In addition, since 2008 the US Army has conducted a series of Training and Doctrine Command (TRADOC) funded joint experiments with a significant enemy UAS threat. These experiments included the Fires Battle Lab's Earth Wind and Fire (EWF) 2008 and 2009 experiments and 2010 Army Functional Concepts Integration Experiment (AFCIE) at Ft Sill, OK, the Mission Command Battle Lab's Omni Fusion 2008 and 2009 experiments at Ft Leavenworth, KS, and the 2011 Joint Forcible Entry Warfighting Experiment (JFEWE) run by the Maneuver Battle Lab at Ft Benning, GA. In each of these experiments the AF provided support in the form of personnel, and in several of the larger experiments the AF provided modeling and simulation support. This article discusses the major AF UAS defense insights gained in the above TRADOC experiments with a focus on the operational level of war, and recommends UAS defense be a topic of discussion at the 2012 Army Air Force Warfighter Talks.

To understand the AF insights, it is necessary to discuss briefly the UAS categories or groups, the scenarios for the experimentation, and the definition of air superiority with respect to UAS.

"Counter UAS is a prevalent problem that we only think is going to get bigger"

Brigadier General, Jeff Colt, USA, Commander, Joint Unmanned Aircraft System Center of Excellence (JUAS COE).[2]

UAS CATEGORIES

Joint Publication (JP) 3-30, *Command and Control for Joint Air Operations*, categorizes US UAS in five groups as per the table below.[3]

UAS Category	Maximum Gross Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Air Speed (Kts)	Modelos de UAS
Group 1	0-20	<1200 AGL	100 kts	Wasp III, TACMAV, RQ-14A/B, Buster, BATCAM, RQ-11B, FPASS, RQ16A, Pointer, Aqua/Terra, Puma
Group 2	21-55	<3500 AGL	<250 kts	Scan Eagle, Silver Fox, Aerosonde
Group 3	<1320	<18000 MSL	<250 kts	RQ-7B Shadow, RQ-15 Neptune, XPV-1 Tern, XPV-2 Mako
Group 4	>1320	<18000 MSL	Any Airspeed	MQ-5B Hunter, MQ-8B Fire Scout, MQ-1C ERMP, MQ-1 A/B/C Predator
Group 5	>1320	>18000MSL	Any Airspeed	MQ-9 Reaper, RQ-4 Global Hawk, RQ-4N BAMS

Above Ground Level (AGL), Mean Sea Level (MSL)

During the Army experiments, the simulations focused on Group 3, 4, and 5 UAS and did not include actions against enemy Group 1 and some Group 2 systems. The author acknowledges that the small UAS in Group 1 and 2, often referred to as "backpack UAS" are a problem; however, unless otherwise noted, the lessons learned and recommendations are for larger Group 2 and Group 3 and 5 UAS. For the purpose of this paper, the author uses the US Joint term Unmanned Aircraft System (UAS) for all unmanned

systems, including the former Unmanned Aerial Vehicle (UAV) referenced in some of the source documents.

SCENARIOS

The majority of these experiments were based on variants of the May 2007 TRADOC "Multi-Level Scenario Module 1: 7th Division," produced by the TRADOC Analysis Center (TRAC) at Ft Leavenworth, KS. The enemy was a "hybrid threat" as defined in current Army Doctrine, and simultaneously employed both regular and irregular forces.[4] In all of the experiments the Army's "World Class Red Forces" employed some number of UAS against friendly ground forces in a division operations area. Some experiments had larger numbers of UAS than others; however, regardless of the phase the experiment occurred in (i.e., JP 5-0 Phase II Seize Initiative, Phase III Dominate, or Phase IV Stabilize) the red forces employed UAS. These experiments focused on conditions at the start of each experiment, rather than the specific "shaping" prior to entry of the ground forces. How the Joint Force Commander/Joint Force Air Component Commander executed theater wide air interdiction and offensive counter air campaigns against the enemy UAS threat during the scenario's early Phase II operations remains unknown. Neither the AF nor the Army gained a concrete understanding of the numbers, types, and percentages of enemy UAS that *could* be attritted by air component, SOF, and long range fires prior to introducing ground forces. Electronic warfare and cyber capabilities were not employed against enemy UAS in any of the experiments.

All of the experiments assumed a Joint Forces Air Component Commander (JFACC) who also served as the Airspace Control Authority (ACA) and Area Air Defense Commander (AADC). When required, the JFACC was the supported commander for the theater wide air interdiction campaign and the supported commander for counter air.[5] AF personnel simulated an Air Operations Center (AOC), Control Reporting Center (CRC), Air Support Operations Center (ASOC), and Tactical Air Control Parties (TACP) at division and below for the experiments. Army personnel simulated Air Defense Artillery Fire Control Officers (ADAFCO) and were co-located with the appropriate AF CRC elements to simulate a Sector Air Defense Command (SADC). The SADC allowed the experiment JFACC to simulate the AADC commit and engagement authorities within the experiments.

AIR SUPERIORITY AS IT RELATES TO ENEMY UAS

JP 1-02 defines air superiority as, "that degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without *prohibitive interference* by the opposing force." With respect to enemy UAS, each component, land, sea, and air, gets a vote on what constitutes "prohibitive interference." During the above listed experiments there were two

questions that were difficult to answer. The first being, how many UAS does the enemy have to fly over the land component AO before they become a prohibitive interference? Which leads to the second question, if the enemy can fly his UAS in proximity to friendly ground forces does the US have air superiority?

The answers to both questions often fall into the dreaded "it depends" category. With respect to the number of enemy systems, much depends on what the ground forces are doing at the time, and what mission the enemy UAS is conducting. A single UAS directing long range precision fires on a forcible entry can have devastating effects on friendly troops. Whereas multiple short range systems not linked to fires might have a lesser effect on ground troops conducting stability operations.

It is important to note that the US has been engaged in ten years of war with air supremacy. JP 1-02 defines air supremacy as, "that degree of air superiority wherein the opposing air force is incapable of effective interference." Whether or not the US can achieve air supremacy in the face of an opponent who has effective UAS systems remains to be seen, air supremacy was not achieved in any experiments listed above.

INSIGHTS

Observations obtained during the experiments led to the formulation of the following seven major AF UAS defense insights.

INSIGHT #1: THE JOINT FORCE MUST COUNTER ENEMY UAS TO ACHIEVE AIR SUPERIORITY

Throughout the experimentation when the enemy could consistently fly UAS systems in the vicinity of friendly ground forces, the supported commanders generally felt the enemy UAS were a "prohibitive interference." Thus, using the joint definition of air superiority, one would assume that a consistent enemy UAS threat creates a prohibitive influence and logically this means the US did not have air superiority. The only way to prevent consistent enemy UAS activity was to defeat either the enemy aircraft, ground stations (including crews), or communications. Therefore, if the joint force cannot effectively counter the enemy UAS, then air superiority cannot be achieved.[6]

INSIGHT #2: UAS Defense is a Joint Endeavor

Shortly after the 2008 EWF experiment at Ft Sill, both the AF and the Army agreed to bring the Joint UAS Center of Excellence (JUAS COE) into the experiments to assist with UAS defense. From the outset, the UAS experts guided the AF/Army team towards a joint solution that linked air and ground based radar, optical, and electronic sensors from multiple services (experimentation included Navy Aegis) to create a common operating picture enabling UAS defense. Systems included all current Air Force and Army radars, E-3, counter rocket and mortar (CRAM), Army Joint Land-Attack Cruise Missile

Defense Elevated Netted Sensor System (JLENS), SENTINEL, and various current and future short range air defense systems. In addition, the EWF experiments had Army high altitude airship (HAA) with a variety of systems. These Army ground and air based systems, coupled with AF and Navy airborne and ship based radars, were critical to the UAS defense fight. The JUAS COE participated in multiple experiments prior to the organization disbanding in 2011.

Virtually all of the twenty plus JUAS COE recommendations involved linking sensors of one service or functional component with sensors or systems of another. The JUAS COE also recommended further study of time sensitive dynamic re-tasking of airborne ISR and electro optical sensors to enable air defense visual ID.[7]

INSIGHT #3: ENEMY UAS ARE PART OF THE COUNTER AIR CAMPAIGN

"After all, the great defense against aerial menace is to attack the enemy's aircraft as near as possible to their point of departure."

Winston Churchill
Memo of 5 Sept 1914[8]

Because UAS are part of the enemy air threat, the joint force should make every effort to target them on the ground. Quoting from JP 3-01, "*Countering Air and Missile Threats*,"

Offensive Counter Air (OCA) operations normally have a high-priority as long as the enemy has the air and missile capability to threaten friendly forces and the JFC does not have the degree of air superiority desired to accomplish the objectives required for the end state. OCA operations reduce the risk of air and missile attacks, allowing friendly forces to focus on their mission objectives. The preferred method of countering air and missile threats is to destroy or disrupt them prior to launch using OCA operations conducted over enemy territory.[9]

Therefore, if the joint force believes enemy UAS will create problems for any component, these systems should be considered in the Joint Intelligence Preparation of the Operational Environment (JIPOE) and enemy UAS should be added to the Joint Integrated Prioritized Targets List (JIPTL) in accordance with JP 3-60, and targeted from the outset of the engagement. There was little doubt enemy UAS were a valid threat in the experiments. Paraphrasing from the AF after action report for EWF 2009, "numerous enemy UAS operating at low altitude over the division's AO negatively affected both fires deconfliction and airspace control."[10]

One of the hardest tasks for the air component during these experiments dealt with controlling high speed fighters operating at low altitude over the ground commander's AO. The fighters were forced to drop down to identify and engage low slow-moving enemy UAS, often in close proximity to friendly UAS and rotary wing aircraft. More on this issue later; however, the more enemy UAS that can be defeated on the ground prior to entering the ground

commanders AO, the better. In future conflicts enemy UAS must be part of the counter air campaign with both kinetic and non-kinetic attack options. Finally, to fully understand the threat from enemy UAS, future AF/Army experimentation events need to include a realistic UAS defense effort at the beginning of Phase II, whether the ground force has entered the theater or not.

INSIGHT#4: AIRSPACE CONTROL AND FIRES DECONFLICTION ARE TOUGH TO DO WITH ENEMY UAS IN YOUR AIRSPACE

In accordance with JP 3-01, airspace control is defined as, "a process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace." As mentioned earlier, these experiments were conducted with a JFACC acting as the ACA in accordance with joint doctrine. The JFACC/ACA is responsible for producing the airspace control plan ACP (for approval by the JFC) and the airspace control order (ACO) for joint operations. The ACA takes airspace requests from the components and builds airspace control measures and fire support coordination measures into the ACO. If conflicts arise during the ACO planning process the ACA's staff makes every effort to resolve the conflict to allow the airspace requesters and fires planners a reasonable expectation that they will have access to the airspace they request. Once the ACO is published, changes must be handled in real time by the agency that controls the airspace. If two entities, whether aircraft or fires, attempt to occupy the same airspace at the same time, the controlling agency gives the nod to the entity with the highest priority. The more uncertainty in the Joint Operations Area, the more real-time changes are required to the ACO, which leads to more real-time airspace control by the controlling agencies. The ACA can delegate authority to control airspace to component airspace control elements, however, only the Joint Force Commander (JFC) "owns" airspace. During all of the experiments defensive counter air aircraft were given the highest priority and frequently had to enter airspace reserved for other users to deal with enemy UAS.

In addition to the airspace control responsibilities the JFC levies on the ACA, and in accordance with JP 3-01, the JFC normally will designate the JFACC as the AADC and the supported commander for counter air. The JFACC/AADC develops, integrates, and distributes a JFC approved joint area air defense plan (AADP). Further, the JFC grants the AADC the necessary command authority to deconflict and control engagements and to exercise real-time battle management.[11]

The JFC delegates the JFACC/AADC the authorities of identification (ID), commitment, and engagement. The JFACC/AADC conducts decentralized execution of air defense through regional and sector air defense commands (RADCs and SADCs) and can delegate these commands ID, commit, and engagement authority.[12] RADCs and SADCs control the air defense mission from the surface up to whatever altitude is required, including space. The JFACC/AADC does not delegate air defense authority to the ACA's airspace control agencies; he/she delegates it to air defense commands. This means that

ACA delegated airspace does not come with the authority to conduct air defense (other than self defense by aircraft or short range ground systems).

Based on more than 10 years of combat activity in Iraq and Afghanistan, the ACO process works fairly well in an environment where the US has air supremacy For the most part, supported commander's airspace requests are approved without fear of the airspace being taken away by another supported commander with a higher priority (this discussion deliberately excludes SOF forces).

Conversely, without air superiority, when the JFACC/AADC responds to a low altitude UAS threat over a ground commander's AO, joint doctrine requires the JFACC to coordinate with the supported ground commander. Because of their time-sensitive nature, DCA operations require streamlined coordination and decision-making processes.[13] To be effective, air defense assets, particularly fighters, must fly their flight tracks and altitudes with respect to the threat rather than in preplanned airspace or routes built into the ACO. Air defense intercepts over a ground AO require real time air battle management and real time deconfliction with ACMs and FSCMs. Observations have shown that even a few enemy UAS over a ground commander's AO can cause airspace control to break down if the JFACC/AADC cannot control engagements and conduct real time battle management while deconflicting with fires and other airspace users.[14]

Soldiers of Detachment 1, Company B, 116th Brigade Special Troops Battalion, 116th Brigade Combat Team train on flying and maintaining RQ-7B Shadow unmanned aircraft systems (UAS) at Camp Shelby, Miss. (Photo by SSG Andrew H. Owen, U.S. Army)

INSIGHT #5: AIRSPACE CONTROL WITHOUT AIR SUPERIORITY DEMANDS POSITIVE ID, AND WHEN REQUIRED, POSITIVE CONTROL.

If enemy UAS are present over an area of operations, then the JFACC must fight for air superiority while simultaneously conducting other operations,

including those in support of the ground commander. Until air superiority is achieved the AADC requires a higher level of control to conduct air defense than the ACA requires for airspace control. The AADCs requirements to provide threat warnings, control engagements, and exercise real time battle management necessitate the ability to rapidly move from procedural control, to positive control—at least until air superiority is achieved. Forces conducting distributed operations solely with "procedural control" do so at a much higher risk when enemy aircraft are present.[15] Air defense elements must have real time visibility of all friendly aircraft and the ability to communicate with them in real time to conduct effective UAS defense operations. This is in keeping with joint air defense doctrine which states, "unity of effort, centralized planning and direction, and decentralized execution have proven to be vital tenets for countering air and missile threats that may have an engagement window of only a matter of minutes".[16]

INSIGHT #6: JOINT AIR GROUND INTEGRATION CELL (JAGIC) TTP CAN ASSIST GROUND COMMANDERS IN THE UAS DEFENSE FIGHT

The AF integrated its ASOC and TACP personnel with Army Fires, AC2, Aviation, and AMD personnel at the division level in the '08 and '09 EWF experiments as well as the 2010 AFCIE and the 2011 JFEWE. This placed AF and Army C2 personnel into a single C2 cell with authority delegated by their respective commanders to integrated and control their component assets. According to both Joint and AF Doctrine, an ASOC is the primary control agency component of the Theater Air Control System for the execution of CAS and is directly subordinate to the Air Operations Center (AOC) in direct support of its assigned Army echelon.[17] The ASOC is delegated authority from the JFACC over the air component sorties operating in direct support of that Army echelon. The ASOC does not have authority over air defense forces; however, air component systems conducting defensive counter air operations over a ground commander's AO will normally coordinate with the ASOC to deconflict from fires and organic Army aviation assets.

For the past six years the Air Force and Army have been developing the Joint Air Ground Integration Cell (JAGIC).[18] ""During experimentation with JAGIC, the ACA delegated a volume of airspace, either below a coordinating altitude or within a high density airspace control zone (HIDACZ) to the cell to conduct airspace control on behalf of the ACA in support of the supported division. While the JAGIC is not delegated air defense ID, commit, or engagement authority from the JFACC/AADC, it is the organization the RADC or SADC coordinates with when air defense assets enter airspace controlled by the AF/Army team at division. [19]

In all of these experiments, JAGIC showed significant promise in the fight against enemy UAS by integrating Army tactical ADA into the theater air defense architecture enabling direct coordination with AADC C2 nodes. AF air battle managers within the JAGIC rapidly passed threat UAS—first detected operating over the division AO to the JFACC's SADC and the Army Air Defense

Artillery Fire Control Officer (ADAFCO). Both the SADC and the ADAFCO were able to rapidly ID and engage enemy UAS that were identified on the COP using the best asset available. The JAGIC also increased battlespace awareness by advising track producers of the correct ID when JAGIC had SA of a track being reported incorrectly. In a few instances, the decision was made to re-role available CAS aircraft to engage the threat. Information flow, up the chain, worked well in virtually every experiment and provided the supported ground commander rapid access to joint air defense capabilities. In addition, JAGIC members were able to find and target enemy UAS launch sites within the division AO and destroy the UAS prior to launch.[20]

JAGIC also conducted a limited amount of real time fires deconfliction and control of ACMs to allow air defense fighters to operate in the division controlled airspace. As would be expected, these tasks were easier in airspace with a low density of firing systems and ACMs, and harder as the density increased.

Unfortunately, JAGIC was less capable of passing information about enemy air threats down the chain. As mentioned previously, the JFACC/AADC has a requirement to provide timely threat warnings and control air-to-air engagements. Due to the distributed nature of mission command, the Army does not have a single element with authority, visibility, and rapid communications with all Army assets, to include aviation assets, operating within the airspace in the time required to conduct UAS defense activities. This required authority does not infer that the Army C2 elements have the power to change the asset's mission or issue new "mission type orders," it merely needs the ability to know what is flying where and to move them out of the way either to affect that asset's survival, or to enable a higher priority mission.[21]

INSIGHT #7: ARMY AIR DEFENSE ASSETS REQUIRE A STANDARD "CALL FOR AIR DEFENSE" TACTICS, TECHNIQUES, AND PROCEEDURES (TTP)

Thus far in this article there has been no discussion of short range air defense (SHORAD). Army Air Defense elements experimented with a number of different systems in the above-listed TRADOC experiments. The air defense community relies on a common operating picture (COP) composed of feeds from a number of sensors including AWACS, ground and ship based radars, and other systems such as the Army Joint Land-Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS). The COP displays friendly systems and raw data for systems that are unknown. One of the primary tasks of air defense elements is to identify unknown tracks and tag them as enemy, friendly or unknown.

In many cases the first person detecting a small, slow enemy UAS will be a soldier on the battlefield. If the soldier can confirm the UAS is an enemy system, he/she has taken the first and often hardest step in the UAS defense kill chain and conducted the ID. Getting what the soldier knows on the COP so the UAS can be engaged by either SHORAD or other air defense assets is the

next important step; however, a standard service or joint air defense request system for visual ID does not currently exist.

The Army and AF need to develop a Joint Air Defense Request System that would include request network and TTP to enable radar and/or COP operators to correlate visual detections from ground units and enable follow on engagements.[22]

The 163rd Reconnaissance Wing MQ-1 Predator is shown during post flight inspection at dusk from Southern California Logistics Airport, formerly George Air Force Base, in Victorville, Calif. (Photo by Master Sgt. Stanley Thompson, U.S. Air Force)

CONCLUSION

USAF participation in Army Experimentation has resulted in a number of significant insights for the AF/Army team, among them UAS defense. Taken holistically, these experiments have identified UAS defense as a joint endeavor from the outset. Enemy UAS must be considered in Phase II targeting and affect the JFC's ability to gain and maintain air superiority. Effective UAS defense operations require the joint force to fuse air and ground based sensors in a real time common operating picture enabling the force to detect and engage threat UAS using lethal and non-lethal options. Command and control of air defense assets must allow rapid UAS engagement while simultaneously providing threat warnings and controlling individual UAS attacks without fratricide. All of this must occur while integrating UAS defense operations with airspace control and fires. If this sounds hard, it's because it is.

As future experiments unfold, it is critical the joint force understands the UAS threat and options for dealing with it in order to validate required capabilities and identify gaps. This must include the small "backpack" Group 1 UAS that were not part of these experiments. At some point, the AF/Army team needs to conduct a Phase II, UAS defense event to develop a realistic expectation of attrition on enemy UAS in scenarios requiring forcible entry operations. Finally, the author recommends UAS defense be a topic in the 2012 Army - Air Force Warfighter Talks. This topic should include kinetic and non-

kinetic options for engaging enemy UAS and the required level of command and control to engage these time sensitive targets. It should also include a way ahead for a "call for air defense" TTP as discussed in insight #7 to ensure distributed ground forces have the capability to defend against enemy UAS. As part of the warfighter talks, both services need to have a frank discussion on the effect of enemy UAS with respect to the current concept of air superiority. The US cannot afford to give up the high ground, regardless of the type of threat a potential enemy brings to bear.

Notes

1. Benjamin S. Lambeth, *Air Operations in Israel's War Against Hezbollah,* (Santa Monica: RAND Corporation, 2011), 130.
2. Josh LeCappelain, "Blue Knight 2010 demonstration concludes in Nevada," USJFCOM Public Affairs, (11/23/10), http://www.defpro.com/news/details/19904/ (Accessed 11/4/11).
3. JP 3-30, *Command and Control for Joint Air Operations*, 12 Jan 2010, Figure III-15, p III-33.
4. TRADOC Pam 525-3-0, Army Capstone Concept, 21 Dec 2009, defines a "Hybrid Threat" in the 2009-2025 Operational Environment as, "A threat that simultaneously employs regular and irregular forces, including terrorist and criminal elements to achieve their objectives using an ever-changing variety of conventional and unconventional tactics to create multiple dilemmas."
5. JP 3-0, *Joint Operations*, 13 Feb 2008 CH(1), p xvi.
6. Don Forrer and Matt Neuenswander, "AF/A5XS AND LEMAY CENTER DETAILED AFTER ACTION REPORT JOINT FORCIBLE ENTRY WARFIGHTING EXPERIMENT 2011**,"** Prepared for US Army Mission Command Battle Lab, 13 May 2011.
7. Steve Brunskole and Tim Duerson, UNITED STATES AIR FORCE AFTER ACTION REPORT FOR ARMY FUNCTIONAL CAPABILITIES INTEGRATION EXPERIMENT 2010 & JOINT EXPEDITIONARY FORCES EXPERIMENT, ANNEX 3 JUAS COE, p 1-5.
8. JP 3-01, *Countering Air and Missile Threats*, 05 Feb 2007, p IV-1.
9. Ibid.
10. Matt Neuenswander, United States Air Force After Action Report for Earth, Wind, and Fire 2009, Prepared for US Army Fires Battle Lab, 1 Oct 2009, p18.
11. JP 3-01, *Countering Air and Missile Threats*, 05 Feb 2007, p II-1.
12. Ibid, p III-16.
13. JP 3-01, *Countering Air and Missile Threats*, 05 Feb 2007, p xvii.
14. Matt Neuenswander, UNITED STATES AIR FORCE AFTER ACTION REPORT FOR ARMY FUNCTIONAL CAPABILITIES INTEGRATION EXPERIMENT 2010 & JOINT EXPEDITIONARY FORCES EXPERIMENT 10-4, Prepared for US Army Fires Battle Lab, 9 Sep 2010, p 6-10.
15. Ibid, p 8.
16. JP 3-01, *Countering Air and Missile Threats*, 05 Feb 2007, p I-1
17. JP 3-09.3, *Close Air Support*, 08 Jul 2009, p 2-6
18. JAGIC is a concept to enhance joint collaborative efforts to deconflict joint air-ground assets. Designed to be established within the Army Division Tactical Operations Center (TOC), JAGIC provides commanders the ability to coordinate, deconflict and control three dimensional operations in the airspace overlying the division Area of Operations (AO) in real-time or near-real-time (RT/NRT). The JAGIC concept co-locates decision making authorities from the land and air component with the highest level of situational awareness (SA). To support the maneuver commander's concept of operations, the JAGIC collaborates to more effectively execute the mission and reduce risk at the lowest levels.
19. Air Force Command and Control Integration Center, Joint Air Ground Integration Cell Concept of Employment, 8 Aug 2011, p 6.
20. Joint Unmanned Aircraft System Center of Excellence, United States Air Force After Action Report for Earth, Wind, and Fire 2009, Prepared for US Army Fires Battle Lab, 1 Oct 2009, Annex 3, p 4.

21. Don Forrer and Matt Neuenswander, "AF/A5XS AND LEMAY CENTER DETAILED AFTER ACTION REPORT JOINT FORCIBLE ENTRY WARFIGHTING EXPERIMENT 2011**,"** Prepared for US Army Mission Command Battle Lab, 13 May 2011, p 19.
22. Matt Neuenswander, United States Air Force After Action Report for Earth, Wind, and Fire 2008, Prepared for US Army Fires Battle Lab, 8 Jul 2008, p 11.

Colonel D. Matthew Neuenswander, USAF-Retired, is the director of the USAF Curtis E. LeMay Center's Joint Integration Directorate and serves as the Air Force's senior doctrine representative to both TRADOC and the Combined Arms Center at Ft Leavenworth, KS. He is a graduate of the US Air Force Academy, Air Command and Staff College (ACSC), Air War College (AWC), and the School of Advanced Military Studies (SAMS) Fellowship. He flew both A-10s and F-16s and commanded a fighter squadron, an Air Expeditionary Group in combat, and was Commandant of the Air Force Air Ground Operations School. He is a veteran of Iraq and Afghanistan and with combat time in both theaters.