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Assimilating Unmanned Aircraft Systems

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Envisioning future unmanned aircraft systems (UAS) as stand-alone weapons is not productive. As these aircraft evolve, legacy systems will advance, and enemies will simultaneously adapt. The resulting mix of future UASs and modernized legacy systems—as well as adaptive enemies—requires uniquely designed organizations, career paths, and strategies. In the following discussion, four airpower theorists and analysts consider historical lessons and current trends that might help airmen build the right combination of leaders, concepts, and institutions to realize the full potential of unmanned aircraft.

Air Vice-Marshal Tony Mason: The assimilation of UASs into national air forces is moving briskly, but in an astonishing array of directions. If there is a clear path to the future for these systems, no one has captured it to my satisfaction. Dick Szafranski and Jeffery Barnett, both of Toffler Associates, you are published futurists on airpower. Sung-pyo Hong, your air force is on a continuous war footing, so you can keep these two futurists grounded in current realities. My questions to the three of you are, "How should airmen assimilate UASs, and what is the best path to the future of these aircraft?" Jeffery, lead us off.

Jeffery Barnett: As a first principle, I think we have to remember that weapons are additive. When new weapons emerge, they add to arsenals; they seldom subtract. For example, today's soldiers don wearable computers—but they still train to kill with knives and rifle butts. Naval ships track and destroy satellites in orbit—but they still carry cannons on their decks. The new F-22 Raptor has supercruise engines, advanced avionics, and stealthy coatings—but it

is still armed with a machine gun. It is a mistake to suppose that new weapons retire their predecessors. New weapons and methods *expand* the scale of war; they don't replace it. Warriors retain the weapons of the past because previous means of war making endure. The small number of weapons that fade away over time, such as sailing ships and horse cavalry, is far too few to refute the additive nature of weaponry.

Dick Szafranski: Types of war are also accretive. Conventional war did not make insurgencies obsolete. Nuclear war did not make insurgencies and conventional wars obsolete. Cyberwar will not make nuclear, conventional, and insurgent wars obsolete. Just as the Third Wave information age changed, but did not replace, the way societies manufacture and farm, so will new waves in warfare change, but not replace, humankind's previous ways of violence. Tribes will still war over land, using First Wave (agrarian age) tools; nations will still war over fuels for factories, using Second Wave (industrial age) tools; and future societies will war over cyberspace, using Third Wave (information age) tools. These three types of war—and all the other types developed by humans over millennia—will inevitably remain.[1] So when we envision future UAS operations, we have to see them in the context of all types of war.

Jeff: Your comments remind me of an interchange during the Air Force chief of staff's confirmation hearing. Senator Daniel Akaka asked Gen Norton A. Schwartz if he believed that the Air Force should continue building its counterinsurgency capabilities or if he thought that doing so would adversely affect preparations for building the future Air Force. General Schwartz replied, " 'Fundamentally, I do not believe it is an either/or condition. . . . The United States Air Force, like the other services, needs to be a full-spectrum capability. . . . The bottom line, Senator, is that we as an Air Force can provide both the kind of concentrated effort required by the joint team in Central Command today and posture ourselves for future potential adversaries at the same time.' "[2]

When it comes to unmanned systems, I think that the guidance from the chief of staff is clear—and reasonable. The US Air Force will develop UASs that integrate with the rest of the force to fight across the spectrum of conflict.

Col Sung-pyo Hong: I think that all of these points are right. Legacy weapons and types of war don't go away. They just absorb new systems to create new military effects. In fact, shouldn't we expect UASs to combine with legacy systems—to produce effects greater than the sum of their parts?

Jeff: I couldn't agree more. Just as warriors of the past integrated industrial- and agrarian-age weapons to fight over resources and land, so will future warriors integrate industrial-, agrarian-, and information-age weapons to fight over resources, land, and cyberspace. Insurgents, for example, will fuse information-age cell phones with industrial-age artillery shells to war over tribal homelands that formed in the agrarian age. They will fuse multiple means of war to produce effects that exceed the power of any single weapon or type of war.

It is the product of this fusion that modern warriors must seek to understand. With this knowledge, they can build operational concepts to master the wars of their generation, and they can develop the talents needed to command modern war as well as the tools to prosecute it. Because we need tools and talent to produce and execute new operational concepts—and because those new concepts demand particular types and numbers of tools and talent—the entire process is iterative. Militaries that seek to posture for the next war must fuse weapons, concepts, and talent in parallel.

Dick: That's the point. Today's generation of military professionals must incorporate UASs into their calculus of future war. These platforms offer revolutionary capabilities on a par with radar, jet engines, surface-to-air missiles, precision weapons, and stealth. Like these previous revolutionary capabilities, UASs will realize their full potential only when fused with legacy systems, novel concepts of operation, and innovative organizational structures.

Jeff: This fusion is easier said than done. Humans tend to use a new capability as simply an improved version of a previous capability. For example, office workers initially used personal computers as word processors. To an ex-

tent this was valid—desktop computers made an existing task (typing) easier and faster. However, desktop computers eventually inserted new functions and ways of operating into our offices. Lots of people fought this transformation for years, holding on to secretaries, refusing to allow telecommuting, and insisting that all staff work arrive in bound form. Those people slowly lost out in the competitive workplace. The lesson learned from the growth of personal computers is that although the initial change may be linear (and compatible with existing structures), the eventual effects may undermine those same structures.

Hong: In other words, understanding new technologies simply as improved versions of their predecessors has a short half-life. Can you apply this theory directly to the UASs of today?

Dick: As we fuse unmanned aircraft with legacy systems to produce new operational capabilities, we need to think of UASs as far more than just uninhabited versions of manned aircraft. Though true, this linear perspective is less and less relevant. UASs are more than just airplanes without pilots, just as cell phones are more than just phones without wires. Our challenge is to foresee where UASs will evolve in unique ways—and then build future concepts of operation and organizations accordingly.

Tony: Let me expand on your point. A need exists for more fusion than that simply between current and future weapons, concepts, and talent. At present, the structure of UAS operations is the legacy of an earlier era. It is determined by location rather than by function. Horizontally, it corresponds to the boundaries of theatres and commands. Vertically, the structure distinguishes among outer space, inner space, and atmosphere. The functions and capabilities of UASs already transcend earthly features. Satellites are unmanned systems. The new structure must reflect function—not location or propulsion. It must present a seamless fusion of netted UASs, responsive to one central executive but flexible enough to remain accessible and available at any operational level. That will require rethinking existing bureaucratic and hierarchical formations, which might prove more difficult than deploying the aircraft themselves.

Hong: This is exactly what Mr. Andrew Marshall of the Office of Net Assessment articulated in his theories on the revolution in military affairs. He said that radically new technologies required new concepts of operation and new organizational structures to realize their full potential. He also said that the first step in building concepts and organizations for the future involved projecting the realistic potential of new technologies.[3]

Dick: We can't predict the future or know what's ahead with precision, but we can project that enabling UAS technologies will continue their rapid advance. Moore's Law endures: bandwidth and computer-processing speeds continue to double every 18 months. Knowledge is now digitized, permitting the rapid sharing of cross-discipline data by billions of people. New types of sensors are spewing from the medical and security spheres. Global spending on information and communications will soon pass $4 trillion a year.[4] Individually, these trends show no signs of slowing. Viewed collectively, they promise logarithmic advances for years to come in multiple technologies enabling UASs.

Hong: If your projections prove true, the UAS of the future will have a full range of capabilities. In Korea we are beginning the debate on employing these systems in air-to-air or air-to-ground combat. Most airmen agree that UASs will eventually take part in future combat missions. Our question is, "When will this happen?" The current consensus is that UAS combat capabilities will lag behind those of manned aircraft for some time.

My personal guess is that our air force will continue to invest in manned fighters, such as the A-50 or a more capable future KFX. We will gradually increase the roles of unmanned aircraft. They will get more attention, but our UAS focus, at least for the midterm, will remain on constant surveillance and reconnaissance.

Jeff: The prospect that UASs will produce constant surveillance is profound. We have never lived in a world where potential aggres-

sors operated under such surveillance. Consider, for a moment, Heisenberg's uncertainty principle, which theorized that the very act of observation affects the object observed.[5]

Though envisioned for physical behavior, this theory would seem to apply to organic behavior as well. If fleets of UASs can persistently observe potential aggressors and if the very act of observation can affect actions, then it follows that skillfully applied observation can have a dynamic effect on adversary nations. In essence, persistent surveillance from UASs may allow militaries to influence enemies through skilled observation.

Anyone who has shined a flashlight on bugs in the basement understands this principle. As soon as the light shines on them, the bugs start scurrying about. Illuminating the bugs changes their behavior.

Dick: Viewed in this light (sorry for the pun), it's clear that UASs will soon offer degrees of persistence unavailable to previous generations of military leaders. They will loiter in massive numbers over practically any point on the earth for days (even months) at a time. Fleets of unmanned aircraft will offer persistent intelligence, surveillance, and reconnaissance; persistent strike; and persistent logistics. These UASs will take full advantage of persistent development. The absence of a human in the cockpit allows far more aggressive and risk-intensive approaches to experimentation, production, and adaptation. An entirely new industrial base should emerge to leverage persistent development.

Jeff: This kind of persistence has strategic implications. The persistent effects made available through UASs, in concert with other joint military capabilities, open new possibilities for persistent deterrence. Nations can persistently engage with other nations—and with insurgents—for extended periods without overtasking manned systems. To meet the emerging "long war" against global terrorism (a type of persistent conflict), nations can engage persistently with UASs. They enable persistent effects against a persistent enemy—at operational tempos that militaries can sustain indefinitely.

Tony: The Heisenberg principle is well founded, and the constant observation promised by UASs may indeed allow "manipulation" of an opponent's behavior. An intelligent opponent who is aware of the threat from UASs, however, may respond with behavior that becomes more difficult to detect, identify, and anticipate. An opponent not constrained by time, unscrupulous in the exploitation of innocents, and impervious to casualties will seek new methods of concealment, deception, and duplicity to counter the observation technologies orbiting above.

Jeff: Enemies will certainly react, but their options will be limited by the scope of potential observation. Let's talk in terms of aviation history. Currently deployed UASs will soon seem as quaint as a Wright Flyer. After all, it took just 15 years for manned aviation to progress from Kitty Hawk to Billy Mitchell's 1918 St. Mihiel offensive with 1,500 Allied fighters and bombers. Within another decade, aircraft were exceeding 300 miles per hour, Charles Lindbergh had flown the Atlantic, and Robert Goddard was launching liquid-fueled rockets. Ten years after that (1938), radar was invented, the DC-3 (with autopilot) was flying coast-to-coast, and jet engines were on the test stands (the first jet-powered aircraft flew in 1939). History's lesson is that aviation technologies advance rapidly.

Hong: Putting these two thoughts together, we clearly see great potential. Aviation's inherent freedom and flexibility, combined with the global information revolution, leave no room for conservative projections of future capabilities. The UAS of 10 to 15 years from now will perform far differently than the one in development today. Given the speed of the information age and its enabling technologies, we should prepare for remarkable UAS advancements in the near future.

Jeff: All of us must avoid "old think." Consider the fact of institutional transformations. Almost 90 years ago, the United States Navy began an equally audacious transformation. The slow-moving fleet of history adopted the airplane. Although sailors accepted it at varying rates, naval leadership in 1921 set a firm course, probably with full awareness of the possible end game, by creating a single institution—within the Navy—to develop naval aviation.

The Bureau of Aeronautics combined decentralized Navy aviation organizations into a single team. It developed technologies, concepts, and personnel for naval aviation as an integrated whole. The bureau built naval aviation while simultaneously integrating its vision with parallel developments across the fleet.

Even more important than creating the bureau was selecting its initial leadership. The Navy chose its best—Rear Adm William A. Moffett, Medal of Honor recipient and battleship commander—as first chief of the bureau. He led it not only with aggressiveness but also for a remarkably long time—12 years (until he died during the crash of the airship *Akron* in 1933). Moffett had the credibility and longevity to implement his acquisition and personnel plans. His successor, Rear Adm Ernest King, had similar stature, eventually rising to five-star rank as chief of naval operations in World War II.

By picking leaders of this standing, the Navy proved its commitment to naval aviation. Leadership of such caliber and longevity gave officers the confidence to bet their careers on naval aviation. This leadership also signaled to the entire Navy to get on board—a crucial step to overcome bureaucratic resistance to transformation of this scale.

Dick: I seem to recall that the Navy replicated this model when it integrated nuclear propulsion. Adm Hyman G. Rickover, the head of Naval Reactors for over three decades (1949–82), personally vetted every officer applying for nuclear-engineering duty. Under Rickover, Naval Reactors executed comprehensive responsibility for the development, design, test, and operation of the Navy's nuclear-propulsion program. As with aviation, the Navy combined all elements of a revolutionary technology into one department and entrusted one individual with authority and longevity. This combination attracted and nurtured top talent while overcoming institutional resistance to new technologies.

Jeff: Recall also that the Air Force took a similar approach with Strategic Air Command (SAC). Within about a decade, SAC had deployed revolutionary weapons (such as jet bombers and tankers, plus intercontinental ballistic missiles), developed an organization dedicated to nuclear warfare, and contributed to the Single Integrated Operational Plan and deterrence theory.

This transformation trinity of technology, organization, and doctrine came about under Gen Curtis LeMay and Gen Thomas Power. LeMay commanded SAC for nine years (1948–57) and then oversaw its continued development as vice-chief of staff and chief of staff of the Air Force for another eight years. Power served as LeMay's deputy at SAC for six years (1948–54) and then commanded SAC himself for seven years (1957–64). Both generals had immense credibility as combat leaders during World War II, shared the same institutional vision, and used their longevity in command to transform SAC—and the entire Air Force.[6]

In these three cases, service leaders understood that revolutionary technologies require transformation across the entire institution—and that this transformation requires focused leadership. The lesson for the Air Force's UASs is obvious.

Dick: We're in violent agreement. As an emerging and potentially revolutionary capability, UASs are on a par with the early stages of the development of manned aircraft, jets, missiles, and nuclear power. Their rapid progress will depend upon similar direction and protection. As a first step, UASs will need long-term, credible leadership to implement multiple, interrelated changes across the force. These alterations will range from personnel promotions and assignments, to acquisition and budgets, to organization and doctrine. Identifying, implementing, and following through on these broad changes is an immense task. Historically, the institution stands the best chance of carrying it out by unifying development, placing the best officer in charge, and leaving that person in power for over a decade. The fact that such longevity runs contrary to current Air Force policy reflects the need for transformational approaches.

Hong: We need to remember that UASs will progress outside the military sphere. The civil sector finds them particularly useful for "dull and dirty" missions such as monitoring climate change, tracking the pace and direction of ty-

phoons, and keeping an eye on pipelines and nuclear facilities. This is why major UAS customers include police departments, which use these aircraft for a range of law-enforcement monitoring activities as well as search-and-rescue missions. Farmers also want to use them for agricultural spraying and pest control.

Tony: The importance of a persistent UAS network cannot be overstated. It can redress a critical asymmetric weakness by promising to recover for the United States and its allies the irreplaceable advantage of time. It can enable them to sustain protracted, low intensity conflicts with acceptable political, economic, and casualty risks, or it can provide real-time response to fleeting circumstances. Persistent UASs can deny opportunities for short-term surprise and match the long-term commitment enjoyed by insurgents and other unconventional war fighters. More than that, a network of persistent UASs will enable political leaders and commanders to determine the time scale of appropriate action in anticipation, preemption, or response: a swift, real-time link between information and action in seconds, or a measured reaction over days, months, or even years.

There is also a need for caution amidst the vision and enthusiasm. Military history records the ebb and flow of technology: the swing of the offensive-defensive pendulum when a weapon or system stimulates a counter. The technology of the UAS will be no exception. The lead enjoyed by the United States is likely to reduce as the burgeoning economies of nations such as India and China enhance the indigenous skills and advanced technology of other countries. A military advantage as great as that conferred by UASs is unlikely to remain unchallenged by any state determined to preserve its own freedom of action, especially if its own airspace is invaded or threatened.

Enthusiasts have always been quick to identify airpower's potential. Although UASs do encourage us towards new horizons, our vision must include the questions "Then what?" and "What if?" We must ensure that the vision not only lies within our reach but also remains within our grasp, despite all efforts of opponents to counter it.

This conversation offers a good start—but only a start. Years will pass before the world's airmen build new concepts of operation, new organizations, and new career paths to realize the full potential of UASs.

I am also troubled by the one-sidedness of this conversation. Our adversaries will have their say. It is too bad that we can't include them in our discussion. They may open our eyes to possible impediments we are overlooking. They may also expose new vulnerabilities that UASs could exploit.

All this said, I enjoyed this dialogue. The three of you have recast my conceptions of future unmanned aircraft. For that you have my profound appreciation. ❑

Notes

1. See Alvin Toffler, *The Third Wave* (New York: Morrow, 1980).

2. John A. Tirpak, "Donley and Schwartz Step Up; F-22 Gets Some Love; Why Not Do Both?" *Air Force Magazine* 91, no. 9 (September 2008): 16, http://www.airforce-magazine.com/MagazineArchive/Documents/2008/September%202008/0908watch.pdf.

3. Andrew Marshall, Office of Net Assessment, conversation with the coauthor, 26 March 2004.

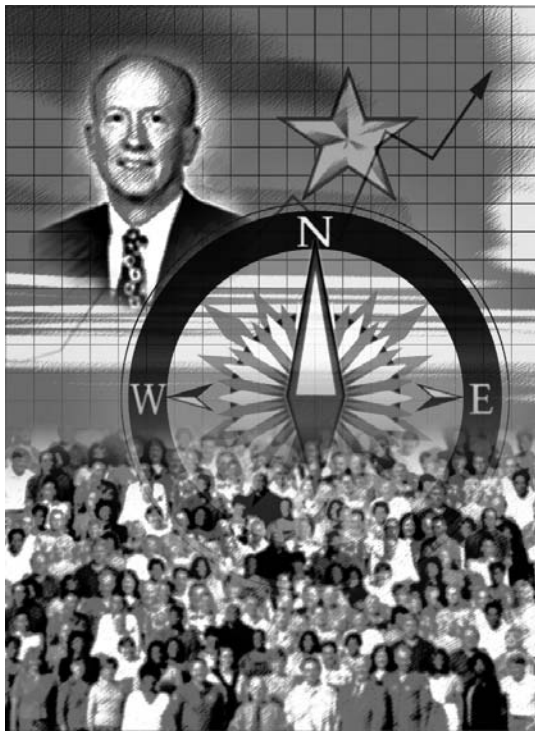
4. *Digital Planet 2008: Executive Summary* (Vienna, VA: World Information Technology and Service Alliance, May 2008), 1, http://www.witsa.org/KL08/DigitalPlanet2008ExecSummary_cover.pdf.

5. According to the Heisenberg uncertainty principle, it is impossible to observe an electron without changing it. The mechanics of observation inevitably affect the target of observation.

6. Another example: Gen Bernard Schriever, the "architect of the Air Force's ballistic missile and military space program," led this effort for a dozen years (1954–66). "General Bernard Adolph Schriever," *Air Force Link*, http://www.af.mil/bios/bio.asp?bioID=7069.

Perspectives on Leadership and Management

Dr. Raymond A. Shulstad, Brigadier General, USAF, Retired



IT WAS 21 April 2006, my retirement day from the MITRE Corporation and from my 40-year professional career.[1] As I sat in an auditorium on MITRE's Bedford, Massachusetts, campus and listened to my bosses and others praise and thank me for my contributions, I thought back over that career, which included 28 years with the Air Force, five with industry, and the last seven with MITRE. I reflected on the many different jobs I had had, the challenges I had faced, the leaders who had mentored me, and the accomplishments that I was proud of. I was struck by the fact that either the people who worked for me or my organizations—not I—should take credit for almost all of those accomplishments. They resulted from the leadership and management I had provided to people and organizations and, of course, others' hard work, initiative, and innovation.

For many years, I recognized that leadership and management, coupled with the performance of talented, hard-working people and teamwork, were the essential ingredients for an organization's success and mission effectiveness. For that reason, I placed a high priority on improving my leadership and management skills and on developing those of my subordinates. Although I was proud of the contributions I had made over the years, as I sat there listening to my bosses praise my leadership and management, I couldn't help asking myself if I had done enough to pass on my perspectives and knowledge in this critical area.

As I settled into retirement and reflected on this question, I came to believe that I should have done at least one thing that I hadn't—formally document my perspectives and knowledge in writing. However, over the past 20 years, I had developed and continuously expanded informal, unpolished notes entitled "Perspectives on Leadership and Management," which I used in a two-hour presentation at various formal and informal leadership and management training programs. I also gave this presentation (or a derivative) to my subordinates within a month of taking charge in every organization that I led. Although I had been asked for copies of my notes many times over the years, I never accommodated those requests because, although good enough for me to talk from, they were too rough to pass out to my audiences. After my retirement, I received support from MITRE

to polish the notes into a report designed to contribute to the company's development programs in leadership and management. Based on that report, this article reflects my attempt to capture and pass on my perspectives on and knowledge of leadership and management.

I need to mention a couple of caveats up front. First, when it comes to leadership and management, no universal model exists, and I strongly believe that leadership and management approaches must be adapted to the situation. Second, this article is not all inclusive; that is, I have not attempted to include everything needed for effective leadership and management. Nonetheless, the principles, philosophies, perspectives, and approaches presented here have served me and many others extremely well in a broad spectrum of organizational environments. Third, the article is based on the personal knowledge and experience that I acquired over my 40-year professional career. Some of that knowledge comes from professional reading and from the many formal leadership and management programs I attended. But an equally important source is the experience I acquired in a broad spectrum of demanding leadership and management jobs. Finally, the outstanding and competent leaders I worked for throughout my career have strongly influenced my knowledge and perspectives. Each of those leaders, like all of us, had his or her own style, strengths, and weaknesses. I learned something from every single one of them.

Underlying Philosophical Beliefs

Before someone can adopt a leadership or management style, he or she has to consider personal philosophical beliefs. For me, it begins with a deep sense of confidence in people. I believe that they really want to do a good job and satisfy their bosses. Therefore, leadership has the fundamental responsibility of making expectations clear and creating an environment where people can succeed. Second, I believe in the power of positive attitude. In his book *Escape from the Box,* Ed Hubbard asserts and defends the notion that people can do almost anything if they believe they can and are willing to put forth the effort.[2] My experiences over the past 40 years strongly support Hubbard's philosophy. Third, setting goals is important, but once people have the goal, they need a plan and must measure progress against the plan. Fourth, customer satisfaction and mission accomplishment always come before organizational interests. Most of the time, it is possible to harmonize actions and decisions to support both, but when a conflict arises, the customer and mission must come first. Finally, if a leader wishes to take an organization forward and effect change, he or she must instill both pride in past accomplishments and excitement about future challenges and opportunities. Leaders have the fundamental responsibility of convincing people that no matter how well they have done in the past, their best is yet to come.

Leadership versus Management

It is not useful to spend a lot of time trying to distinguish between leadership and management, but since this issue comes up so often, I will comment on how I think about it. First, one should look at the functions that are clearly interdependent and overlapping. Management functions include establishing objectives, planning, organizing, directing, and controlling execution. Leadership functions include setting the vision, goals, strategies, and priorities and then motivating people to fulfill them. Leadership involves getting people to execute management's plan. In his briefings on leadership, Colin Powell sets the leadership bar even higher when he says, "Leadership is the art of accomplishing more than the science of management says is possible."[3]

Others have approached the distinction a little differently. For example, some say that we manage things (e.g., processes, cost, schedule, performance, etc.) and lead people. Of course, most jobs require both. Others, like Warren Bennis, writing in *Leaders: The Strategies for Taking Charge*, say that "managers do things right while leaders do the right things."[4] Again, we really need both: leaders who are good man-

agers and managers who are good leaders. Faced with making a choice, though, we should think about Bennis's observation that failing organizations are usually overmanaged and underled.[5]

Thoughts on Leadership

Before getting into a discussion of what I believe are the essential elements of good leadership, I'd like to offer some general comments on leadership.

General

Many organizations have developed leadership-competency models to serve as the cornerstone of their leadership-development programs. The models highlight qualities or competencies important to leadership, including integrity, vision, technical competence, management skills, communication skills, and a customer/mission focus. Of these, the most important quality is integrity, the bedrock of character because character and integrity are essential to gaining people's respect and inspiring their confidence. Ultimately, these qualities determine whether people will follow someone and whether that person's leadership will be effective.

Occasionally, leaders will make mistakes, but most of the time, they can recover and remain effective except when the error involves an integrity issue. At times, doing the right thing can be difficult, but no one ever goes wrong by always doing the right thing! In his lectures, Gen Norman Schwarzkopf has addressed this issue even more emphatically when on occasion he has said, "Leadership is a potent combination of strategy and character, but if you must be without one, be without strategy."

Clearly, leaders are made and not born. As in my own case, leadership is developed through formal instruction, learning from other leaders, and, most importantly, through experience. Leaders must improve their knowledge continuously and then apply it to the job. There is just no substitute for a person's learning by doing and then practicing what he or she has learned. People who can't say they are better leaders today than they were five years ago are not working hard enough at it!

Elements of Effective Leadership

Good, effective leaders must (1) care about people; (2) set the organization's direction in terms of vision, goals, priorities, and strategies; (3) communicate effectively; (4) embrace and instill a positive attitude; (5) stay proactive; and (6) mentor and develop subordinates:

Care about People. The fact that mission accomplishment largely depends upon efforts of the leader's people, not his or her own, compels a people-oriented focus. Leaders must empower, inspire, enable, encourage, and support subordinates. Their welfare is of great import, and leaders must show them with words and actions that they really care about them. Telling followers what they need to do and delegating the "how" to them enables them to accomplish much more than any leader ever thought possible. Delegation creates a greater sense of responsibility in people that synergistically enhances their strong, innate desire to succeed and satisfy the leader, who should not forget to praise and reward them when they do a good job. Equally important, they should receive immediate feedback if they fall short and disappoint. Finally, if their behavior is inappropriate or their performance substandard, the leader must counsel or reprimand them and take action, including firing in some cases. The morale, order, and effectiveness of the organization as well as leadership effectiveness depend on correcting the situation promptly.

A tough job, whether managing a project or running an organization, demands selection of the right people for the leadership team. In his book *Good to Great*, Jim Collins advises leaders to put the right people on the bus before even figuring out where the bus ought to go.[6] Colin Powell's lecture "A Leadership Primer" cites 18 lessons in leadership learned over his career. In lesson number eight, Powell asserts that "organization doesn't really accomplish anything. Plans don't accomplish anything either. Theories of management don't matter much. Endeavors suc-

ceed or fail because of the people involved."[7] Further emphasizing the importance of people, he sets forth his rules for picking people as lesson number 13: "intelligence and judgment, and, most critically, a capacity to anticipate, . . . loyalty, integrity, a high energy drive, a balanced ego and the drive to get things done."[8] I agree completely with his rules and would add only one thought regarding how I selected people. I avoided filling key positions with stereotypes of myself, looking instead for opportunities to pick people who had strengths and personalities that would complement mine. The power of diversity cannot be overstated, but leaders must take those differences into account when they interact and communicate with people!

Set the Organization's Direction. Organizational effectiveness, advancement, and alignment require the leader to collaboratively set and communicate the vision, supporting goals, priorities, and top-level strategy. To optimize contributions to the organization, people need to understand what it aspires to be and to achieve, as well as how it is trying to move in that direction. The organization benefits greatly when its people view their jobs not just as a set of tasks they get paid to do, but as work that contributes to the organization's success.

Communicate Effectively. I cannot overemphasize the importance of effectively communicating organizational goals and expectations. Over my 40-year career, the root cause of many of the problems I saw was a failure to communicate. If the leader's people understand the organization and mission, understand their roles, and know what he or she expects from them, I guarantee that the leader will rarely be disappointed. Leaders must work hard—and then harder—at communicating up, down, and across the organization. Here are a couple of examples of things I did to meet this challenge.

Within a month of taking over an organization, I would gather the first couple of layers of senior leaders and talk to them about my leadership and management style, my personality in terms of Myers-Briggs behavioral preferences, my expectations of them, and what they could expect from me. To communicate these matters to my subordinates, I had to take the time for self-reflection and figure these issues out myself. I held this session soon after I took over because I knew that the sooner they understood what I expected, the sooner I would get it from them. I described very specifically what I liked and didn't like. For example, I told them I liked being informed and did not like surprises; I liked teamwork and did not like activity without action; I liked initiative and innovation and did not like passivity and stagnation; I liked and expected responsiveness when I asked them to do something; and I liked communication and action between staff meetings and did not like internecine bickering and whining.

Staff meetings are absolutely essential to organizational communication, but they are not sufficient. The message that a leader communicates at the meeting gets filtered and translated many times through many layers of the organization. Leaders simply don't know what message actually gets communicated to many of their people, but they can do several things to address this problem. If the message is especially important, they can put it into an e-mail or letter and personally send it to all employees. The leader can also hold periodic all-employee forums to discuss the organization's state of health, celebrate achievements, and highlight current challenges. Another technique entails visiting each organizational unit annually and holding town meetings with a small but representative number of employees. At these meetings, lasting an hour or so, I would encourage their leaders to tell me about accomplishments, current work effort, and any issues they might have. I would then share with them my perspective on key organizational initiatives and challenges, asking for their support. The meetings would conclude with a question-and-answer period during which they could ask me anything.

Embrace and Instill a Positive Attitude. Leaders must embrace and promote a positive, success-oriented, can-do/will-do attitude. They must instill such an attitude in their people. No matter how tough the challenge, leaders should have confidence in themselves and their people. Then everyone must work as

hard as necessary to attain the objective. In his famous reflection on the importance of attitude, the renowned philosopher Charles Swindoll concluded that "life is 10% about what happens to me and 90% about how I react to it."[9]

Retired colonel Ed Hubbard, an Air Force colleague and hero of mine, spent six-and-a-half years as a prisoner of war in Vietnam. In his book *Escape from the Box*, Ed maintains that he and fellow prisoners survived their ordeal by adopting an attitude that called for supporting their determination to survive with extraordinary efforts to keep their minds and bodies as healthy as possible. These efforts were complemented by a deep faith in their country and the unwavering belief that one day they would be free again and reunited with their loved ones. He supports this assertion with many gut-wrenching stories that illustrate the power of attitude. Simply stated, Colonel Hubbard's philosophy, as espoused in his book, is that people can do anything if they believe they can and are willing to put forth the effort.[10] I firmly believe that his philosophy reflects the kind of positive attitude required to become a successful leader. Embracing and instilling this philosophy in people are the key to and challenge of good leadership. People who don't do this can't be good leaders. Those who do, can't miss.

Stay Proactive. Leaders must be proactive and assertive, taking the initiative and making things happen. They must not be afraid of making mistakes. When they do make one, they learn from it and then move on. They are bold and creative, encouraging their people to be the same. They also push them to become proactive, striving to spend more time preventing problems and less time solving them. They trust their instincts and are willing to make decisions on imperfect, incomplete information. And they accept accountability for those decisions.

Mentor and Develop Subordinates. Leaders have no greater responsibility than developing the leadership and management skills of those under them. They set the example, ever mindful that their subordinates are observing them. They spend a great deal of one-on-one time with their followers discussing organizational challenges, objectives, and strategies. In spite of the demands of carrying out the current mission, not only do they move their people into new positions in which they can continue to grow, but also they make them available for professional-development programs. They do so because they know that investing in their professional development also represents an investment in the future success of the organization.

Thoughts on Management

I view management as having two basic aspects. The first focuses on managing projects or programs, and the second on managing the organization. I have divided this section of the article into these two basic management aspects.

Program/Project Management

Management of a project starts with a tangible objective that the organization desires to produce or attain. A manager then puts together a plan and a team, directs the team, and controls execution of the plan. Direction and control are facilitated by defining and measuring progress against the plan. Performance-to-plan metrics, which involve measuring actual values in terms of cost, schedule, and technical performance and comparing them to planned values during execution of a project, are essential to effective management.

As I moved into senior management positions, I focused more on organizational management and delegated project management to others. Effective delegation is challenging, but putting someone in charge and holding him or her accountable constitute the keys to success. Doing so can be greatly facilitated by senior management's approving the objective and plan up front and then moving into a manage-by-exception mode. My subordinates understood that between in-process reviews, I assumed that the project was tracking to plan unless they informed me otherwise. I also consider such reviews fundamental to effective management and believe that managers must inspect to get what they expect. The question is how often and to what depth they must re-

view progress. Unfortunately, the answer is not simple and depends on the importance of the objective and the confidence that managers have in the person they put in charge.

Effective management must orient itself on results and demand the measuring of progress and the taking of proactive action to stay on plan and prevent problems. When problems arise, the manager must take prompt action and get back on plan. I always preferred to use a collegial, collaborative approach to problem assessment and decision making, with participation by the team and outside experts. When building a consensus proved too hard or did not yield the best solution, however, I was ready to make the tough decisions.

Time management is probably the most important daily problem that every project manager faces. Splitting time among managing the project, solving problems, and reporting progress or problems to the management chain can become overwhelming at times. Managers always have too much to do, and they will never have enough staff. I have found that prioritization offers an answer to this dilemma. I operated off a "must do" weekly and daily list of actions as well as a mid-/long-term top-10 list that always had 10 items on it because whenever something was removed, something else replaced it.

Organizational Management

My approach to organizational management (1) is goal driven; (2) integrates near-term action to support long-range vision and goals; (3) centralizes top-level planning and delegates detailed planning and execution to empowered, accountable people; (4) focuses on measurable results; (5) actively promotes organizational change and transformation; and (6) strives to align strategy from top to bottom in the organization. It is a tailored version of the Harvard Business School's Balanced Scorecard approach, developed by Robert Kaplan and his colleagues, beginning in the mid-1990s.[11]

I had been applying early versions of my own approach, starting in the mid-1980s, as I began a 20-year journey to undertake a series of progressively higher-level organizational-management jobs. From 1986 to 1988, I led and managed the largest multiprogram system program office in Air Force Systems Command by baselining more than 70 programs' cost, schedule, and key performance parameters. I conducted quarterly reviews of each program to assure it remained on course. Between reviews, I required program directors to report the cause of baseline deviations and send a "get well plan" to me. In 1989 I published the first corporate plan for the Rome Air Development Center, then one of the Air Force's research and development laboratories. The plan laid out a vision and long-range goals to fulfill through a number of specific, near-term initiatives and strategies owned by senior leaders in the center.

Over the years, I brought the approach to maturity, based on my experience and Kaplan's many papers and books on Balanced Scorecard. As I arrived in 2001 for my final assignment in organizational management with MITRE's Air Force Center, I found that MITRE was moving toward such a management framework. With the encouragement of my superiors, active participation of my executive directors, and help from some extraordinarily smart and talented engineers, I seized the opportunity and pioneered the adoption of an advanced, Web-enabled form of the approach in the Air Force Center.

Until my last couple of years at MITRE, I did not openly admit that I was managing the organization using a Balance Scorecard type of approach. Three primary concerns drove my reluctance to do so. First, although Harvard is widely regarded as one of our premier management schools, many people considered a number of its concepts too academic and work-intensive to implement. Second, my review of a number of successful and failed case studies involving the Balanced Scorecard gave me concern that implementation focused too strongly on strategic alignment not linked in a meaningful way to tactical operations and execution. Finally, and related to the second concern, I thought that many of the metrics generated in support of corporate strategy maps overly emphasized easy-to-collect, but not really meaningful, activities instead of actions

and results. My tailored approach greatly alleviated these concerns. In spite of my misgivings, I have the highest regard for Robert Kaplan and his Harvard colleagues, whose concepts and work have strongly influenced me.

The underlying operating model of my Balanced Scorecard approach is the formulation of a layered strategy map in which a vision drives long-range goals, which drive a number of objectives or outcomes, which spawn a number of near-term strategies and initiatives ultimately owned by one or more of the leaders and staff. This framework has the great advantage of explicitly recognizing near-term actions as the way to achieve long-term vision and goals. Long-range planning and tactical-operations planning are linked and integrated within the framework.

Over the years I spent in both government and industry, I found that about four or five long-term goals are sufficient to drive an organization toward its vision. One goal should focus on current mission performance and improvement, and another on growth or expansion of the mission. A third should concentrate on the organization's value proposition, reducing its cost or improving its competitive position. A fourth should address an engaged and productive work force—that is, people. A for-profit company would have a fifth goal, focused on its financial well-being, measured principally by three outcome objectives: (1) an increase in sales or revenue, (2) good profit or margin, and (3) best-in-class shareholder value or return on investment.

In my approach, those four or five long-term goals of the corporation were supported by one or more broad, all-encompassing outcome objectives, each measured by a set of metrics as well as by tracking progress on initiatives that flowed down into the performance goals of the staff. The most important metrics included customer satisfaction, performance-to-plan for project delivery in terms of budget and staff years, work-program value and impact, and staff demographic data tracked over time to highlight trends.

We attained organizational alignment by flowing outcomes and initiatives down to every layer of the organization and ultimately into individual performance goals. From bottom to top, the work of the staff contributed to achieving the outcome objective, which advanced the organization toward its long-range goals and vision. Although this bottom-up contribution is good and essential, it is not sufficient to assure timely organizational responsiveness to a dynamic strategic environment. For that reason, I added a complementary top-down and more strategic contribution to the process in the form of an annual strategic-environment assessment of the implications of changes in our internal and external environment. I used the outcome of this assessment to identify focus initiatives and put a director-level team in charge of planning and making progress in these critical areas.

Before leaving the subject of organizational management, I want to highlight that I also used both the top-down and bottom-up elements of my approach to effect organizational change and transformation. No matter how good an organization, it can be better; and no matter how solid its business base, it can be improved. Spencer Johnson's book *Who Moved My Cheese?* urges companies to move proactively to find better cheese before their current cheese goes bad or dries up.[12] I believe strongly in his advice—it is far better to be proactive and innovative than remain complacent and risk obsolescence.

Conclusion

Certainly, none of the leadership and management approaches and best practices presented here is new or unique. To the contrary—they are time tested and proven successful by me and many others. I have merely tried to bring to bear my life experience as a real practitioner who has toiled in the trenches at many levels, and to offer a succinct, integrated overview. By sharing this, I hope that other leaders can apply these positive lessons in their jobs, grow professionally, and better prepare themselves for future leadership and management challenges. ❑

Notes

1. A not-for-profit, federally funded research and development center, MITRE provides systems engineering for information-technology systems to the government.

2. Edward L. Hubbard, *Escape from the Box: The Wonder of Human Potential*, ed. Art Nicolet (West Chester, PA: Praxis International, 1994), 58.

3. Colin Powell with Joseph E. Persico, *My American Journey* (New York: Ballantine Books, 2003), 255.

4. Warren Bennis and Burt Nanus, *Leaders: The Strategies for Taking Charge* (New York: HarperCollins, 2003), 20.

5. Ibid.

6. Jim Collins, *Good to Great: Why Some Companies Make the Leap—and Others Don't* (New York: HarperBusiness, 2001), 13.

7. Oren Harari, *The Leadership Secrets of Colin Powell* (New York: McGraw-Hill, 2002), 258.

8. Ibid., 259.

9. Charles Swindoll, *Strengthening Your Grip* (Nashville: Word, 1982), 207.

10. Hubbard, *Escape from the Box*, 259.

11. The Balanced Scorecard approach to organizational management and alignment calls for developing a strategy map to link vision to goals to objectives to initiatives, as well as defining and using metrics to measure progress.

12. This concept is explained in Spencer Johnson's book *Who Moved My Cheese? An Amazing Way to Deal with Change in Your Work and in Your Life* (New York: Putnam, 1998).

Understanding the Enemy as a Complex System

A Multidisciplinary Analytic Problem Requiring a Multidisciplinary Team Approach

D. Lee Fuell Jr., Defense Intelligence Senior Leader, USAF

Our greatest challenge today is to identify and understand the enemy we need to affect.

—Lt Gen David A. Deptula
Deputy Chief of Staff for
Intelligence, Surveillance,
and Reconnaissance
Headquarters US Air Force

THE AIR FORCE'S intelligence, surveillance, and reconnaissance (ISR) strategy requires the Air Force ISR enterprise to understand current and potential enemies as a system—a complex "organism" dependent on leadership, people, resources, infrastructure, defenses, the environment in which it operates, and myriad other factors that determine war-fighting capabilities and vulnerabilities.[1] Understanding the adversary as a complex system requires comprehensive knowledge well beyond order of battle and disposition of forces; moreover, it is fundamental to an effects-based approach to operations.[2] This knowledge allows US strategists and operational planners to predict enemy behavior and select means of attack that achieve maximum effect with maximum efficiency, whether the desired effect is to influence or to destroy.[3] Without comprehensive knowledge of the enemy, armed conflict can degenerate into an extended, bloody, and expensive war of attrition.

Developing such an understanding of foreign air and space forces as complex systems is the responsibility of the National Air and Space Intelligence Center's Global Threat Analysis Group (NASIC/GTG), whose mission is to deliver predictive intelligence on global integrated capabilities across the air, space, and information domains.[4] GTG analysts are charged with synthesizing intelligence data and other intelligence assessments from across the breadth of "Boyd's Trinity" of "people first, ideas second, and things third" into cohesive and coherent assessments of foreign air and space war-

fighting capabilities and vulnerabilities, from tomorrow to as far as 20 years in the future.[5] As the technical director for global threat, I provide senior oversight and guidance to the group's analysis and production—analysis as intellectually challenging as graduate-level research and production that generates assessments on par with master's theses and, occasionally, PhD dissertations, and sometimes more so. In some cases, the breadth and depth required, combined with the need to deal with active denial and deception by the enemy whom the analysts seek to understand, surpass any level of academic research in difficulty and complexity.[6]

In the GTG, we challenge our analysts of air and space force employment to "think like a foreign general officer."

Assessing an adversary as a complex system is a daunting analytic task, fraught with numerous organizational and behavioral challenges and requiring extensive expertise in multiple disciplines. This article examines two of those challenges—analyst expertise and teamwork—and recommends changes that the Air Force's ISR leaders can consider to overcome them.

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To improve analysis, we need better analysts.

—Dr. Thomas Fingar
Former Deputy Director
of National Intelligence
for Analysis

Analysis of foreign integrated air and space war-fighting capability—developing that understanding of the adversary as a complex system—requires a breadth and depth of expertise difficult for a single individual to obtain. A country's ability to employ air and space forces is affected by diverse factors including, but not limited to, strategy, doctrine, training, national and organizational culture, morale, order of battle, logistics, maintenance, intelligence, geography, and any number of other tangible and intangible influences. Some of the tangible factors, like weapon-system performance and order of battle, lend themselves well to objective analysis based on the sciences and engineering. Others, like human motivations and intentions, are "fuzzier" and require different, less-well-defined skill sets to assess. In the GTG, we challenge our analysts of air and space force employment to "think like a foreign general officer"—a concept difficult to grasp for many junior- and midlevel military and civilian analysts who lack the experience and skill sets of a joint force air component commander.

The Air Force ISR enterprise, well manned with analysts skilled in the sciences and engineering, has an excellent track record of scientific and technical intelligence analysis of foreign weapon system (and "system of systems") capabilities and limitations (Boyd's "things"). Formal education opportunities in the sciences and engineering abound, and the Air Force makes good use of both active duty and civilian scientists and engineers to do this kind of analysis. Expertise in the hard sciences alone, though necessary, is not sufficient to develop the required understanding of enemy forces as a complex system—we must also understand the less objective, more human-centered factors (Boyd's "people" and "ideas"). Unfortunately, opportunities for formal education in the art of employing air and space forces are not as readily available as those in the hard sciences. Although Air University's Air Command and Staff College (ACSC) awards an accredited master's degree in military operational art and science (including a course in research and analysis methodology) to its graduates, military officers attend ACSC as majors for the most part.[7] By the time intelligence officers have been formally educated in the theory, principles, and practices of employing air and space forces, as well as critical thinking and analysis, career development dictates that they move out of analysis and into leadership positions. Without a change in our career-development mind-set, the skills and

knowledge that officers develop at ACSC cannot be directly applied to intelligence analysis.

Opportunities exist for civilian analysts to attend ACSC in residence and earn a degree, but those opportunities are not sufficient to educate all of the analysts required by the mission. Fortunately, the Air Force has an enlightened enrollment policy for nonresident developmental education that allows midlevel civilian analysts to complete ACSC via distance learning. Though not as beneficial as the in-residence program, nonresident ACSC at least provides a structured education in the theory, principles, and practices of the operational art of employing air and space forces.

Perhaps more important than formal education is actual experience at planning and employing air and space forces at the operational level of war. This experience is even harder to come by than education, but a prior assignment or rotational detail in an air operations center's (AOC) strategy or combat plans division would be a plus for an analyst charged with assessing an enemy's integrated air and space war-fighting capability. Unfortunately, the same career-development factors cited above complicate the use of experienced planners as intelligence analysts.

Expertise in air and space operational art, though necessary, is not sufficient. Predicting enemy behavior also requires extensive knowledge of subjects as diverse as international affairs, foreign policy, culture, religion, sociology, and a host of other factors.[8] The knowledge required to attempt complex system analysis of an enemy far exceeds what we can reasonably expect an individual to master, driving us to the need for multidisciplinary analytic teams.

Actions the Air Force can take to improve the individual expertise of analysts tasked with developing understanding of the enemy's air and space war-fighting capability as complex systems include the following:

- Changing the paradigm for the career development of intelligence officers to value post-ACSC and/or post-AOC service as an analyst, providing that analysis focuses on the operational level of war.
- Increasing the emphasis on nonresident ACSC, or similar developmental education that emphasizes operational art, as part of the individual development plan for midlevel civilian analysts, providing increased on-duty time and resources to do the course work.
- Increasing emphasis on, and funding for, graduate-level study in other disciplines required to establish in-depth knowledge of adversaries as complex systems.
- Establishing opportunities for rotational assignment or extended temporary duty for intelligence analysts in an AOC's strategy and combat plans divisions to provide them at least an exposure to the complexities of employing air and space forces.
- Actively recruiting retired officers with operational war-fighting experience as civilian analysts of air and space force employment, and reforming civilian hiring practices and compensation to make such employment more attractive.
- Leveraging the experience of Air Force senior mentors to assist with developing analysts' expertise in air and space operational art.

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We've got a lot of smart people, but none of them are smart enough by themselves to adequately address the array of very complex, fast-moving issues that we're asked to analyze.

—Dr. Thomas Fingar
Former Deputy Director
of National Intelligence
for Analysis

Building knowledge requires a team.

—Lt Gen David A. Deptula
Deputy Chief of Staff for
Intelligence, Surveillance,
and Reconnaissance
Headquarters US Air Force

No matter how well we develop individual expertise in analysts charged with developing the understanding of our adversaries as com-

plex systems, the challenge remains too broad and deep for a single individual to accomplish on his or her own. As the Air Force's ISR strategy correctly notes, mastery of such complex problems becomes possible only through the actions of high-performing teams.[9] Comprehensive analysis of enemy forces requires not only the broad, "big picture" perspective of analysts schooled and experienced in operational art, but also the in-depth knowledge of analysts more tightly focused on the constituent components of overall war-fighting capability. It is not simply a matter of aggregating separate assessments of the constituent components; the synergy between breadth and depth obtained by the dynamic interaction of analysts who bring expert knowledge from multiple disciplines with different perspectives working toward a common goal produces insight not obtainable by single analysts working alone. Also, research indicates that reasoning by groups with different pools of knowledge modulates individual bias and prevents errors in individual reasoning, producing higher-quality judgments than simple aggregation.[10] All things considered, the ability to function as a team player and to put team accomplishment ahead of individual accomplishment is an essential attribute of an intelligence analyst in today's Air Force ISR enterprise.

The ability to function as a team player and to put team accomplishment ahead of individual accomplishment is an essential attribute of an intelligence analyst in today's Air Force ISR enterprise.

Unfortunately, our performance-evaluation processes (for officers, enlisted members, and civilians) tend to be based more on individual rather than team accomplishment. Raters are frequently reminded to describe actions and their effects in appraisals that value *individual* action verbs like "led" or "discovered" or "implemented" more highly than more amorphous phrases such as "key member of." We stratify our *individuals*: "my no. 1 captain of 20" is a highly desirable appraisal bullet. Our awards and decorations process is also biased toward individual accomplishment; awards for team accomplishment are not valued as highly as those for individuals. Do any of us believe that any Air Force member would rather have an Outstanding Unit Award than a Meritorious Service Medal? In this culture, it is not surprising that many analysts would rather work individually than as team members on broad, multidisciplinary analyses of overall integrated war-fighting capability. Asking our analysts to emphasize teamwork while evaluating and rewarding them for individual excellence sends a mixed message that leaders must strive to overcome. At worst, such a message can result in a "self before service" mind-set in analysts more motivated by personal advancement than mission success. Air Force ISR needs high-performing individuals in order to have high-performing teams, but ISR leaders need to do more to encourage and reward participation in analytic teams—formal or informal, top-down driven or bottom-up self-synchronized, or anything in between.

Intelligence-analysis organizations like NASIC are often functionally organized, with suborganizations grouped by analytic discipline (e.g., grouping all fighter-aircraft analysts into a single flight). However, the task of understanding the enemy as a large-scale system does not bin well into a unidisciplinary organizational element. All organizations develop unique identities and cultures, and if a unidisciplinary suborganization becomes insular and inwardly focused, it undermines the ability of the larger organization to form high-performing multidisciplinary teams that cross organizational boundaries. A contributing factor to this insularity is the desire for "credit" for work done—analysts and their leaders may perceive that they will receive less credit for their work as members of a multidisciplinary team than for more narrowly focused work performed within their "box" on the unit's organization chart. A functional organizational structure has great benefit for training and equipping intelligence analysts to perform a specific ana-

lytic task within a discipline, but that discipline alone will rarely prove sufficient to understand the enemy as a complex system.

An "ownership" mentality with regard to a suborganization's mission can also emerge as an unintended consequence of a functional organizational structure. Such a mentality can manifest itself as reluctance to share knowledge, reticence toward participating in teams, resentment of other analysts' mentioning "their" subject in a product, or any of a number of other antiteamwork pathologies. In reality, analysis missions overlap and are interdependent; it is neither possible nor desirable for an analyst or leader to claim sole ownership of a topic. Instead, analysts and leaders must embrace the concept of mission overlap and interdependency in order to make high-performance teams possible. In fact, some degree of overlap is necessary to provide the common perspective and purpose that analytic teams need in order to work broad, complex problems successfully; leaders should not view this necessary overlap as duplication.[11] Ultimately, analysts and their leaders should think of themselves as *stewards* of their mission and knowledge, not owners. We should also learn to think of functional organizations as capability providers to multidisciplinary teams for their area of expertise, much as we have learned to view the individual services as capability providers to the joint combatant commands. Analysts may be "ADCON" (administrative control) to functional organizations, but "OPCON" (operational control) to cross-functional, multidisciplinary integrated analysis teams formed to solve complex, large-scale intelligence problems.

The Air Force's ISR strategy for 2008 addresses these challenges by emphasizing cross-organizational information sharing and the need to foster multidimensional leaders.[12] The ISR strategy calls on us to favor sharing too much information over sharing too little, but for years the intelligence community has marched to the drum of "need to know." Transitioning from a "need to know" to a "responsibility to share" mind-set represents a major cultural change for experienced intelligence professionals, with all the attendant leadership challenges. The ISR strategy also calls on us to "reserve our leadership positions for those who demonstrate the ability to lead teams to create knowledge" and identifies our most valuable people as "those who successfully lead cross-domain, cross-discipline teams to create actionable knowledge."[13] In addition to increasing the emphasis on team *leadership*, in order to field high-performance teams, we must do the same for team *membership*. If we fail to value and reward participation on teams as highly as individual accomplishment, team achievement will continue to be less valued than individual achievement.

Ultimately, analysts and their leaders should think of themselves as* stewards *of their mission and knowledge, not owners.

Realizing the vision of the Air Force's ISR strategy will require some significant changes to the way we evaluate and reward our people and the way we organize for and perform intelligence analysis. Some recommendations include the following:

- Increasing the emphasis on collaboration and team performance in training programs for all ISR analysts.
- Requiring a team-performance element on all performance plans for civilian analysts and emphasizing team accomplishments on performance appraisals.
- Issuing guidance to raters to emphasize team leadership and team accomplishment on performance reports for officers and enlisted members.
- Issuing guidance to promotion boards to value team leadership and team performance as highly as, if not more than, individual accomplishment.
- Increasing the number and type of ISR awards for team accomplishment and

perhaps decreasing those for individual accomplishment.

- Concerning ourselves less with credit for mission accomplishment and more with mission accomplishment itself.
- Formally defining functional organizations as "capability providers" to cross-functional analysis teams.
- Establishing integrated analysis teams as the norm, not the exception, for Air Force ISR analysis and giving those teams OPCON of analysts required to perform their assigned task(s).

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Dominating capabilities . . . will not evolve from the skills, institutions and platforms of the past. They demand a uniquely trained, equipped, integrated, and empowered enterprise.

—Lt Gen David A. Deptula
Deputy Chief of Staff for
Intelligence, Surveillance,
and Reconnaissance
Headquarters US Air Force

The threats and challenges that the Air Force will continue to face in the twenty-first century are diverse and complex; deterring and defeating them will require an unprecedented depth and breadth of understanding of and capability to predict and influence adversaries' capabilities, limitations, and intentions. The Air Force's ISR strategy provides the overall guidance and philosophy for developing that understanding; this article has identified some of the personnel and institutional challenges to implementing that strategy and recommends actions that ISR leaders can take to overcome them. Clinging to the skills, processes, and rigid organizational structures of the industrial age is a recipe for failure in the information age: we will fail to sufficiently understand our enemies and anticipate their actions, allowing them to fight us on *their* terms, to *our* detriment. We need greater depth and breadth of expertise and more flexible and adaptable organizational constructs, necessitating fundamental changes in our sight picture of how we do intelligence analysis and whom we select to do it. ❑

Notes

1. Lt Gen David A. Deptula, *Lead Turning the Future: The 2008 Strategy for United States Air Force Intelligence, Surveillance and Reconnaissance* (Washington, DC: Headquarters US Air Force, 4 July 2008), 8, http://www.af.mil/shared/media/document/AFD-081201-007.pdf.
2. Air Force Doctrine Document 2, *Operations and Organization*, 3 April 2007, 19, http://www.fas.org/irp/doddir/usaf/afdd2.pdf.
3. Deptula, *Lead Turning the Future*, 8–9.
4. Global Threat Analysis Group (NASIC) mission statement.
5. For "Boyd's Trinity," see Grant T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian Institution Press, 2001), 110.
6. Bonnie Wilkinson, 711 HPW/RHCS, Wright-Patterson AFB, OH, interview by the author, 10 September 2008.
7. Col Tomislav Ruby, AF/A2DD, to the author, e-mail, 27 October 2007; and "Welcome to the Air Command and Staff College," http://www.au.af.mil/au/acsc/aboutACSC.asp.
8. Wilkinson, interview.
9. Deptula, *Lead Turning the Future*, 10.
10. Kevin Dunbar, "How Scientists Really Reason: Scientific Reasoning in Real-World Laboratories," in *Creative Thought: An Investigation of Conceptual Structures and Processes*, ed. Thomas B. Ward, Steven M. Smith, and Jyotsna Vaid (Washington, DC: American Psychological Association, 1997), 461–93.
11. Wilkinson, interview.
12. Deptula, *Lead Turning the Future*, 9.
13. Ibid., 9, 10.

Maj D. K. Stanford, USAF, Chief, Professional Journals

Unmanned Aircraft Systems

This is one of those inflection points, one of those times when the whole path of history shifts. . . . That's what's happening, and the question is whether the United States Air Force wants to be on that wave or left behind.

—Gen Norton Schwartz
Chief of Staff of the Air Force
19 February 2009

A NEW CHAPTER IN airpower history is being written. Unmanned aircraft systems (UAS) have proven their military worth, both to ground and air forces. Undoubtedly, UAS technology will continue to evolve and become a greater asset; moreover, an important debate taking place right now will determine not only how to use this tool but also who should use it.

Questions regarding the proper role of UASs in the joint fight remain unanswered. Opinions diverge widely on whether these systems require trained pilots or highly skilled technicians—perhaps enlisted personnel. Another issue concerns whether each service should build its own UAS fleet and, if so, how that service should integrate these weapons systems in the joint battle. The answers to these questions will shape the future force as well as our concept of airpower.

This debate is healthy and necessary—and in many cases passionate. There is no doubt that UASs will assume more critical war-fighting roles, that technology will advance, and that they will become more ubiquitous. In January 2009, Lt Gen Norman Seip, commander of Twelfth Air Force, pointed out that "next year, the Air Force will procure more unmanned aircraft than manned aircraft. . . . So I think that makes a very pointed statement about our commitment to the future of [the] UAS and what it brings to the fight in meeting the requirements of combatant commanders."[1] The manner in which we integrate this unmanned capability remains controversial. Will an Air Force culture dominated by manned flight relegate unmanned systems to discrete mission sets, or do they represent a fundamental shift in the delivery of airpower, ultimately replacing manned systems as the primary platform?

General Schwartz recently observed that "there will always be a need for manned aviation, but it will be a lesser proportion of the fleet than is currently the case."[2] This shift, whatever its size, will be profound and will drive changes in doctrine, force structure, and technical training. Although we can accurately describe UAS technology as evolutionary, it offers capabilities that are revolutionary. This issue of *Air and Space Power Journal* (*ASPJ*) includes insightful articles that wrestle with all of these topics. Although the healthy debate over the proper role of UASs will surely continue, we hope that this edition of *ASPJ*, the professional journal of the Air Force, promotes dialogue on this fascinating topic. ❑

Notes

1. Megan Orton, "Air Force Remains Committed to Unmanned Aircraft Systems," *Air Force Link*, 14 January 2009, http://www.af.mil/news/story.asp?id=123131324 (accessed 26 March 2009).

2. Michael Briggs, "Chief of Staff Sees UAS Role Expanding," *Air Force Link*, 20 February 2009, http://www.af.mil/news/story.asp?id=123136606 (accessed 27 March 2009).

Capt Lori Katowich, USAF, Deputy Chief, Professional Journals

Publishing in *Air and Space Power Journal*

MANY PEOPLE INQUIRE about our process for determining the publication potential of articles submitted to *Air and Space Power Journal* (*ASPJ*). The following offers a rough outline of that process. After we receive an article, members of the editorial board meet to review it and discuss its merits. Submissions significantly over our 5,000-word limit are returned to the author without specific action. If the topic seems to be of interest to our readers, however, we may suggest revisions for bringing the article within that limit.

Keeping in mind our editorial focus on the operational level of war, including issues related to strategy and policy, we review articles for content, scholarliness, relevance to Air Force concerns, support, currency, value to force development, and quality. Moreover, our articles should support the multilevel thinking that characterizes today's professional dialogue. Submissions of a purely historic nature generally fall outside our focus area. Our feedback to authors ranges from specific technical aspects (spelling, grammar, word choice, etc.) to recommendations on strengthening weak areas or correcting illogical organization. However, we often reject poorly written articles, regardless of topic, without revising them. Similarly, we may also reject articles that lack the necessary documentation.

Authors should submit high-resolution photographs and graphics suitable for printing in black and white as separate files rather than importing them into the text file; furthermore, they should properly credit all images. Although photos from Air Force or other government sources do not require a credit line, authors should nevertheless include one so we can verify that it was not overlooked.

It takes commitment on the part of both the authors and editors to significantly revise submissions. Academic papers written for various education classes, whether military or civilian, may be of interest to *ASPJ* but often do not meet our needs in terms of either article length or formatting. For that reason, we advise authors to review AU-1, *Air University Style and Author Guide* (available online at http://aupress.au.af.mil/resources/style/austyle_guide.pdf or in hard copy from Air University Press), prior to submitting. Although based on the *Chicago Manual of Style*, AU-1 adds terms and examples peculiar to the military environment. The editorial board will provide advice regarding our formatting needs, but the responsibility for meeting those requirements remains with the author.

Referees (subject-matter experts) vet an accepted submission through a peer-review process, validating it in terms of concepts and evaluating the soundness of the supporting argument; they do not judge the article on the basis of their personal feelings about its content. Furthermore, neither referee nor author knows the other's identity. After we receive the referees' comments, we forward them to the author so that he or she can address any concerns or simply withdraw the submission.

We then submit the revised article to the Public Affairs Office for a security and policy (S&P) review, which examines it for sensitive content that may pose a security risk. After we receive a clearance, we schedule the article for publication, based on focus area, timeliness, and available space.

Not specifically assigned to *ASPJ*, the referees and S&P reviewers complete their work on an "as available" basis, which requires extra processing time. Therefore, although we provide "latest submission" dates for upcoming issues, we highly encourage authors to submit articles as early as possible.

We hope that this overview has increased your understanding of *ASPJ*'s publication procedures. We always want our authors to look good in print. For more detailed information, please see the "Submissions" page of our Web site at http://www.airpower.au.af.mil. ❑

Ricochets and Replies

We encourage you to e-mail your comments to us at aspj@maxwell.af.mil or cadreaspj@aol.com. We reserve the right to edit your remarks.

MEDALS FOR MEDIOCRITY: HOW TO RESTORE MEANING TO AIR FORCE DECORATIONS

Lt Col Raymond M. Powell's article "Medals for Mediocrity: How to Restore Meaning to Air Force Decorations" (Spring 2009) has totally missed the point. Now that the Air Force has over 100 awards and decorations that can be worn on the uniform, it is time to *do away with many of these decorations*. When I go on Air Force bases these days, I see young Airmen with more ribbons on their chests than I had in 26 years of service, most of it spent on Strategic Air Command combat aircrews and a tour in Vietnam. When I see company-grade Air Force officers and senior noncommissioned officers (NCO) with more ribbons on their uniforms than General LeMay had on his, I *know* it is time to back off from some of these decorations—it looks ridiculous! I submit that only medals awarded for valor in combat, campaign medals, and the Airman's Medal belong on the Air Force uniform. Eliminate all of the other awards and decorations currently authorized. Badges are also overdone on the Air Force uniform. Only pilot, officer aircrew, enlisted aircrew, and jump wings should be authorized. I fondly recall the days when virtually no one, officer or NCO, wore any ribbons, even on the Class A [service dress] uniform. The exception was for parades, for which it was mandatory. That was when we saw the Silver Stars, Distinguished Flying Crosses, Air Medals, and other awards for valor that people wore. I liked the way that General Eisenhower and General Marshall wore only one row of ribbons on their Class A uniforms. I saw a picture of Charles Yeager (when he was a major) in a fairly recent issue of *Air and Space Magazine* wearing a Class A blue uniform, and the only things on his blouse were his "US" insignia and his senior pilot wings; that's class!

CMSgt Stanley E. Allen, USAF, Retired
Indianapolis, Indiana

The article on returning power and prestige to medals is an excellent piece of work (in my humble opinion) and should be executed as policy. I cannot number the times when I felt disappointment that the most outstanding troops had to wait until their next assignment to receive their medals and that they sometimes received the same end-of-tour award as someone who did not accomplish very much at all. Lieutenant Colonel Powell's insight is

not new, but he words this in such a way that it becomes much more useful. I personally never lost any sleep over my own medals, but I fought hard to get them for the most deserving troops, and I believe that Lieutenant Colonel Powell's thoughts on this should be elevated and reviewed.

MSgt Gregg Williams, USAF, Retired
Universal City, Texas

I just wanted to take a moment to tell you how much I enjoyed Lieutenant Colonel Powell's article in the latest issue of *Air and Space Power Journal*. As an Air Reserve technician at March Air Reserve Base, California, I can especially understand his concerns with the burdensome steps associated with awarding personnel a medal. Of particular interest is the disparity that was apparent when I attended the Noncommissioned Officer Academy in residence in 1998. On days when all in attendance wore service dress uniforms, I noticed that our active duty counterparts typically had a rack with at least one Meritorious Service Medal and often two or even three Commendation Medals, whereas our Guard and Reserve counterparts had racks with little more than the "automatic" ribbons (e.g., the Air Reserve Forces Meritorious Service Medal). I believe that the author's idea of a quota has merit and hope that his article generates dialogue aimed toward improving a process that, sadly, has become unrealistically labor intensive.

MSgt Phillip C. Maffett, USAFR
March ARB, California

Let me offer a radically different view of medals and award criteria in general. There used to be a very interesting little book in the Air War College library—*Fighting Power: German and US Army Performance, 1939–1945* by Martin van Creveld—that touches in part on the practical effects of medals in the US Army and German Army during World War II. I did a small paper on it (Squadron Officer School, class 83D), and some of the concepts advanced in that book have stuck with me over the years.

One of the interesting points in the book was that the US Army policies towards medals seriously devalued the awards whereas the Nazi approach actually enhanced the value. The disturbing thing that occurred to me was that the US Army approach to medals and awards in World War II was very similar to the current Air Force approach. In contrast, the German approach was that medal awards were not just "hanging some decorative color" on the uniform. German military medals were specifically intended to be a morale and motivational enhancement for the spectators as well as the recipients. Medal awards were used specifically to recognize and nurture qualities that the military organization valued—not simply to designate the end of a particular assignment or tour. At least in van Creveld's argument, the German approach worked.

If I remember it correctly, in the German approach, following orders or doing one's job—no matter how hazardous—did *not* merit any award whatsoever. Without a prominent display of personal initiative, charging a Russian tank with a hand grenade and pistol was simply a German infantryman doing what was required. Furthermore, there were *no* awards whatsoever for "been there, done that!" The argument was quite involved (and it was a bit challenging to consider any Dutch/Jewish author admiring the Nazi military machine), but the arguments as presented were compelling.

Van Creveld concluded that medals, awarded for the proper purposes and with the proper criteria, served a serious purpose by enhancing the fighting prowess of a military organization. If one accepts this finding, it is in a military organization's best interest to enhance and focus the meaning of the medals rather than to cheapen them through relaxed criteria for their award. He further concluded that there is little purpose to awards granted for "as expected" performance, in spite of the often herculean administrative efforts required to process and award them.

If the administrative tedium of awarding meaningless awards were not enough of a speed brake on an organization, there are the compounding issues of using these token award "trinkets" as institutionalized "brownie points" for advancement. When everyone is expected to get a medal for each tour, how can the true achievers be distinguished from

the "been there, done that" masses? How do we distinguish those who simply did their duty from those who showed initiative and took personal risks to achieve?

Like all of my peers, I received my share of the "present and accounted for" medals and ribbons during my 15-year Air Force career. I am sorry to say that none of them have very much personal meaning as anything more than a line of text on my personnel record. The fact that I had an "achievement medal" certainly has no meaning whatsoever to others other than "he was alive." Today, as was noted in the original article, awards without meaning have become even more of a bureaucratic necessity and a rite of passage than in World War II. At the organizational level, the incessant processing of meaningless "end of tour" awards has even become a managerial "efficiency objective" tracked diligently on practically all staff levels, diverting time and effort from the true missions assigned. At the personal level, we have ended up expecting awards simply for doing our jobs. Because of the emphasis, via the career-advancement policy, we end up concerned when we don't receive that ribbon, or we spend time wondering how many tours in Al Udeid, and at what rank, are needed for what medal.

We should bestow medals and military awards to identify and publicly recognize the military excellence of the individuals to whom they are awarded—they should not just adorn the uniform. Anything less cheapens the awards as well as perhaps cheapens and diverts the organization that proffers them.

Perhaps the Wehrmacht had the right idea.

Robert Keeter
Hanscom AFB, Massachusetts

I enjoyed Lieutenant Colonel Powell's article "Medals for Mediocrity." As a civilian Air Force employee, I attend commander's calls and have often wondered about how generous the Air Force is at handing out medals. It certainly wasn't like this when I was in the Army in the sixties.

I remember a family portrait of my uncle, recently deceased at age 92, taken about the time of his discharge from World War II. This man fought his way across France, including the Battle of the Bulge, crossed the Rhine at Remagen bridgehead, and helped liberate a death camp. He rose from buck private to major in three-and-a-half years—and had only three ribbons on his chest. But I see junior Airmen who've been in service for a year or two, never in actual combat, and they have a whole chest full of ribbons!

I know that Airmen work hard, and they deserve recognition, but the public associates ribbons/medals with awards for bravery or service in actual combat theaters, such as my uncle and his World War II comrades. Handing them out for merely doing one's job—even if it was important and done exceptionally well—seems to cheapen the idea. When civilians see that Airman with the chest full of ribbons, they assume that they were awarded for bravery under fire, when actually they may be for "outstanding service in installing $1,400,000 worth of water lines." (I work in a civil engineering squadron, and this happens a lot.)

I also remember a scene from a classic Eisenstein movie; I think it was *Ten Days That Shook the World*. The tsar's army is demoralized and in full retreat from the Germans, so they start handing out medals to restore morale—shoveling them out by the bucketful, then the barrelful, then the carload—but it's all a useless gesture. The poor peasant soldiers are so beaten down by their cruel officers that no number of medals can restore their courage. (OK, it's a communist movie, but the point remains.)

Andy Hayes
Malmstrom AFB, Montana

Interesting article. Having spent six months in Afghanistan and been involved in a joint awards process there, I know that it is not just an Air Force problem. Task force commanders of more than 500 "outside-the-wire" combat-support personnel struggle to receive a Bronze Star at the end of a one-year tour, while junior enlisted and junior officers downrange get them routinely—with the same awards board and commander approving them all. Air Force, Navy, and Marine personnel in the Army-heavy Combined Joint Task Force (CJTF) 101 fare poorly, even though they are regularly shoulder-to-shoulder with their Army brethren in the

fight. In CJTF 101's defense, they see hundreds of joint awards each week for four services and various governmental agencies, with terms of deployment from a few weeks to years. The awards process of the International Security Assistance Force for US personnel is another story.

In an increasingly joint military, the process could use some equalization across services; obviously, the mechanism for that would be difficult to manage and too easy to micromanage in a peacetime military. In a combat zone, however, the war-fighting commanders could easily have their service-component commanders coordinate this from the outset for standardization. (For example, US Air Forces Central is currently involved in the approval of all, including joint, awards for Air Force personnel but is nowhere close to Army standards for the awarding of Purple Hearts.) Outside the combat zone, the decorations frameworks could be roughly aligned with each other since they all have comparable service awards, and Lieutenant Colonel Powell's ideas could be implemented easily and somewhat effectively at the lower echelons.

Lt Col Tony Haugrud, USAF
Eglin AFB, Florida

THE DILEMMAS OF PROVIDING LANGUAGE INSTRUCTION FOR THE US AIR FORCE

I found Lt Col Jay Warwick's article "The Dilemmas of Providing Language Instruction for the US Air Force" (Spring 2009) very interesting. I decided to go active duty some seven years ago to use my language skills and have been able to use them only at one assignment. I'm a Spanish speaker with bachelor's and master's degrees in Spanish. I taught Spanish while earning my degrees for a total of five-and-a-half years. I did get to use my language on two different deployments—one to El Salvador and one to Colombia. I'm an intelligence officer and am looking to go to regional affairs strategist / political-military affairs strategist training soon, perhaps via the Naval Postgraduate School or an Air Force Institute of Technology degree program in international relations. The author mentions that Spanish is one of the strategic languages, yet unless someone is in a billet identified for that language, he or she doesn't get the pay. I love the language and strive to keep it up (I also keep up Brazilian Portuguese, though it's not as good as my Spanish), so I don't need money to motivate me. Yet the Air Force message is incongruent: learn a language, maintain it, and, in my case, we won't pay you for it. I would like some broader programmatics from the Air Force level in this area to help guys like me use my language more actively.

Capt Jeremy Cole, USAF
Barksdale AFB, Louisiana

ASYMMETRIC AIR SUPPORT

Maj Gary Burg's article "Asymmetric Air Support" (Winter 2008) does a good job of highlighting the challenge of today's support in Operations Enduring Freedom and Iraqi Freedom but falls short of really addressing the bigger issue of getting an Air Force that can support irregular warfare (IW) around the globe. Aviation in IW brings a true asymmetrical advantage to the joint force. Airpower provides time-critical and actionable intelligence that often can be gathered only from a bird's-eye perspective. It also provides mobility and flexibility for the always-changing battlefield. "Fires" is usually the end phase of an operation—if required at all. In the special-operations counterinsurgency targeting model of find-fix-finish-exploit-analyze, "finish" does not always mean kinetic but usually means capture of the insurgent. For IW, intelligence is operations! Even the assault forces on the ground are training in "sensitive site exploitation" (SSE) to garner intelligence while on target. That SSE often leads to the next target. When it comes to intelligence, surveillance, and reconnaissance (ISR), I believe that we in the Air Force have fallen short of appreciating the needs to provide this capability to meet the demands of IW. When a majority of F-16 taskings is nontraditional ISR, why do we still call it nontraditional? With multirole, multicapable assets, we need the ability to support a variety of missions with surges across the spectrum.

The air tasking order / airspace control order process has often conflicted with how forces ask for and get air support, and, as the author states, it doesn't match how we fight. How is an ISR asset capable of close air support (CAS) different from a CAS asset capable of ISR? We can no longer afford to have a fleet that is comprised of "unitasker" missions. The fleet must have multiple capabilities—that is reality. The fact that the mission is boring or requires endurance does not mean that only unmanned aircraft systems (MQ-1 or MQ-9) should accomplish it. Though these systems are cost effective at times, there are benefits of manned assets over unmanned for these same mission sets—hence the MC-12 Liberty Ship initiative. I agree with Major Burg's premise that we cannot continue to use our assets under our current construct. To quote the IW Joint Operating Concept, "Waging protracted irregular warfare depends on building global capability and capacity." Airpower will be needed to support potentially hundreds of small, dispersed teams operating globally in permissive, contested, and denied areas. We cannot neglect one requirement for another (major combat operations or IW). We need to ensure that we have a mix of capabilities to operate across the spectrum of operations and recognize that the Air Force cannot do it all alone. We will need joint, coalition, and interagency support to ensure that we have the right force at the right place at the right time.

Lt Col Peter LeHew, USAF
Creech AFB, Nevada

WHY WE SHOULD END THE AVIATOR CONTINUATION PAY BONUS PROGRAM

I am writing with regard to Maj Brian Maue's article "Why We Should End the Aviator Continuation Pay Bonus Program" (Winter 2008). Although I am a Coast Guard aviator in a service without a version of aviator continuation pay (ACP), I see many benefits to the program that the article did not address. The most notable argument is the experience of the aviators that the program retains. ACP targets the midgrade officers who still operate on the front lines with the upcoming generation of flyers, imparting knowledge and wisdom as they go. Any program that keeps these officers around is beneficial to the Air Force and the United States. The author mentioned how important seniority is in the airlines. A loss of ACP would make it probable that officers on the fence about staying or going would be more likely to go in order to gain seniority before the next round of furloughs. I agree that military aviators obtain skill sets marketable in the civilian workplace. However, waiting until the end of 20-year career and starting all over again at the bottom of a seniority list is a tough pill to swallow. ACP makes this pill a little easier to choke down. These are just a few thoughts from an aviator who will never see ACP—but it would be nice.

LT Mike Woodrum, USCG
Coast Guard Air Station Kodiak, Alaska

Major Maue's article was interesting, and I've read plenty of responses to it that were filled with emotion and a few facts. Just so you know my background, I am a pilot and have flown for about 15 of my 18 years in the military. I've spent three years of that time at the Pentagon in the Air Staff, part in Plans and Programs in charge of funding undergraduate flying training and the other part in Operations and Training in the division that manages rated force policy. AF/A3O-AT has a community of practice—Headquarters US Air Force A3 Conference (which focused on rated force management)—that met on 4–5 November 2008 at Andrews AFB, Maryland. A briefing entitled "Rated Manning Strategic Assessment" found in the "briefings" folder (see https://afkm.wpafb.af.mil/ASPs/CoP/OpenCoP.asp?Filter=AF-OP-00-08) will provide some facts regarding why we're not doing away with ACP right now.

I have said several times in the past that the bonus is a retention tool, not an entitlement. But since the cost and time required to create a qualified aviator to be an instructor or staff officer are high, the bottom line the Air Staff is presenting is that we need to retain every aviator we can at this time, or else drastically reduce our rated requirements. The community of practice is very informative—it's another data point that wasn't available when Major

Maue did his research. The bottom line is that the Air Force will keep ACP in place as long as the service is failing to meet its requirements.

Lt Col Edward R. Presley, USAF
Dyess AFB, Texas

Editor's Note: The link to the community of practice in Lieutenant Colonel Presley's letter has restricted access and is not available to all readers; however, Major Maue's response addresses most of the pertinent points.

WHY WE SHOULD END THE AVIATOR CONTINUATION PAY BONUS PROGRAM: THE AUTHOR RESPONDS

Sir, given your background, you are by far the most qualified person who has offered data for review. Before I respond to the slides from the community of practice, I would like to focus on your statement "I have said several times in the past that the bonus is a retention tool, not an entitlement. . . . The bottom line is that the Air Force will keep ACP in place as long as the service is failing to meet its requirements."

First, I agree that, given the unmanned aircraft systems (UAS) and other human-airframe needs, the Air Force could definitely use every (qualified, productive) aviator that it can retain.

Second, my policy review of the ACP bonus used this standard: "Does the ACP bonus *cause* pilot retention?" To elaborate, "causality" or the claim that "factor A caused reaction B" depends upon three standards:

1. Factor A occurred before reaction B.
2. Changes in reaction B occurred in correlation with changes in factor A.
3. No other factor simultaneously caused reaction B.

Within the context of the ACP policy, these three standards might be stated as follows:

1. The ACP bonus's ability to affect a pilot's retention decision occurs before a pilot decides to remain in, or separate from, the Air Force. This causal standard is not in dispute.
2. Changes in retention rates occur in correlation with changes in ACP bonus amounts. This standard of causality is *not* met. A cursory review of retention rates before and after the terrorist attacks of 11 September 2001 (9/11) (such as the ones in the community of practice slides) shows that retention rates did *not* gradually climb as ACP bonus amounts rose. Instead, retention rates correlated with a competing causal explanation, as elaborated in causality standard no. 3.
3. No other factor simultaneously caused the increased pilot retention. Condition three does *not* hold with regard to ACP's causality. A strong case can be made that the simultaneous factor of "civilian airline opportunity declining" caused the increased pilot retention. Using pre-9/11 data, a fighter pilot (who also earned a PhD) researched this issue. (See Col Richard Fullerton, "An Empirical Assessment of US Air Force Pilot Attrition," *Defense and Peace Economics Journal*, 2003.) His logistic regression analysis suggested that the biggest factors predicting retention were "the pay differences between the airlines and the USAF, the strength of the US economy, and the demand for pilots by the major airlines."

This corresponding pattern of pilot-retention behavior continued after 9/11, when civilian airline opportunity declined as furloughs increased, annual earnings were cut, and pension values declined from "defined benefit" plans to "defined contribution." Compared to civilian airline opportunities, the excellent pay and benefits of the military became even more attractive. Patriotism must have played some part in the higher retention rates, but such patriotism was not, by itself, strong enough to keep retention rates high before 9/11, when increased operations tempo caused increased stress to the rated force (e.g., family separation).

Thus, I agree with statements such as "the cost and time required to create a qualified aviator to be an *instructor* or *staff officer* are high." At the same time, based upon the evidence that I have reviewed, I believe that these

statements should also include the following: "Yet ACP has *not* been shown to *cause* retention of those positions, at least not when compared to the magnitude of the impact from reduced airline opportunity or operations-tempo stresses." We might also note that "cadets sign up for their 10 years of service, which will include instructor pilot duty, without consideration of the ACP bonus."

Additionally, if I am interpreting your Air Staff reference correctly, I must begin by stating that I have never served on the Air Staff, so I can only speculate about the implied Air Staff belief that ACP is helping "retain every aviator we can at this time." If the Air Staff's guiding rationale is to be able to say to Congress or the chairman of the Joint Chiefs of Staff, "We are doing everything that we can to obtain high pilot retention, including large bonuses," then continuing the ACP policy makes sense from that rationale.

At the same time, if the senior leaders are saying, "The ACP bonus is *causing* our higher retention rates," then they have probably been misinformed. The rational, empirical perspective strongly favors "lower civilian airline opportunity" as the dominant reason for the higher retention rates.

Unnecessarily spending bonus money is accompanied by an "opportunity cost." That is, given that the preponderance of the evidence suggests that ACP has an "insignificant causal effect" on retention abilities, where might that ACP money be better placed in order to create a more effective war-fighting force? Sir, I would wager that you have more accurate numbers than I, but for the moment, let us assume that each ACP cohort has a contract of five years, with an average of 500 pilots accepting each year. That stream of money would then be $62.5 million per year (500 pilots x $25,000 per year per pilot x 5 cohort years = $62,500,000). It would seem that $62.5 million per year could significantly enlarge the UAS school for nonrated individuals (simultaneously increasing the pilot population while reducing the need for undergraduate pilot training graduates to do the UAS mission). (See SSgt Matthew Bates, "Air Force UFC: New Course Teaches Airmen the Basics of UAS Operations," *Airman Magazine*, 25 February 2009, http://www.airmanonline.af.mil/articles/story.asp?id=123137103.) Alternatively, that money could be directed to improve our nation-building abilities through security forces bonuses, civil engineer bonuses, and foreign language immersion schools.

Given the space constraints associated with writing this response, I must selectively comment on but a few of the community of practice slides that you offered. These slides appear to mirror many of the assumptions that surround the ACP-effectiveness discussion. For example, one slide shows a predicted retention line and includes the accompanying statement "assumes ACP in place for the outyears." Why "assumes"? The slide implies that ACP will cause the retention rate, which appears to be a misinformed assumption when viewed from an evidence-based perspective. Another slide states that "rated retention is currently a bright spot" without bringing in the causal link of reduced opportunity in civilian airlines. The term "currently" also seems to imply a fragile condition—there is no mention of the higher than 60 percent retention rates of the last several years, nor of the projected continuation of poor opportunities in civilian airlines. (See "Airlines 'Shrinking by All Measures,'" *CNNMoney.com*, 20 December 2008, http://money.cnn.com/2008/12/30/news/air_traffic_falls.reut/index.htm.) Lastly, one slide states "the goal for FY09: retain every rated officer possible *while being fiscally responsible*!" Given the excellent pay, health benefits, pension benefits, and aviation career incentive pay that pilots already receive, the case for the ACP's representing fiscal responsibility, when viewed from a causality framework, appears weak.

If I have overlooked any of your concerns (or any additional current reader's concerns) or any other key information, please let me know, and I will respond accordingly. I appreciate the opportunity from *ASPJ* to offer you a response as well as explore further the issues of "fiscal responsibility, relative to dollar effectiveness."

Maj Brian E. A. Maue, USAF
US Air Force Academy

The Merge

In air combat, "the merge" occurs when opposing aircraft meet and pass each other. Then they usually "mix it up." In a similar spirit, Air and Space Power Journal*'s "Merge" articles present contending ideas. Readers are free to join the intellectual battlespace. Please send comments to aspj@maxwell.af.mil or cadreaspj@aol.com.*

Managing the Human Weapon System

A Vision for an Air Force Human-Performance Doctrine

Lt Col Anthony P. Tvaryanas, USAF, MC, SFS
Col Lex Brown, USAF, MC, SFS
Nita L. Miller, PhD*

> *The basic planning, development, organization and training of the Air Force must be well rounded, covering every modern means of waging air war. . . . The Air Force doctrines likewise must be flexible at all times and entirely uninhibited by tradition.*
>
> —Gen Henry H. "Hap" Arnold

In a recent paper on America's Air Force, Gen T. Michael Moseley asserted that we are at a strategic crossroads as a consequence of global dynamics and shifts in the character of future warfare; he also noted that "today's confluence of global trends already foreshadows significant challenges to our organization, systems, concepts, and doctrine. We are at an historic turning point demanding an equally comprehensive revolution." Furthermore, to revolutionize the twenty-first-century Air Force, according to General Moseley, we must start with our Airmen since "any organizational renaissance begins with people. We must prepare our Airmen for a future fraught with challenges, fostering their intellectual curiosity and ability to learn, anticipate and adapt."[1]

An evolving recognition of "the human as the most important weapon system in the Global War on Terrorism" is evident in the special operations forces' declaration that "humans are more important than hardware" in asymmetric warfare.[2] Consistent with this view, in January 2004, the deputy secretary of defense directed the Joint Staff to "develop the next generation of . . . programs designed to optimize human performance and maximize fighting strength."[3] In response, US Joint Forces Command began a transformation of force health protection (FHP) by addressing human-performance standards, metrics, capabilities, and gaps via a new Joint Human Performance Enhancement Joint Capabilities Document.[4] In 2005 the director of the Office of Net Assessment sparked wider interest by publishing *Human Performance Optimization and Military Missions*, which prompted the Department of Defense (DOD) / Health Affairs to sponsor a conference on human-performance optimization in June 2006.[5] The conference report advocated such optimization at all DOD

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levels, but as yet, no overarching implementation strategy has appeared.[6]

In the Air Force, human-performance programs are generally more product oriented than human-centric, and relevant strategy and doctrine are limited to health services.[7] As General Moseley reminds us, "History is replete with examples of militaries that failed due to their inability to transform organizations and culture, adopt new operational concepts, or leverage breakthrough technologies."[8] The Air Force cannot leverage breakthroughs in human performance unless it is organizationally and culturally ready. Similarly, the 2008 Air Force Medical Service (AFMS) Capabilities Review and Risk Assessment concluded that we must make the most of human capital in terms of recruitment, selection, training, operational performance, cross training, retention, and postretirement health and well-being.[9] The assessment recommended a coordinated program to operationalize human performance for all Airmen by developing an overarching human-performance doctrine, organizationally redefining human performance as a line responsibility with health-services input, and developing ethical and legal frameworks for Air Force human performance.

In rising to Defense Secretary Robert Gates's challenge to "think out of the box" in continuous pursuit of better ways to support the joint force, we believe it is high time to address the shortfall in Air Force human-performance doctrine.[10] We propose a holistic doctrine that incorporates a capabilities-based, total life-cycle approach to managing Airmen—a performance-based force-projection model that concentrates on human performance while continuing to provide health care and casualty prevention to joint force commanders.

Transforming from Force Health Protection to Human-Performance Doctrine

Doctrine for FHP, defined as "all measures taken by commanders, leaders, individual Service members, and the Military Health System to promote, improve, or conserve the mental and physical well-being of Service members across the range of military operations," characterizes every service member as a *human weapon system* requiring total life-cycle support and maintenance.[11] It specifically describes this support in terms of three interrelated pillars: "healthy and fit force," "prevention and protection," and "medical and rehabilitative care."[12] With this framework in mind, FHP catalyzed the genesis of our model for human performance as providing capabilities of human weapon systems to the joint force commander. We departed from the health focus of FHP and embraced a large scope of application by accepting two transformational tenets. The first involves *managing Airmen consistent with other military weapon systems.* This necessitates the creation of capability-based requirements with associated performance thresholds and objectives derived directly from needs identified by the combatant commander to drive Airman acquisition and sustainment programs.[13] These programs should be managed by a program executive officer (with associated program managers using integrated process and product development) who provides a single organizational focus for the total life-cycle management of Airmen and remains accountable for life-cycle costs, schedule, and performance.[14]

The second tenet requires health-service support to *focus on human performance in addition to health care as the primary means of supporting the joint force commander.* Although this may seem at odds with the historical objectives of health-service support, it actually expands upon them, once we understand that health is a prerequisite for performance but that the presence of health does not guarantee performance.[15] Given the prerequisite need for health, addressing performance satisfies the FHP pillars of "healthy and fit force" and "prevention and protection" (which we can equate with primary and secondary preventive medicine). In fact, superior performance itself is a means of prevention and protection. For example, victorious forces historically suffer lower casualty rates than defeated forces, and improving situational awareness decreases the risk of fratricide.

Managing Airmen's capabilities through human performance erects a new doctrinal edifice with three foundational pillars: performance sustainment, performance optimization, and performance enhancement (fig. 1). Since no universally accepted human-performance definitions exist, the names chosen for the pillars serve as placeholders for major enterprise areas rather than specific definitions.[16] Figure 1 also depicts the pillars resting on an organizational foundation that embodies attributes of the university model: dissemination of knowledge, research, and teaching.[17] Doctrine, organizations, and weapon systems are interrelated—history demonstrates that advances in one area without corresponding advances in the others limit the overall effectiveness of weapon systems.[18] Thus, the university model represents the organizational change needed to support the human-performance doctrinal vision for the human weapon system.

Performance Sustainment for Airmen

Performance sustainment covers accession through separation/retirement with the goal of *maintaining target performance levels throughout a career while minimizing total life-cycle costs.* It also embraces the FHP pillars of "healthy and fit force" and "prevention and protection." Preventive medicine is a major contributor to performance sustainment because physical and mental health remains a necessary, but not sufficient, precursor for performance. Performance sustainment contains most health-service support functions with the exception of consequence management.[19] The objective calls for sustaining performance in the face of enemy actions, full-spectrum (natural and technological) environmental threats and stressors, and advancing age.

If we accept the paradigm of the human weapon system, then the breadth of performance sustainment fits comfortably within the larger framework of the DOD acquisitions life cycle (fig. 2), specifically including the use of requirements derived from the Joint Capabilities Integration Development System. Applying the Defense Acquisition Management Framework to Airman acquisitions affects the AFMS and Air Force in the following transformational ways:[20]

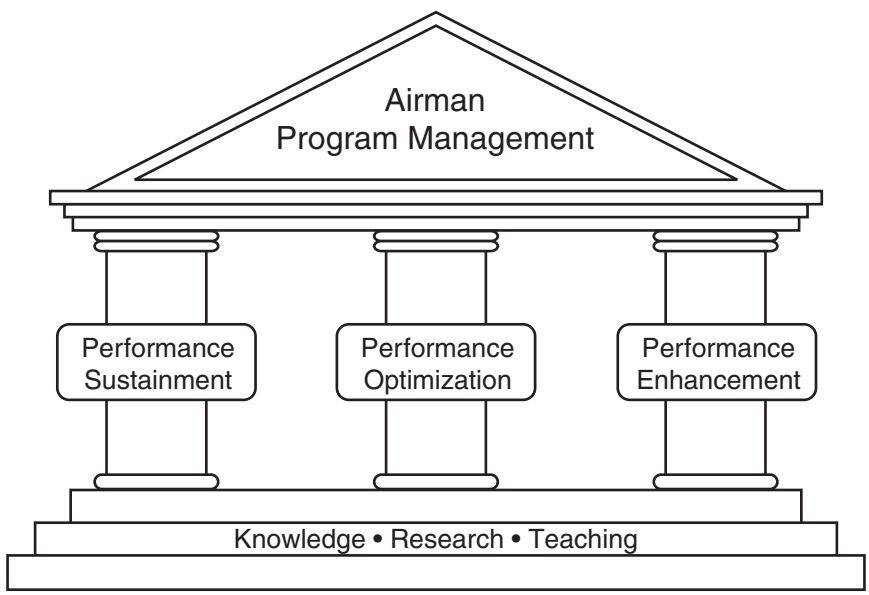

Figure 1. Three pillars of program management for Airmen

- Development of a portfolio of Airman capability documents (ACD) derived from the Joint Capabilities Integration Development System for groups of related Air Force specialty codes incorporating physical, physiological, psychological, and cognitive performance thresholds and objectives.[21]
- Formulation of a supporting test and evaluation master plan (TEMP) for each ACD, which becomes the source document for conducting preaccession screening, gauging developmental progression during training, and monitoring performance over a career.[22]
- Consideration of the time from accession to end-of-life instead of a nominal 20-year career during ACD development and preaccession screening, with the aim of minimizing total life-cycle costs.
- Alteration of the AFMS's preventive health assessments to performance and health assessments, primarily focusing on physical, physiological, psychological, and cognitive performance (based on the ACD and TEMP), with continued emphasis on health maintenance. Examples of performance monitoring include duty-specific fitness assessments, exposure-driven mental-health screening, and neurocognitive assessments.
- Deployment of tailored, multidisciplinary expeditionary-performance support teams

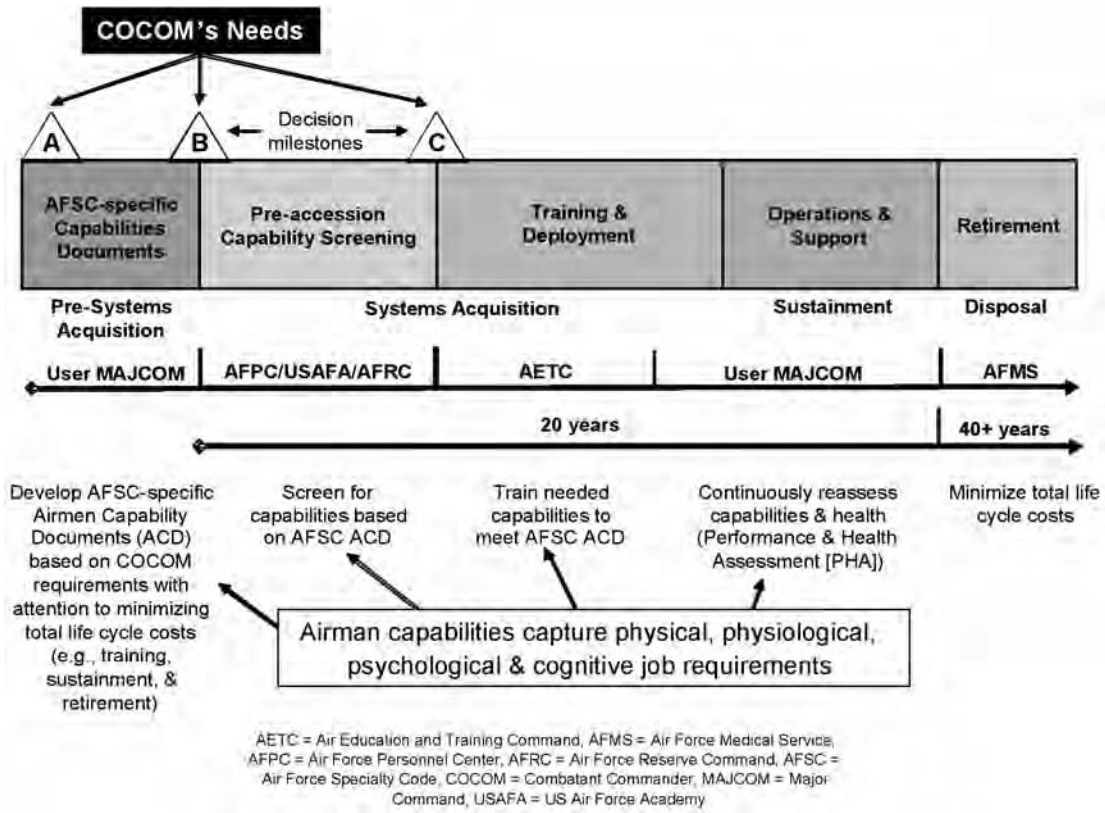

Figure 2. Application of the Defense Acquisition Management Framework to Airman acquisitions. (From Defense Acquisition University, *Introduction to Defense Acquisition Management*, 7th ed. [Fort Belvoir, VA: Defense Acquisition University Press, 2005], 49.)

containing traditional expertise in preventive medicine augmented by expertise in the physiological, psychological, and cognitive domains.

Performance sustainment will drive research and development of continuous, real-time, and periodic performance-assessment tools to support both the ACD and TEMP; mitigation strategies of the performance-degrading effects of advancing age; and physical and psychological countermeasures to maintain performance during warfare or exposure to environmental threats such as climatic extremes, g-forces, fatigue, weapons effects, prolonged mental stressors, and witnessing or participating in violent acts. However, the systems-engineering process, rather than the development of countermeasures and personal protective equipment, offers the primary means of mitigating threats and stressors.[23]

Performance Optimization for Airmen

Performance optimization seeks to *achieve the most efficient use of limited human resources* by comprehensively integrating Airmen within the Air Force's sociotechnical systems.[24] People are the critical elements within systems, so adopting a human-centric perspective of systems increases total system performance and minimizes total ownership costs.[25] Optimization occurs in defense acquisitions, starting with the specification of system requirements and flowing down through system design, development, and deployment. It goes well beyond human-machine interface design and *involves deliberate planning to efficiently leverage the Airman through the process of human systems integration (HSI),* a process model for obtaining performance. Perhaps more importantly, that model defines the domains of performance: human factors engineering (HFE); personnel; training; manpower; environment, safety, and occupational health (ESOH); habitability; and survivability.[26] We obtain better system performance with lower ownership cost by actively managing the interactions and trade-offs between domains rather than simply optimizing individual domains. As an illustration, employing intuitive automation in the design of a workstation to simplify a work process (HFE domain), thereby reducing manpower and training requirements (manpower and training domains), yields significant savings over the life cycle of a system. In addition, the HSI tool enables program managers to counter shortfalls in one domain by augmenting another to achieve targeted system performance. For example, a program forced to accept shortfalls in cockpit design (HFE domain) could respond by augmenting training (training domain) or selecting more capable or experienced aircrew members (personnel domain). Failure to adequately attend to HSI results in a degraded weapon system that can become prohibitively expensive to repair.

A new, high-level conceptual model of the HSI process (fig. 3) better explains the essential relationships between the HSI domains and human performance.[27] The input domains (manpower, personnel, training, and HFE) are typical items or services procured by the DOD, which makes their specification as process inputs more congruent with the DOD's capabilities-development process. Additionally, focusing on the four input domains greatly simplifies the challenges of forecasting the impact of HSI trade-offs through modeling and simulation, a necessary consideration given DOD initiatives for simulation-based acquisitions.[28] In contrast, the ESOH, habitability, and survivability domains represent desired system attributes or behaviors not directly procurable; rather, they emerge through various combinations of the input domains. These three domains also collectively describe the FHP pillar of "prevention and protection," directly linking performance optimization to FHP and providing an avenue to address FHP through a systems-engineering approach.

Performance optimization affects performance sustainment, during which the bulk of prevention activities occur. The HFE domain drives the human physical, physiological, and cognitive performance requirements that, in turn, must be sustained throughout the life of a system. System requirements specified for the ESOH, habitability, and survivability domains influence the likelihood of future hazardous exposures that will require prevention

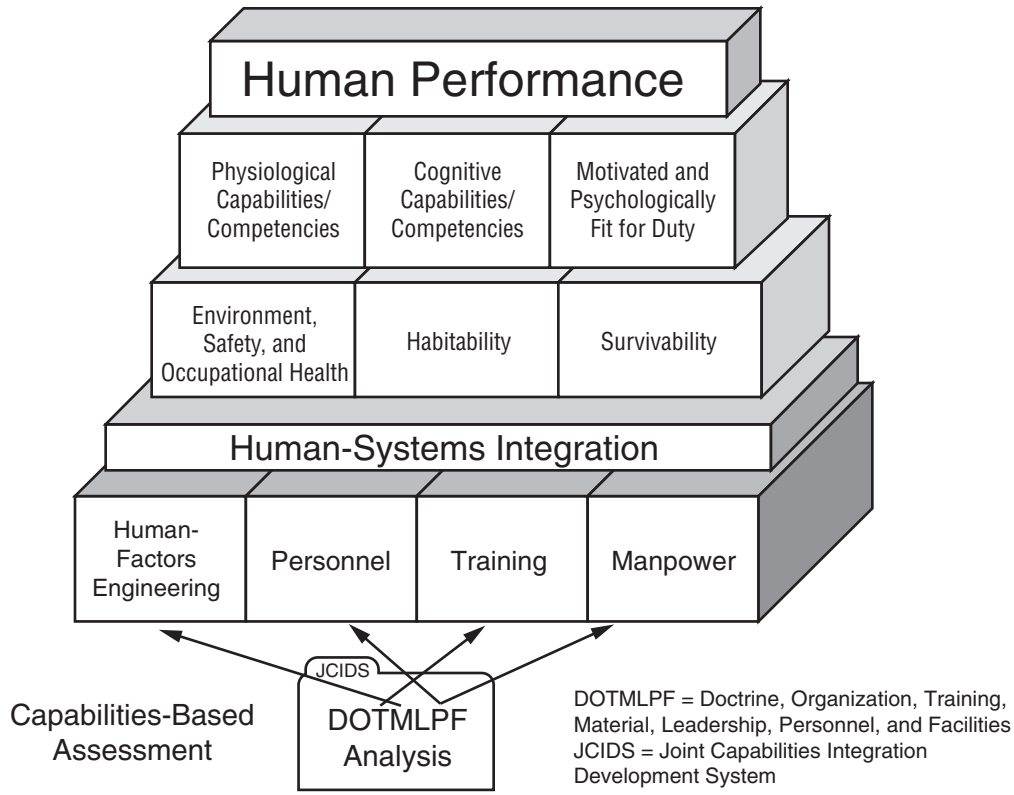

Figure 3. Linkages between the HSI process model and the Joint Capabilities Integration Development System gap analysis. (Adapted from Robert Lindberg, to the author, personal communication regarding the 711th Human Performance Wing's HSI model, 23 July 2007.)

and protection. Failure to compensate for human weaknesses or to capitalize on human strengths when specifying system requirements drives research and development of countermeasures to prevent injury or illness. Therefore, performance optimization maximizes efficiencies and cost savings through primary and secondary prevention.

Performance Enhancement for Airmen

Performance enhancement occurs chiefly through science and technology initiatives that *enable Airmen to operate beyond established and sustainable performance* thresholds, a spectrum ranging from intrahuman (biotechnology and pharmacology) to extrahuman (hardware and software). We developmentally plan a human-performance science and technology road map "by investigating future threats; recognizing capability gaps and requirements; capturing needed system-performance characteristics; and understanding technology gaps, risks, and needs."[29] Advances in performance enhancement create new capabilities for Airmen, enabling performance sustainment and optimization by expanding the existing performance envelope and providing solution sets for tradeoffs in the HSI domain. Thus, the three foundational pillars of program management for Airmen in figure 1 become a set of interrelated enterprises rather than distinct and independent efforts. *Integration* becomes the key word when we organizationally, functionally, and financially address human performance.

Summary

The world's security environment is changing dramatically in many dimensions—political, economic, social, and military. In response, "the Air Force is transforming into an effects-based, efficient provider of human combat capability, which can sustain air, space, and cyberspace superiority for the joint force and our Nation."[30] As General Moseley pointed out, "It is the *Airmen* who transform hunks of metal, buckets of bolts, microprocessors, and circuitry into the Nation's warfighting edge" (emphasis in original).[31] Providing capability for human combat, however, requires related doctrine on weapon systems. This article has proposed a vision for a broad human-performance doctrine for the Air Force—to sustain, optimize, and enhance Airmen. It addresses "how we think" about human performance and lays the foundation for future doctrine describing "what we think" about human performance. Ultimately, human-performance doctrine should provide a capabilities-based, total life-cycle approach to managing Airmen. Within the AFMS, it is time to *move from a health-based FHP model to a performance-based force-projection model.* In this new paradigm, the medical service maximizes successful force projection through its contribution to the human-performance mission while simultaneously standing ready to mitigate performance failures through consequence management. That said, the AFMS alone cannot implement the vision described here: its scope is driven by the breadth of application of human performance, which goes well beyond health services. The Air Force, therefore, must think strategically about its human weapon systems and develop both doctrine and the supporting organizational structures to operationalize human performance for all Airmen. We agree with General Moseley's observation that we are at a strategic crossroads, believing that a holistic approach to human performance is critical to the posture of the Air Force. We cannot say it any better than did our former chief of staff: "America's Air Force will succeed in the 21st century only by developing and resourcing a coherent strategy that closes the gap between ends and means. The window of opportunity is shutting fast. Time is not on our side."[32] ❑

Notes

1. Gen T. Michael Moseley, *The Nation's Guardians: America's 21st Century Air Force*, CSAF White Paper (Washington, DC: Department of the Air Force, Office of the Chief of Staff, 29 December 2007), 3, 6, http://www.af.mil/shared/media/document/AFD-080207-048.pdf.

2. Patricia A. Deuster et al., "Human Performance Optimization: An Evolving Charge to the Department of Defense," *Military Medicine* 172, no. 11 (November 2007): 11, http://www.siib.org/news/367-SIIB/version/default/part/AttachmentData/data/HPO%20Mil%20Med%202007.pdf.

3. PowerPoint briefing, 2007 Military Health Services Conference, subject: "Human Performance Optimization (HPO) within DOD," slide 6, http://www.tricare.mil/conferences/2007/Mon/M107.ppt (accessed 27 May 2008).

4. Ibid.

5. A. Russell, B. Bulkley, and C. Grafton, *Human Performance Optimization and Military Missions: Final Report*, GS-10F-0297K (Washington, DC: Office of Net Assessment, May 2005).

6. Deuster et al., "Human Performance Optimization"; and PowerPoint briefing, 2007 Military Health Services Conference.

7. Air Force Doctrine Document (AFDD) 2-4.2, *Health Services*, 11 December 2002, 47–52, https://www.doctrine.af.mil/AFDCPrivateWeb/AFDD_Page_HTML/Doctrine_Docs/afdd2-4-2.pdf.

8. Moseley, *Nation's Guardians*, 2.

9. Headquarters US Air Force, Assistant Surgeon General for Operations, *United States Air Force Medical Service 2008 Capabilities Review and Risk Assessment: Operationalize Human Performance for All Airmen* (Washington, DC: Department of the Air Force, 31 March 2008).

10. Michael W. Wynne, secretary of the Air Force, and Gen T. Michael Moseley, chief of staff of the Air Force, to all Airmen, memorandum, 24 April 2008.

11. Joint Publication 4-02, *Health Service Support*, 31 October 2006, I-3, http://www.dtic.mil/doctrine/jel/new_pubs/jp4_02.pdf; and AFDD 2-4.2, *Health Services*, 21.

12. Office of the Secretary of Defense (OSD), *Force Health Protection* (Washington, DC: Department of Defense, 6 November 2003), 10, 13; and Department of Defense Directive (DODD), 6200.04, *Force Health Protection*, 9 October 2004, 2, http://www.dtic.mil/whs/directives/corres/pdf/620004p.pdf.

13. Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01F, *Joint Capabilities Integration and Development System*, 1 May 2007, A-3, A-8, http://www.dtic.mil/cjcs_directives/cdata/unlimit/3170_01.pdf.

14. Office of the Undersecretary, Acquisitions and Technology, *DOD Guide to Integrated Process and Product Development* (Washington, DC: Department of Defense, 5 February 1996), 1-1 through 2-12; and DODD 5000.01, *The Defense Acquisition System*, 12 May 2003, 2, 10, http://www.dtic.mil/whs/directives/corres/pdf/500001p.pdf.

15. Deuster et al., *Human Performance Optimization*, 3, 5.

16. Many organizations have become interested in pushing the limits of human performance, and they have developed terminology corresponding to their interests and funding (e.g., AFMS and Joint Forces Command—human-performance enhancement; Office of Net Assessment and DOD Health Affairs—human-performance optimization; Defense Threat Reduction Agency—human-performance modification). This multiple, overlapping terminology reinforces stovepipes and prevents effective unity of effort, potentially harming the larger Air Force and DOD mission. V. Martindale, to the author, personal communication regarding "Point Paper on Human Performance Terminology for AFMS," 25 July 2007.

17. Jaroslav Pelikan, *The Idea of the University: A Reexamination* (New Haven, CT: Yale University Press, 1992), 32–43, 58–62, 78–98.

18. I. B. Holley Jr., *Ideas and Weapons* (New Haven, CT: Yale University Press, 1953), 175–78.

19. Consequence management is defined as those individual and organizational activities directed at halting the progress of disease or limiting the damage caused by injury and reducing the long-term social disability produced by any residual impairment.

20. Department of Defense Instruction (DODI) 5000.2, *Operation of the Defense Acquisition System*, 12 May 2003, 2, http://www.dtic.mil/whs/directives/corres/pdf/500002p.pdf.

21. CJCSI 3170.01F, *Joint Capabilities Integration and Development System*, A-8.

22. DODI 5000.2, *Operation of the Defense Acquisition System*, 35.

23. Beverly S. Cohen, "Industrial Hygiene Measurement and Control," in *Environmental and Occupational Medicine*, ed. William N. Rom (Philadelphia: Lippincott-Raven, 1998), 1753–55.

24. The term *human-performance optimization* has been discussed as a focus area for the Joint Medical Research Command. See Deputy Assistant Secretary of Defense, Force Health Protection and Readiness, to Assistant Secretary of Defense, Health Affairs, memorandum, 26 December 2006. The use of performance optimization in the context of this proposal is not congruent with the formulation of human-performance optimization as used by that command; nor is it intended to suggest that HSI is solely a health-services function since it clearly crosscuts multiple functional capabilities described in the Agile Combat Support Concept of Operations (e.g., acquisition, civil engineer, logistics readiness, manpower, personnel, safety, science and technology, training, test and evaluation, etc.). We use the term *performance optimization* simply because it best describes the proposed enterprise area.

25. DODI 5000.2, *Operation of the Defense Acquisition System*, 43.

26. Ibid., 43–45; and MIL-HDBK-46855A, *Department of Defense Handbook: Human Engineering Program Process and Procedures*, 17 May 1999, 19–20, http://hfetag.dtic.mil/docs-hfs/mil-hdbk-46855a.pdf.

27. Nita L. Miller and Lawrence G. Shattuck, "Rethinking HSI: An Applied Approach," draft, 2007.

28. Since the key word in *human systems integration* is *integration*, any modeling and simulation effort needs to capture domain interactions in order to accurately predict the impact of domain trade-offs on total system performance and ownership costs. For example, assuming we could model performance by using a log-linear model, capturing domain-interaction effects requires a full or saturated model. When we work with all seven human-systems integration domains, the resulting model would have 127 terms—a significant computational challenge. However, by considering only the four input domains, we reduce the model to a more manageable 15 terms.

29. Gen Bruce Carlson and Maj Stephen Chambal, "Developmental Planning: The Key to Future War-Fighter Capabilities," *Air and Space Power Journal* 21, no. 1 (Spring 2008): 5, http://www.airpower.maxwell.af.mil/airchronicles/apj/apj08/spr08/spr08.pdf.

30. *Air Force Roadmap: 2006–2025* (Washington, DC: Department of the Air Force, June 2006), 19, http://www.af.mil/shared/media/document/AFD-060713-002.pdf.

31. T. Michael Moseley, "America's Air Force: The Nation's Guardian," *Joint Force Quarterly* 49 (2d quarter 2008): 11, http://www.ndu.edu/inss/Press/jfq_pages/editions/i49/8.pdf.

32. Ibid., 13.

The Air Force Commander

The Power of Interaction and Vision

Col William Mott, USAF*

HOW DO YOU measure command success? Simply by the next job you are awarded? Or by combat victory, plain and simple? If you care about these questions, this article has something for you. The target audience is US Air Force commanders, but I suspect that any leader can improve by paying careful attention to the subjects of interaction and vision.

Many individuals measure command success by a combination of mission and people. The question is, "How do you successfully fulfill the mission and maximize your people's potential?" Answer that, and you probably have the essence of command! Command is "the legal authority to direct and order subordinates to perform duties or accomplish actions to attain military objectives."[1] One way of measuring commanders' success involves considering their command climate—the environment in which they exercise their authority and guide their people to carry out the mission. This article addresses the tools, means, and feel that a commander uses to create a successful environment.

I have experience as commander of an F-22 operations group. Before you decide, "Well, I'm not one of those!" let me simply say that it puts me in a unique position of having both subordinate commanders and an immediate superior in close proximity to my command. This position as a middleman allows some insight into command because I not only give direction and observe the firsthand effects, but also react to the directions of my commander.

Command Climate

Command is about impact! Coach Tom Landry of the Dallas Cowboys once said, "Leadership is getting someone to do what they don't want to do, to achieve what they want to achieve." Combat commanders have been inspiring followers ever since Alexander the Great led the charge that routed the Persians at the river Gaugamela. It is what today's commanders need to do. The question is, "How can Air Force commanders make a difference from the moment they enter their units until they head home?" Everything that occurs affects the *command climate*, which, though perhaps more of a joint term than an Air Force one, means "a state or condition existing from shared feelings and perceptions among soldiers about their unit, about their leaders, and about their unit's programs and policies. This condition is created by the commander and his chain of command from the commander's vision and leadership style, and influenced and perpetuated by their communication and their leadership."[2]

A positive command climate blends the importance of people and mission into an organizational climate that breeds success. Commanders can be either the moat that prevents

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their units from attaining the goal or the bridge that enables them to reach it. Whether they excel or just plod along, the commander's leadership will make a difference, either for good or bad.

How do you shape a favorable command climate? How do you create a unit that Airmen fondly recall, saying, "That was a great squadron," or "That was a golden time at Base X," or "The ORI [operational readiness inspection] rated us outstanding because. . . ."? You do it through interaction with subordinates and superiors and through a well-communicated command vision. Finally, preparation for an ORI will test these command skills.

Command Interaction

Commanders shape their units. Their mere presence affects mission accomplishment and Airmen's perceptions of the unit. The means and tools that the commander uses to interact with his or her command are critical.

Unfortunately, human interactions can't be boiled down to cookbook solutions or checklists of things to do or say. The nature of command interaction is dynamic, and what applies in one situation may not apply in another. For example, one of my subordinates asked me for an appointment. I determined that the meeting would certainly be a "routine" discussion about assignments since the officer was scheduled for reassignment, so the best means to get ready called for reviewing his personnel records. When the officer sat down, I started talking about potential training and assignments. Suddenly, I learned that the real reason for the meeting was the officer's personal situation and how the assignment might affect his family—not exactly what the "checklist" said about a counseling session.

That is the point about using a checklist or an academic approach to interactions within the command. Personnel issues are not easily divisible into subject areas or readily handled with a checklist. There is no checklist for each meeting because you never know where that encounter is going. Yet, even though you can't have a checklist for every type of meeting, some key guidelines do exist for the different types that a commander might face.

Rule one: every interaction with people has an effect on the command climate. Whether it is with your superior, subordinates, or family and friends, it all makes a difference. After even a small interaction, someone walks away with an opinion of you and your command.

Consider the commander's personal staff. How the commander walks into the office and starts the day is key. Like it or not, the commander's demeanor will answer questions they all have, such as "Will it be a good day or a bad day?" and "What kind of mood is the boss in?" The way the commander starts the day with his immediate staff will shape how they deal with the rest of the command. You can't afford to have a quiet morning or bad day—you simply must start with enthusiasm, courtesy, and excitement.

How often does the average Airman interact with his or her commander? I would say that time with the commander is less available than most of us would like to admit. In fact, some of your subordinates' only contact with the commander will occur through the staff. How many phone calls do the executive officer and secretary field each day that never reach the commander's office? A great many. The staff represents you and may "impact" more of the command than the commander. How the commander interacts with his staff has a cascading effect throughout the entire command.

What about your interactions with subordinate commanders and leaders? Just as your staff deals with your Airmen, so do your subordinate commanders touch everyone under their command. Commanders interact with subordinate commanders via writing or by communicating one on one or in a group. Within these engagements a commander makes his or her influence felt within the unit.

Letters—now e-mail—offer an easy way to communicate. You state your case, hit "send," and move on to something else. There is no need to converse, explain, debate, or align your schedules. Personal digital assistants (PDA) and e-mail make access nearly instantaneous. Written communication to subordinates has a great number of advantages, and, clearly, a

modern commander must use e-mail to exercise command. Those who say that "e-mail leadership is no leadership" must come from a different generation! Nevertheless, you must be careful when using written communication, especially instant communication. How many e-mail addicts do you know—people with cell phones attached to their belts and set to vibrate for every message received? The addictive and impersonal nature of e-mail warrants special care when used by a leader.

Immediate written communication carries hidden dangers. Certainly, the risk of being misunderstood is high unless you are a careful writer. Do you have a humorous personality? Someone may simply interpret your e-mail humor as sarcasm or worse. What about that instant access to your subordinates or commanders? What message do you convey when the date and time tag on your e-mail says Saturday at 0200? Do you expect an immediate response? Does it send an implied message about your priorities at home? Maybe not, but your recipient can infer something about your leadership—perhaps a message that you do not want to convey.

Pres. Abraham Lincoln supposedly wrote letters to his generals that he never sent. He obviously put some thought into his directions yet found it better not to send them. Perhaps a similar lesson applies to e-mail communications: some thought needs to go into the crafting of messages, and perhaps more than a few should not go forward!

Commanders can also communicate with subordinate commanders one on one, a style that offers the best chance for interaction. I consider the time I get with the wing commander precious. Any small conversation with him answers questions that save me from sending e-mails, and I hear what is important to him. Face-to-face time with the boss is invaluable. And so it is with your subordinate commanders. That communication must occur frequently, outside your office. You must move around so that your Airmen can see you talking to subordinate commanders and supervisors in their work areas. Not only do they get to see you outside the ivory tower, but also you get to see the "ground truth" of the facilities and people under your command.

What should you say during one-on-one conversations with subordinate leaders? Again, there is no checklist to use. Commanders have an agenda, and subordinates have theirs. I suggest that the more the subordinate talks, the more the commander can support him or her. Think of it as *bump steering*, a term that describes how a pilot can adjust an aircraft's autopilot while keeping it engaged: small control-stick inputs that "bump" the aircraft to the correct heading and altitude. Similarly, subordinate commanders need to remain engaged and receive only small guidance from the senior. You should spend less time talking and more time listening when interfacing one on one.

The more common method of communicating with subordinate commanders occurs via meetings. Most units have a leaders' meeting at least once a week, but is it a pleasure or a pain? Is it productive or stifling? As expected, the way the commander conducts the meeting determines the environment that, in turn, will affect the unit. Does communication take place in one direction? Does the commander allow dissension? Does the conversation delve too closely into the subordinate commander's area of responsibility? The commander must ensure that the meeting is productive, enjoyable, and marked by open communication and clear decisions. Ultimately, are the commander's meetings "councils of war" in which democracy reigns or a means of gathering data, listening to opinions, and making decisions? I prefer the latter style.

Here are two insights that speak to the power of meetings. In one case, I was chairing a meeting with subordinate commanders. Jokingly, one of them said, "Sir, I've been elected to talk to you on a certain issue." It seemed humorous, but it raised the question of whether I was approachable or too autocratic. If subordinate leaders are not comfortable voicing dissent, then they are not likely to talk openly about difficult issues. And that can mean that their vision may not cover the commander's blind spot.

In a second case, while attending a meeting chaired by the wing commander, I noted that

when someone brought up bad news, members of the audience kept their eyes not on the briefer but on the commander. They wanted to read his body language—to see how he would react. In the same manner, the "eyes and ears of the wing" were looking at the subordinate commanders at the table to see how they would react—to see if they would get along, fix blame, or say nothing. The conduct of the leaders at any meeting, even their interactions, influences command climate.

As in one-on-one discussions, large meetings provide a means by which the commander influences his or her unit, for good or bad. In the Air Force, we traditionally call the room to attention out of respect for the commander. Just as that focuses everyone on the commander's presence, so should the commander focus on his or her conduct during the meeting. Commanders have the power to concentrate on the mission's and their people's success, and to build a positive command climate.

Command interaction is a powerful part of commanding the staff and subordinate commanders, but especially members of the unit. How should the commander interact with Airmen? The commander is the identity of the unit and the representative of the Air Force enterprise to those Airmen. If you can't be approachable, if you can't share some information, how are your Airmen supposed to know what is important to you? Most of us have seen pictures of Gen Dwight Eisenhower meeting with members of the 101st Airborne Division prior to D-day. Some might think it was a media stunt, but in reality it was good for the men and good for Eisenhower. According to one account,

> Corporal Kermit Latta was struck by the "terrific burden of decision and responsibility" which showed on his face and by the sincerity of his effort to communicate with his young soldiers. He paused to speak to their group, and we can detect in his exchanges something of the deft personal appeal which was to make him the United States' most popular postwar president:
>
> "What is your job, soldier?"
>
> "Ammunition bearer, sir."
>
> "Where is your home?"
>
> "Pennsylvania, sir."
>
> "Did you get those shoulders working in a coal mine?"
>
> "Yes sir."
>
> "Good luck to you tonight, soldier."
>
> This exchange demonstrates that Eisenhower not only spoke to soldiers, he saw them as well. That was and is rare for generals.[3]

On that night of 5 June 1944, General Eisenhower watched the members of the entire 101st Airborne Division board their C-47s, waited while they launched, and saluted each plane as it took off.[4] I think there was something real in the general's command interaction—an attitude that connected the commander with his men. This is an essential aspect of command interaction.

I look for that interaction all the time. When I step out to fly, the crew chiefs and flight-line supervisors know that the commander is coming out. Those five minutes before I need to climb in and go fly are critical. The same is true when I'm in the staff car driving or walking the flight line during a launch. As a commander, you see the other commanders often, whether in daily meetings or because "you're the boss." But the people that you meet for five minutes on the flight line don't see the commanders as often. Those few minutes of interaction represent their complete picture of them. You can't afford that time to be negative in any way. Like General Eisenhower, you must "see" your Airmen.

Here is an example that humbled me and emphasized the power of words from a leader. I was having breakfast with the wing's chiefs and with those of Air Education and Training Command and went through the dining-hall line first. I was polite, engaging, and pleasant to the Senior Airman who was cooking. Or so I thought. As I waited, the two chiefs ordered their food and chatted with the Senior Airman and other servers. In the time it takes to cook an omelet, the chiefs learned where the Senior Airman was from, how he joined the Air Force, that he was a football player, that he was finishing his college degree, and that he liked his job at Tyndall AFB, Florida. The two

chiefs joked with one another and complimented the young Airman on his service to the country. All I got was an omelet, but I was pleasant! The Airman got a memorable conversation with two command chiefs. Who did the better job as a leader?

In summary, a commander's interaction with subordinate leaders and Airmen will create an environment depending solely on his or her style. But without a purpose, message, and vision, it can amount to nothing more than pleasantries. It is essential that a commander communicate a vision—the purpose behind all this interaction. A commander's interaction becomes more than words, e-mails, or meetings when he or she communicates the core of the mission—the vision.

Command Vision

A commander's interaction style must be precise and purposeful. You can't have one without the other. Vision is a powerful thing, but without the tools to communicate, it is wasted. That is why I spoke of command interaction before vision.

Vision is a tough concept to master. Is it just words or a true means by which the commander communicates his or her intent? Think of "Integrity, Service, Excellence." Is it a slogan or powerful set of words? Is it a saying on the bottom of PowerPoint slides, or is it truly our core values? I think it is what we are because I can weave those words into any mission, action, or event with which I am associated. Gen Douglas MacArthur said, "'Duty,' 'Honor,' 'Country'—those three hallowed words reverently dictate what you want to be, what you can be, what you will be."[5] This is true for the US Military Academy's "Duty, Honor, Country," and it is the same with the Air Force's "Integrity First, Service before Self, Excellence in All We Do." But it is that way only because leaders make it part of their everyday actions. Vision—specifically, the Air Force's core values—frames our daily operations.

Vision is an equally tough concept to implement. It is the inspiration for future operations, while the activity of daily operations can either detract from achieving the vision or help it along. The point is that just as a commander's interactions affect Airmen's ability to accomplish the unit's mission, so can daily routine hinder attainment of the commander's vision.

How do you shape a vision, craft it, and make it valuable to the unit? Command vision can be defined as that which "empowers, inspires, and challenges. . . . Vision is the rudder that keeps a ship on course."[6] It is that concept to which all unit efforts return. When crafting a vision, you should begin by referencing mission and vision statements for echelons of command above the unit (Air Force, major command, numbered air force, wing, and even combatant command, if applicable). Next, you should write a vision statement for the unit, focusing it on the future, grounding it on current operations, and dividing it into components.

We can explain the crafting of a vision statement simply by analyzing one. Consider the vision that I espouse for my F-22 / F-15 / Air Battle Manager operations group: "Shape the CAF [Combat Air Forces] with Air Dominance War Fighters of Character." I think it works as a vision statement because I can break it into components that reflect the values of my group. The main component ideas are "shape," "war fighters," and "character." The 325th Operations Group is a training command. Our focus is air dominance. And war fighters are needed in the global war on terror. Every student will someday be in a position to influence the CAF. Before long, our graduates will become instructors at Tyndall; most instructors are in only their third or fourth year of flying in their weapon system. Finally, the students who depart Tyndall are leaving Air Education and Training Command and going to the CAF after nearly two years of flying training that started at a commissioning source focused on character development. Isn't it appropriate that their last training unit again emphasize character? I've had the privilege of flying with many pilots, and I remain convinced that the great ones were people of character.

A vision statement that can be broken into components directly relating to the mission is useful and helps move the unit ahead. However, a vision can simply become a set of words.

I was in a unit that had very impressive slides for various meetings, but I began to notice that the last slide always included a powerful quotation, something that could easily be a mission or vision statement—yet it wasn't the current wing mission. It wasn't even the major command's mission. Then it changed! Depending on the briefer, the ending slide had a different slogan. It took me a while to track down those words and discover that they were old but that they had lingered on the PowerPoint master slide! Unfortunately, they had become just words.

If a well-crafted commander's vision can be powerful, how does he or she capture that power and make it work for the unit? How does the commander take the time available each day and shape it so that the unit's efforts reach towards the vision—the goal? Two means for a commander to do that include keeping a combat focus and planning for each day in command.

I have flown in combat, and, clearly, the best way commanders can push their vision is to have a combat focus. That is all there is to it. We have one mission to execute, one activity for which everyone in the unit is responsible. When all else fails, combat employment, execution, and mission are number one! That is the emphasis. We are warriors, and a combat focus is the first step towards achieving a commander's vision. Think of professional football, whose teams concentrate on winning the Super Bowl. Nothing else matters. The same is true in the Air Force—winning in combat is all that matters.

To be focused, a commander requires a daily plan of attack. Commanders will likely be bombarded with 50 e-mails a day that can shackle them to their computers, just as the paperwork in-box can occupy them for hours. Paying excessive attention to immediate needs can detract from commanders' long-term goals.

Here are some ideas to help control the needs of today and meet the goals of tomorrow. First, have a calendar—marked not only with other people's meetings that you have to attend but also with things that you want to do. If you want time to walk the flight line, then schedule it. If you want time to work out, then schedule it. If you want time to talk with another commander, then schedule it. With my own calendar, after I subtract time for flying and meetings, I have roughly two days each week to meet my priorities. Commanders shouldn't leave time open on the calendar and wait to see what comes up. They should have a plan for their time that will support their goals, address their concerns, and support the unit's vision.

Second, control your in-box—both for paperwork and e-mail. I worked for a man who kept his in-box in a desk drawer. I supposed he did so purely for aesthetics—for keeping the commander's desk looking neat. But I noticed that he would look at the in-box only when he wanted to, checking it in the morning and evening. He would go through it when he had the time, and by limiting his constant attention to it, he always had a small stack of paperwork to plow through. He maximized his time by limiting his "nibbling" at the in-box. This wasn't an accident; it was planned.

The same is true of e-mail messages: you could spend all day answering them. Although you would never miss anything, consider the effort necessary to answer e-mail as it arrives. You've seen the guy with the belt-mounted PDA set to buzz for each new e-mail. He grabs it, enters his password, selects "messaging," selects "e-mail," and then waits for the program to open. If he doesn't reply, he takes time to close the program and return the PDA to his belt. Think of the time it takes to answer each e-mail—how it adds up over a day, a week, a year. Haven't we learned something from the industrial revolution of American history? Wouldn't it be better to set aside time for e-mail, much as you do for an in-box, and plow through it all at once? I think so, and I don't set my PDA to ring for new e-mails—or wear it on my uniform! (Although I know you can, this is my technique!)

So what is the point of controlling the literal and electronic in-box? To generate time to realize your command vision, not simply react to daily activities. The payoff is having time to focus on goals and objectives rather than jumping for every other organization's priorities. A commander must keep perspective on

the needs of daily correspondence versus its impact on the overall game plan.

For example, an e-mail from the unit training manager appeared one day, containing various details found in a status-of-training report as well as comments on additional training that the group lacked. This includes routine events such as fire-extinguisher training—mandatory items reportable to headquarters because they reflect the unit's and each individual's ability to deploy. This particular e-mail listed 238 events overdue in the operations group, consisting of five squadrons. Two hundred thirty-eight events! Good grief! This required immediate commander involvement! I made it a priority to "solve this problem" and make our "stats" improve. Unfortunately, however, these events had no effect on our daily mission; this training did not support my vision. Their completion, whether immediately or later, would neither change the number of sorties we flew nor improve the safe execution of our primary flying mission. Worse yet, it turned out that the operations group and all of its Airmen had over 20,000 ancillary training events to fulfill! This e-mail about the status of ancillary training identified less than 1.2 percent of the annual training requirements that were delinquent! What would a reasonable level of training amount to? Perhaps 90 percent complete? That translates to 2,000 events not completed—and we would still be at 90 percent!

The point is that an e-mail arrives announcing a problem, but without a comprehensive approach to determining its priority and relevance to the mission, it can quickly become a snare for a commander's time. Commanders need that time to make their vision real. How often has an e-mail arrived announcing a deadline for required information to "solve a problem"? I suggest that, often, the problem is neither a mission-threatening issue nor worthy of the given deadline. True, a commander must react to his or her superiors, but without a game plan for e-mail, the "ping" can be translated down into the unit with the wrong message about priorities and focus.

Simply stated, have a command vision, and make time to move it along. Keep a combat focus, keep moving forward, and keep managing distractions. The largest percentage of a commander's time should concentrate on carrying out the mission and making the vision a reality—not managing the daily routine. An ORI offers one way of determining the success of your vision and command-interaction skills.

Application: Preparation for an Operational Readiness Inspection

A commander's interaction with his or her command—whether individually, in meetings, or via electronic communication—is critical to success. The way that the commander applies his or her vision to the unit contributes to the command climate.

How can you know that your unit is on the right track? We are a warrior culture and a nation at war, so combat would represent the ultimate test. Short of that, consider an ORI. In the preparation for and execution of this inspection, a unit commander faces a strong challenge of his or her command climate.

Earlier, I talked about command interaction and then about vision. I chose this order because without the tools for communication, a good vision will rot within the commander. But a major event like an ORI demands that we start with vision. We always want to begin with "outstanding" and work from there. We're all winners; it's why we are in the service and desire to fight the good fight. But what if you declare "an 'outstanding' or go home" and then garner only an "excellent"? A better place to start is to simply say, "We'll do our best" and build a game plan that focuses on the ORI's major areas.

I was once involved in an ORI, working closely with the chief of Standardization and Evaluation (Stan/Eval), who told me point-blank that the best we could expect was a "satisfactory" since there were just too many issues to correct in the time remaining. It was a truthful and accurate assessment. To our credit, though, both of us agreed to attempt to earn the best possible rating. It took commitment, far more extra effort than expected, and close

interaction between us to find the key areas and determine where to place our main effort. It wasn't fun preparing, but we achieved our vision—an "outstanding" rating. To this day, I think we succeeded because we started small and worked big. We literally applied the old adage that "the journey of 1,000 miles begins with a single step." We transferred vision from wishful thinking into something that produced practical results—and that chief of Stan/Eval was a true hero!

Now I'll bet you want more detail than "work from small to large" when facing an ORI. Your ORI is probably not the unit's first. A review of past reports offers a good place to start. Beyond that, here are some focal points for inspection preparation:

1. Obvious discrepancies. Do not have an obvious, lingering issue that would cause the inspector general (IG) to say, "Our hands are tied. Sorry!" Determine what must be at 100 percent.

2. Checklists and Air Force instructions (AFI). Every inspector asks, "What do you do?" and follows with, "Show me your checklist and AFIs." We all do our jobs, but can we show why we do them that way and document training and execution?

3. Programs. Whether they are major, like Stan/Eval or Quality Assurance, or minor, such as recall rosters, if they are programs, they will be inspected. So they must be in good order! Consider trying an information-exchange program between units with similar programs.

4. Attitude. Likely, the IG team will find faults in every area it examines. If inspectors find nothing on first glance, they will continue to dig. I suspect that subjective judgment plays a role in determining the final grade. The unit with attitude (which includes dress, appearance, customs, and courtesies) can win that "gray area."

5. Staff-assistance visits and self-inspections. These are powerful tools for the commander because they are often conducted by the same people who will return to inspect during the ORI. The key is to think like the inspectors and use the same procedures they use. The IG inspectors are Airmen, just like us. They run checklists and inspect according to the AFIs, so there is no magic involved! What they can do, you can too.

If that answers vision, what of interactions? An ORI tests commanders' interaction with their commands. Clearly, they have the greatest experience with inspections and know the mission and operations. Quite literally, commanders can best endure the brunt of the inspection and handle all details. But, of course, they can't do that. They have to get their units ready, get them to do the work, be ready to meet inspectors, and solve problems. This is the test of communications within a unit.

An ORI is known as a leadership test. Although it tests vision—the ability to set a goal and reach it—the ORI really gauges a commander's ability to interact and communicate with his or her Airmen. After the inspection, we quickly forget the grade—but not the months of preparation. The methods, tone, and environment created by the commander's approach to the ORI will remain. The ORI tests the commander's skill at interacting with Airmen in the face of a challenge. When the IG tells the commander, "We have a finding you need to know about," his or her interaction skills are going to be stressed and tested.

The ORI will assess commanders' ability to overcome obstacles to fulfilling their vision. It requires honed interaction skills that are both logical and practical. Some say that we should do away with ORIs or call them something else, but that is nonsense! Tested units perform better, and tested commanders improve their leadership skills.

Conclusion

This article is one of many on command. It won't be the last, and it presents no new trick or fad. I sought to take some of the mystery out of formulating a command vision and to emphasize that command interactions are

powerful tools. I hope it made you think, "I've been there" or "I'll watch for that."

I concentrated on command climate—the subjective assessment that a unit is good or bad. Commanders play the greatest role in determining the unit's status by setting the vision, focusing the unit's eyes on the goals, and de-emphasizing the daily routine. At the same time, they build a cohesive unit via personal interactions that inspire confidence in their leaders and trust amongst their subordinates. The effort placed on command interactions makes all the difference.

What does it all add up to? Some call it moral toughness within a unit, good morale, or positive command climate. Any way you interpret it, I say it adds up to successful command! ❑

Tyndall AFB, Florida

Notes

1. Air University (AU)-2, *Guidelines for Command: A Handbook on the Leadership of People for Air Force Commanders and Supervisors* (Maxwell AFB, AL: Air University Press, September 2003), 1, http://www.maxwell.af.mil/au/aul/aupress/Books/au-2/AU-2.pdf.

2. LTC Duane A. Lempke, "Command Climate: The Rise and the Decline of a Military Concept" (master's thesis, US Army War College, April 1988), 33, http://stinet.dtic.mil/cgi-bin/GetTRDoc?AD=ADA194178&Location=U2&doc=GetTRDoc.pdf.

3. Merle Miller, *Ike the Soldier: As They Knew Him* (New York: G. P. Putman's Sons, 1987), 617.

4. Ibid., 618.

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6. AU-2, *Guidelines for Command*, 23.

America's Two Air Forces

Lt Col Robert Spalding, USAF*

ALTHOUGH AMERICA NEEDS two air forces, it is buying neither. Lately the US Air Force has been caught aloft in uncertain skies and has lost its way. Its message certainly does not resonate with the civilian leadership or Congress.[1] Even Airmen have started to doubt their worth to the nation. The service has answered with a Madison Avenue–styled ad campaign, engaging everyone in furious debate.

A better method may involve trying to understand what is precipitating the doubt and then composing a rebuttal—if indeed the Air Force is important to the future health and prosperity of our nation. I believe that it is, and I think I understand people's confusion regarding airpower. By trying to do all things well, the Air Force has lost sight of what it was created to do best.

This article focuses narrowly on conventional combat airpower, mentioning neither space nor cyberspace. Incorporating the variables associated with each of those functions would complicate the airpower analysis. Nor does it discuss nuclear operations since they differ from conventional combat airpower and thus would require an independent analysis. I also exclude strategic airlift, tanker support, and special operations. Just as no one disputes that special operations are part of the combat air forces, so would no one question the requirement for a special-operations component within the Air Force.

One might argue that the US military already has too many combat air forces. Given the fact that each of the other services (Army, Navy, and Marine Corps) has one, it might seem that having an independent air force amounts to overkill.[2] However, those other services' air forces have not been able to meet all of the nation's airpower requirements—witness the Air Force's heavy involvement in seven continuous years of war in Afghanistan and Iraq. This fact, coupled with the Air Force's simultaneous maintenance of worldwide strategic commitments, demonstrates why we need an independent air force.

One solution to the nation's dilemma that instantly comes to mind entails merely increasing the capability of the air forces already resident in the Army, Navy, and Marine Corps. Indeed, the Army has argued strenuously for just this option.[3] On the surface, this seems a tantalizingly easy solution; however, many factors absent from the current conflicts in Iraq and Afghanistan demand an independent air force. In the end, soldiers are adept on land, airmen are adept in the sky, and the nation will be better served by an autonomous air force fully engaged in the irregular fight than by a larger air component within the ground forces.

Some individuals believe that the nature of warfare has changed forever. Thomas Barnett, for example, argues that the end of the Cold War ushered in a new era of conflict among peoples, not nations.[4] Others agree that we need to better prepare for irregular war and accept more risk when confronting potential peer competitors.[5] During any war, however, it is natural to think that the character of the present struggle reflects that of future wars.

Can a lone superpower afford to dismiss the threat of a peer competitor, even if it seems a remote possibility? Can an independent air force that merely augments combat capabilities already present in the Army, Navy, and Marine Corps and that provides support in the form of airlift as well as intelligence,

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surveillance, and reconnaissance be expected to defend against this possibility?

Assuming that we cannot dismiss threats from peer competitors, let us look at a superpower's requirement for an independent air force. Can we field a single air force that can meet any contingency on a spectrum bounded by the peer competitor at one end and the urban guerrilla at the other? What type of aircraft should form the core of that air force?

Since the end of the Cold War, we have witnessed a transformation of the Air Force that involved dismantling a service that had as its core platform the heavy bomber and creating a new one around the versatile F-16. We are now on the verge of replacing that platform with the Joint Strike Fighter (JSF), which, despite its modern wizardry, merely improves a similar capability. The Air Force seems intent on having a multirole fighter aircraft as its institutional core.[6] Can an independent service with such a core platform meet any contingency on the combat spectrum? I argue that it cannot. In fact, America's defense requires two air forces, and the aircraft that form each one's core differ in form, function, and use. Air Force no. 1, the peer-competitor force, is characterized by such terms as *strategic capability*, *deterrence*, *long range*, *stealth technology*, *static precision*, *high technology*, *speed*, *B-2*, *F-22*, and *centralized control*.[7] Air Force no. 2, the irregular-warfare force, is characterized by such terms as *tactical capability*, *persuasion*, *persistence*, *stealth effects*, *dynamic precision*, *low technology*, *slowness*, *A-10*, *Predator*, *Reaper*, and *decentralized control*. The following discussion contrasts each air force's requirements, term by term.

Joint Strike Fighter

Strategic versus Tactical

Ask some Airmen what "strategic airpower" means, and their answer will be "nukes."[8] Such a connection between the terms *strategic airpower* and *nuclear* was a perversion of the original airpower theorists' ideas about airpower, brought on by necessities of the Cold War. The enormous destructive power of nuclear weapons made up for the inaccuracy of the bomber's ordnance-delivery system. By the time the Berlin Wall came down, Airmen had forgotten that *strategic* meant *long-range airpower*, long before "nukes" came around.

Meaning more than just *long range*, *strategic* implies having the capacity to create strategic effects—something that few forces in America's arsenal can do. Fewer still can do so anywhere on the earth within mere hours. Only one type of aircraft is strategic in this sense: the bomber. To be fair, at any given time, all aircraft can be considered strategic, depending on their current mission. The bomber, however, remains the only aircraft that is strategic at its core.

On the other hand, we can consider any aircraft tactical, even when its mission calls for achieving a strategic objective. Although *tactical* has sometimes become synonymous with *fighter*, given today's technology, any combat aircraft can create tactical effects. Bombers have demonstrated this fact for years over the skies of Iraq and Afghanistan. Therefore, an independent air force capable of producing tactical effects is not limited to any specific type of combat aircraft.

Most nations are content to shape their own regional environment, but a superpower must shape the global environment. Airpower theorists such as Gen Billy Mitchell consid-

ered the airplane revolutionary because of its ability to create strategic effects. Knowing that officers in a terrestrial service would fail to grasp this concept, he lobbied for an independent air force. If Mitchell's argument remains valid, a nation that seeks to create strategic effects beyond its regional environment must have such an air force that is strategic at its core. Therefore, any superpower's independent air force must have the bomber as its core aircraft—the platform characteristic of Air Force no. 1.[9]

The F-22 is also crucial to Air Force no. 1—but not as our service has sought to use it (as a bomb dropper). We would do better to utilize it as offensive-counterair support to penetrating bombers, as well as defensive counterair for high-value airborne assets. Other F-22 missions might include suppression or destruction of enemy air defenses. Although it drops bombs quite capably, that is not what it was primarily designed to do. We have misused aircraft in past wars—witness our interdiction of the Ho Chi Minh Trail during the Vietnam War.[10] No doubt the F-105 jet could perform that mission, but analysis identified the AC-130 gunship as much more efficient because of its long persistence, heavy payload, and slow speed.

Deter versus Persuade

Deterrence and *nuclear capability* also became synonymous during the Cold War, but they are distinct ideas. The ability to deter need not mean mutually assured destruction.[11] Rather, it can give a tyrant clear indication of our ability to create effects detrimental to his rule. Many times, airpower has done just that: during Operation El Dorado Canyon, when President Reagan sought to deter Libyan leader Mu'ammar Gadhafi; Operation Desert Fox, when President Clinton sought to deter Saddam Hussein; and Operation Allied Force, when President Clinton sought to deter the Serbians. Each time, the Department of Defense relied heavily on the bomber.

An independent air force must have the core capability of deterrence, yet it must also be able to persuade. It can do so by working in concert with sister services and allies alike. Because a superpower's financial resources may enable it to procure advanced aircraft and weapons beyond the means of its allies, that superpower must develop a range of capabilities suitable to any level of conflict, allowing it to provide those countries more affordable equipment and training. This interaction also establishes goodwill that lessens the risk of conflict. Typically, a developing nation's main combat platform is a cheap tactical aircraft. Thus, if a superpower requires an independent air force capable of persuasion, that air force must field such an aircraft.

Long Range versus Persistence

Useful strategic aircraft must have good range among their key traits; indeed, one would have difficulty deterring a distant enemy with aircraft not made to cross oceans. Range becomes more important than speed or stealth during attempts to deter. Obviously, speed or stealth may allow entrance to the enemy's domain, but that foe has nothing to worry about if aircraft cannot reach his region. Air Force no. 2 requires persistence rather than long range. Larger aircraft with more efficient engines feature both range and persistence.

In our current inventory, only bombers and unmanned aerial vehicles have both of these attributes.[12] Close to the fight, we could attain tactical persistence with a lightly armed, propeller-driven aircraft such as an AT-6, a platform less technologically sophisticated than a bomber. An air force capable of providing dedicated support to ground forces during an irregular war could use such an aircraft.

Stealth Technology versus Stealth Effects

The idea of stealth conjures up images of sophisticated technologies and large defense programs, but this need not be the case. Both air forces must be able to produce stealth effects. Only Air Force no. 1 requires stealth technology to do so because only that air force

must penetrate an integrated air defense system (IADS).

Aircraft from Air Force no. 2, on the other hand, can produce stealth effects by loitering high enough so that an irregular foe can neither see nor hear them—a daily occurrence in Iraq and Afghanistan. By understanding the necessity of producing stealth effects, we can save precious defense dollars by fielding simpler aircraft, which could form the backbone of Air Force no. 2.

Static Precision versus Dynamic Precision

A peer competitor will have precious, immobile infrastructure that we can attack and destroy with static-precision weapons accurate against stationary targets. Thus, Air Force no. 1 requires static precision. Irregular war, however, which involves constant motion and takes place among the populace, carries the potential for substantial collateral damage. For this reason, Air Force no. 2 requires dynamic precision weapons of low destructive power that can be controlled throughout their flight.[13]

High Tech versus Low Tech

For all of the reasons already mentioned, Air Force no. 1—an expensive asset absolutely necessary for a global power such as the United States—must be high tech. Without this "silver bullet," belligerents would spout their rhetoric more easily. It is no accident that North Korea is keenly aware of a B-2's arrival in the Pacific theater.

Air Force no. 2, however, which relies on dynamic weapons, synchronized sensors, and constant communication, can get by with low-tech platforms. The aircraft themselves merely need to loiter for a long time, hardly a technical challenge today. Air Force no. 2 doesn't need high tech, which, in fact, hinders the mission. The less technically complex the aircraft, the easier it is to fix and the less logistical support it requires. Air Force no. 2 must have platforms that can take a daily beating yet rely on little maintenance or fuel to remain airborne. "Silver bullets" are wholly unsuited for this environment.

Fast versus Slow

Until air superiority is established, Air Force no. 1 needs speed. It must enter and leave the dragon's lair before the dragon notices it has even been there. Speed refers to the capability to penetrate and exit an IADS. Thus, the aircraft must be fast.

Air Force no. 2 needs fast response. This response, however, comes from the speed of communications and the weapons employed. Police forces discovered long ago that they did not need faster cars since radio waves travel faster than any automobile. The same holds true for airpower during an irregular war. As long as Air Force no. 2 remains tied to ground forces, its speed comes from communications and the weapons employed. Thus, the aircraft themselves can be slow.

B-2 and F-22 versus A-10, Predator, and Reaper

Each of these aircraft carries within its design the implicit explanation of the air force to which it belongs: B-2 and F-22 to no. 1, and A-10, Predator, and Reaper to no. 2. Conspicuously absent is the JSF, which does not fit into either because it has neither the range required for Air Force no. 1 nor the persistence required for Air Force no. 2.[14]

Centralized Control versus Decentralized Control

We once considered centralized control the key doctrinal tenet of airpower, but Airmen are starting to understand that the proper degree of centralization depends on the situation. Centralized control works for Air Force no. 1 engaged in a national- or theater-level fight but not for Air Force no. 2 engaged in a highly localized fight.[15] Some people have noted that Army and Marine Corps captains are linchpins to the counterinsurgency effort

in Iraq.[16] Their services give them broad mission orders and allow them to adjust their approach, based on the locality. Centralized control in irregular warfare prevents the Air Force from similarly capitalizing on the creativity of its young officers.

Recommendation

If budget realities force us to choose between the two air forces, without question, America needs Air Force no. 1, whose core must be the next-generation bomber. We should also buy more F-22s, which we currently do not have in sufficient quantity to provide adequate support for such a force. To pay the costs, the Air Force can either significantly reduce or eliminate the JSF program. More suited to the other services, that aircraft will also find a home with the regional air forces of our allies. Since aircraft required for irregular warfare are relatively inexpensive, we would then be able to afford enough platforms to build Air Force no. 2—specifically, the Predator, Reaper, and a new combat version of the T-6 to replace the aging A-10. Organizationally (assuming we decide to fund no. 2), the Air Force should move that component towards decentralized control for irregular warfare.[17] The Air Force's new doctrine for irregular warfare recognizes this necessity, yet the service remains encumbered by its own legacy.[18]

A-10

If the Air Force does not want to buy Air Force no. 2, it could simply build more bombers. Since those aircraft are suited to both types of conflict, the Air Force would not have to train pilots for both bombers and light tactical aircraft; nevertheless, it could still handle both types of scenarios. Since we can never be sure about the kind of war we will fight, this course of action would give the same flexibility to the war fighter but at less cost to the Air Force in terms of personnel and infrastructure. ❑

Maxwell AFB, Alabama

Notes

1. See Peter Spiegel, "Military Doesn't Back Soldiers Enough, Gates Says," *Los Angeles Times*, 22 April 2008, http://www.latimes.com/news/nationworld/iraq/complete/la-na-gates22apr22,1,701682.story.

2. I do not include the Coast Guard here, focusing instead on the combat air forces.

3. Roxana Tiron, "Air Force, Army Clash Again on Unmanned Aerial Vehicles," *Hill*, 30 October 2007, http://thehill.com/business--lobby/air-force-army-clash-again-on-unmanned-aerial-vehicles-2007-10-30.html (accessed 17 April 2008).

4. See Thomas P. M. Barnett, *The Pentagon's New Map: War and Peace in the Twenty-first Century* (New York: G. P. Putnam's Sons, 2004).

5. "We will have no global peer competitor and will remain unmatched in traditional military capability." *The National Defense Strategy of the United States of America* (Washington, DC: Department of Defense, March 2005), 5, http://www.defenselink.mil/news/Apr2005/d20050408strategy.pdf. See also Brian G. Watson, *Reshaping the Expeditionary Army to Win Decisively: The Case for Greater Stabilization Capacity in the Modular Force* (Carlisle, PA: Strategic Studies Institute, August 2005), http://www.strategicstudiesinstitute.army.mil/pdffiles/PUB621.pdf.

6. The Quadrennial Defense Review notes that

> the Air Force has set a goal of increasing its long-range strike capabilities by 50% and the penetrating component of long-range strike by a factor of five by 2025.

> Approximately 45% of the future long-range strike force will be unmanned. The capacity for joint air forces to conduct global conventional strikes against time-sensitive targets will also be increased. . . .
>
> [The Department of Defense will] develop a new land-based, penetrating long-range strike capability to be fielded by 2018 while modernizing the current bomber force.

Quadrennial Defense Review Report (Washington, DC: Department of Defense, 6 February 2006), 46, http://www.comw.org/qdr/qdr2006.pdf. Yet, the Air Force's budget submission for fiscal year 2009 does not allocate any money for a new long-range strike aircraft. See *Procurement Programs (P-1): Department of Defense Budget, Fiscal Year 2009* (Washington, DC: Department of Defense, February 2008), http://www.defenselink.mil/comptroller/defbudget/fy2009/fy2009_p1.pdf.

7. These terms are not meant to be mutually exclusive. For instance, in some cases we will need aspects of Air Force no. 1 in an irregular environment; however, Air Force no. 2 can fulfill most requirements of an irregular conflict. Global Hawk, for example, is useful across the spectrum of conflict.

8. The author did not conduct a survey but nevertheless makes this claim because Air Force officers who reviewed this article assumed that *strategic airpower* meant *nuclear weapons*. Though not prima facie evidence of the correctness of this assumption, it does indicate that the association of the two terms is alive and well with at least some Air Force personnel. Perhaps a future study could examine the prevalence of this association within the Air Force.

9. Although some individuals may claim that fighters have become modern-era bombers because they have flown the majority of conventional-bombing missions since the end of the Cold War, this may have been the case because the Air Force has sought to procure ever-increasing numbers of fighters during that period. In this article, the term *bomber* refers to an aircraft with range and a payload at least equivalent to that of the current B-2, B-1, or B-52.

10. See Col Herman L. Gilster, "The Commando Hunt V Interdiction Campaign: A Case Study in Constrained Optimization," *Air University Review* 29, no. 2 (January–February 1978): 21–37, http://www.airpower.maxwell.af.mil/airchronicles/aureview/1978/jan-feb/gilster.html (accessed 8 May 2006).

11. Keir A. Lieber and Daryl G. Press, "The Rise of U.S. Nuclear Primacy," *Foreign Affairs* 85, no. 2 (March/April 2006): 42–54, http://www.foreignaffairs.org/20060301faessay85204-p0/keir-a-lieber-daryl-g-press/the-rise-of-u-s-nuclear-primacy.html.

12. Some people may disagree, saying that fighters can provide similar persistence with refueling, but one has to question whether this makes sense, given the current high price of fuel. Efficiency becomes even more important during irregular warfare, due to the length of time required to conduct operations.

13. The new terms *static precision* and *dynamic precision* clarify the requirements of the two air forces. The former refers to the ability to precisely destroy immobile targets. The latter refers to the ability to destroy mobile targets.

14. See "Developing an Affordable Fighter for the Future," RAND Research Brief (Santa Monica, CA: RAND Corporation, 1997), http://rand.org/pubs/research_briefs/RB35-1/index1.html. The JSF may provide some capabilities that the Air Force can leverage, but by buying 1,763 of them, the service is actually building its institution around the multirole fighter because it will fly most conventional combat missions. Such reliance also unduly increases the burden on an already overtaxed tanker force. Not only could bomber or unmanned aircraft, which provide 10 times the range and endurance of the JSF, diminish the tanker workload but also they could carry out the mission from more distant, secure bases that possess a better logistics infrastructure. Finally, because JSF pilots would fill most combat air force (CAF) staff positions, a JSF-centric view would likely develop at the staff level and resonate throughout the CAF. This would culminate in a staff viewpoint myopically focused on what fighter aircraft can do for the war fighter, rather than what the Air Force could do for the war fighter if given the right equipment.

15. "Air Force planners may have to adapt and develop creative C2 [command and control] relationships to facilitate successful mission accomplishment and optimize the tenet of centralized control / decentralized execution. Due to the localized nature of most [irregular warfare] enemies and specifically insurgencies, decentralized execution is vital to the successful integration of airpower." Air Force Doctrine Document (AFDD) 2-3, *Irregular Warfare*, 1 June 2007, 66, https://www.doctrine.af.mil/AFDCPrivateWeb/AFDD_Page_HTML/Doctrine_Docs/afdd2-3.pdf. This statement may have been a compromise between those who advocate decentralized control in irregular warfare and those who continue to favor centralized control, regardless of the situation. From the author's own experience in Iraq, permitting local ground commanders to exercise tactical control in irregular warfare can yield synergy because it allows assigned Airmen to become intimately familiar with the "human" terrain not readily visible from the air. To compensate, the Air Force has increased the number of joint terminal attack controllers, but the Airman in the cockpit still must spend precious time becoming oriented to the human terrain once on orbit. Because this orientation is never complete, it is difficult for the Airman to become a thinking (and creative) addition to the team. After all, during a sortie, an airborne Airman must operate in many local environments, each with its own unique and unfamiliar "human" terrain.

16. See Michael Kamber, "Sovereigns of All They're Assigned, Captains Have Many Missions to Oversee," *New York Times*, 21 March 2008, http://www.nytimes.com/2008/03/21/world/middleeast/21captain.html?ref=world.

17. Perhaps the Air Force could adapt US Marine Corps doctrine for air support to ground forces.

18. See AFDD 2-3, *Irregular Warfare*, 66.

Editor's Note: PIREP *is aviation shorthand for* pilot report. *It's a means for one pilot to pass on current, potentially useful information to other pilots. In the same fashion, we use this department to let readers know about items of interest.*

Optimizing the Effectiveness of Directed Energy Weapons with Specialized Weather Support

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When the thunderclap comes, there is no time to cover the ears.
—Sun Tzu

ACCURATE CHARACTERIZATION of the atmosphere is essential to maximizing the use of directed energy (DE) weapons. Developing, procuring, and sustaining such weapons has been and will continue to be difficult; therefore, it is imperative that they achieve optimum effect when employed. The atmosphere, a highly dynamic medium in which these systems must operate, can significantly impact their effectiveness, thus necessitating an understanding of this environment and a capability to predict it. DE systems, particularly high-energy lasers (HEL) employed at low altitudes, will exhibit significant variations in performance based on location, time of day, and time of year. Through the Air Force Weather Agency, the Air Force Weather (AFW) community provides centralized terrestrial and space weather support to the Joint Chiefs of Staff, Air Force, Army, unified commands, national intelligence community, and other agencies as directed.[1] This article outlines some of the unique atmospheric influences on DE weapons and the ways that specialized weather support can enhance the mission capability and efficacy of those weapons.

Anticipating the changing nature of warfare is part of the responsibility that AFW shares with other parts of the Department of Defense (DOD) after the terrorist attacks of 11 September 2001. AFW cannot afford to wait for DE weapons events to happen and then react. According to the *Quadrennial Defense Review Report* of 2006, "new capabilities [are] needed by Combatant Commanders to

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confront asymmetric threats."[2] Not all of the "new capabilities" are the weapons themselves; much of the advancing technology in the DE weapons realm involves the transition of high-fidelity modeling and simulation competencies into mission-planning tools. These decision aids, coupled with timely and accurate environmental assessments, would enable the DE weaponeer to optimize an employment strategy. AFW's ability to guide the employment of DE weapons in all environments—via accurate determination of how to exploit information on target-area weather conditions to best advantage—is essential to secure the battlespace of tomorrow. Identifying the optimum time of day, attack heading, and attack altitude for low-altitude employment of HELs serves as an example of such information exploitation.

Major Types of Directed Energy Weapons

This article addresses two types of DE systems: the HEL and the high-power microwave (HPM). Whereas HELs direct a beam of focused energy to a precise point on the target to damage or destroy it, HPMs do not physically destroy a target. Rather, they invade the electronics and disrupt the components, circuitry, and switches inside the device. Additionally, they can cause behavior-modifying sensations in living organisms. HPMs, which do not require the precise aiming necessary for HELs, can function as area weapons, depending on the frequency, field of view, range to the target, and selection of either a large or small footprint.[3]

These weapons complement each other, each having advantages and disadvantages. HPM weapons cannot focus on as small an area as can HEL weapons but have proven effective through clouds and fog since they experience about two orders of magnitude less extinction (i.e., loss of energy due to absorption and scattering) in those conditions than do HELs. HPMs generate high electric fields over the entire target, in sharp contrast to the intense energy delivered by a laser to a typically small and precisely selected target area.[4] Furthermore, they can affect enemy electrical systems regardless of whether those systems are on or off.[5] For example, HPMs can stop air-, land-, or seaborne systems in their tracks. Additionally, HEL and HPM systems can engage multiple targets nearly instantaneously since they propagate at the speed of light.[6] DE systems can have a "deep magazine," which means that their ability to fire is limited only by their capacity to recharge and cool themselves.[7] Because DE weapons only expend energy, the cost per shot represents the sole cost of powering the device. Electrically generated and free-electron lasers require nothing more than power sources, eliminating the need to transport, store, and load munitions, and minimizing the logistical footprint, compared to conventional weapons. The fact that the factory can directly resupply chemical lasers eliminates the need for long-term storage.[8] HEL weapons provide almost surgical precision, greatly minimizing the potential for collateral damage.

Issues with the Atmosphere

In a vacuum, electromagnetic energy travels unattenuated, reaching its target with the theoretical maximum energy available; however, Earth's atmosphere contains mitigating factors that affect the intensity of DE received at the target. These factors include linear and nonlinear processes in the atmosphere that can affect the propagation of DE systems or electromagnetic energy in general. Linear processes are those in which the DE beams do not modify the characteristics of the atmosphere—for example, scattering caused by molecules, aerosols, rain drops, or other particles. Nonlinear effects such as thermal blooming, a defocusing of the beam caused by heating of the beam path due to absorption, result from the presence and intensity of the DE beam itself.[9] Both linear and nonlinear effects combine to reduce intensity at the target.

Because the atmosphere decays exponentially with height, its effects on HEL/HPM propagation vary most dramatically in the vertical. Thus, a definition of the atmosphere's vertical structure is in order. For the purposes

of this article, the atmosphere consists of the boundary layer; lower, middle, and upper atmospheres; high altitude (as defined by the Air Force); and space regions (fig. 1).[10] The atmospheric zone where each DE system operates influences not only those systems' capabilities but also their support requirements.

Critical to the success of military weapon systems is understanding the conditions in which they must operate. Atmospheric differences can affect DE systems in various ways, depending on whether the weapon operates over water or land within the boundary layer or in the upper atmosphere (fig. 1). For example, although a system may operate in the boundary layer, many different climates exist within this area (e.g., desert, tropical, woodland), not to mention variations associated with the four seasons. The varied DE systems under development or planned for military use must account for the environments in which they are designed to function.

Directed Energy Weapon Systems and Environments

The armed forces will develop unique DE weapon systems tailored to their various missions. Land warfare dictates smaller engagement ranges than may be encountered through the air or via the seas. The Army, Air Force, Navy, and Marine Corps must adapt DE systems to their unique environments.

Army Systems and Their Anticipated Operating Environment

The Mobile Tactical High Energy Laser (MTHEL), a combined effort of the US Army and Israel, seeks to defeat rockets/artillery/mortars (RAM), cruise missiles, short-range ballistic missiles, and unmanned aerial vehicles in the boundary layer of the atmosphere.[11] In addition to defeating the RAM threat, the Army might also consider using DE solutions

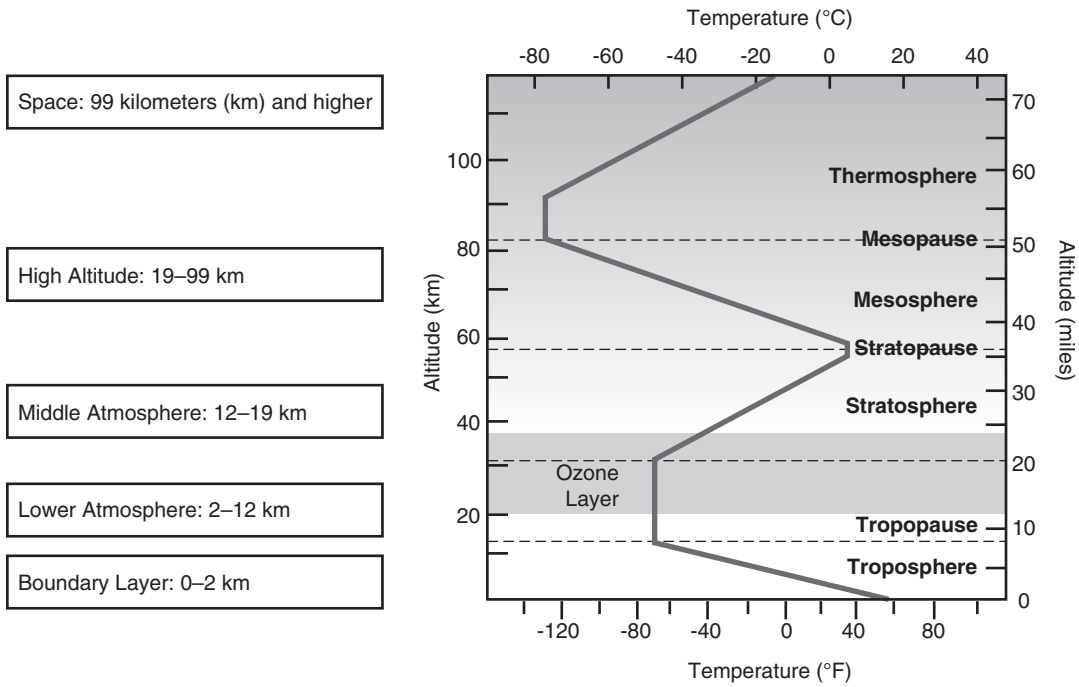

Figure 1. Structure of the atmosphere. (Adapted from "The Atmosphere," Directed Energy Professional Society, High-Energy Laser Weapon Systems Short Course, sec. 6, p. 50.)

to counter improvised explosive devices and man-portable air defense missiles.[12] Although not currently an active program, the MTHEL helped pave the way for other programs such as Skyguard, a land vehicle produced by Northrop Grumman that provides a laser-based air defense against short-range ballistic missiles, RAM, unmanned aerial vehicles, and cruise missiles.[13] Skyguard protects aircraft from man-portable air defense systems out to a range of roughly 20 km (12.4 miles); against harder RAM targets, it has an effective range of 5 km (3.1 miles).[14] Additionally, a laser ordnance-neutralization system integrated onto a Humvee, dubbed "Zeus," has seen action in Iraq for destruction of surface land mines and unexploded ordnance. Another descendant of the MTHEL, the High Energy Laser Rocket Artillery Mortar vehicle, developed by Northrop Grumman, is a truck-mounted HEL designed to defeat the RAM threat.[15]

In the future, Army DE systems may operate at ranges from tens of kilometers against larger weapons, to hundreds of meters against small-arms fire, primarily confined to long and nearly horizontal paths in the boundary layer. The potential to employ DE weapons on other Army platforms (e.g., tracked vehicles, wheeled vehicles, and helicopters) grows as DE weapons become modular and smaller. The precision and speed of HEL weapons raise the possibility of use in the countersniper or sniper mission. Due to the stealth of these systems (HELs emit no visible light beam and produce no sound), they may offer a level of tactical surprise not previously realized in warfare.[16]

The ground-based nature of potential Army HEL engagements will be strongly affected by the required long, oblique slant paths through the dense atmospheric boundary layer. Additionally, the most stressing effects of aerosols and optical turbulence, which create distortions within the atmosphere, will often occur near the aperture of the HEL, where any induced bending or spreading of the energy is more likely to reduce the weapon's effectiveness.[17] Thus, operational weather forecasting and tactical decision aids will likely play key roles in the employment of the Army's HEL weapons.

Air Force Systems and Their Anticipated Operating Environment

The Air Force manages the airborne laser (ABL), a modified Boeing 747-400 aircraft designed to carry a high-energy chemical oxygen-iodine laser (COIL) and shoot down enemy ballistic missiles during their boost phase. The ABL operates primarily at altitudes between 12 and 16 km, nearly ideal for a high-energy COIL because of the general absence of clouds, the vast reduction of water-vapor content, and pressure that amounts to only about 20 percent of that at sea level, which further reduces absorption. Here, the laser has an expected range of hundreds of kilometers. In January 2007, the ABL fired two solid-state illuminator lasers at the NC-135E "Big Crow" test aircraft, verifying the ability to track an airborne target and measure atmospheric turbulence.[18] On 8 September 2008, the ABL aircraft successfully fired its high-energy chemical laser for the first time during ground testing at Edwards AFB, California.[19] The ABL is scheduled to conduct its first intercept test against an in-flight ballistic missile in 2009.[20]

The Advanced Tactical Laser (ATL), a modified C-130 aircraft with an integrated COIL designed to support special operations, functions in and through the boundary layer with the laser primarily directed toward Earth's surface. Thus, the diurnal variation of aerosol effects, coupled with other manifestations of the dynamic nature of the lower and boundary layer of the atmosphere, is of extreme importance for the ATL, which has an expected range of tens of kilometers.

The degrading effects of the boundary layer on HEL propagation vary throughout any given day with changes in relative humidity (fig. 2). Furthermore, the thickness of the boundary layer and the strength of optical turbulence also vary diurnally. At times, high relative humidity can cause increased attenuation due to scattering, but a correspondingly thinner boundary layer or lower optical turbulence could offset this negative effect somewhat. Efforts to quantify these effects to optimize HEL engagement performance are likely to be of paramount importance.

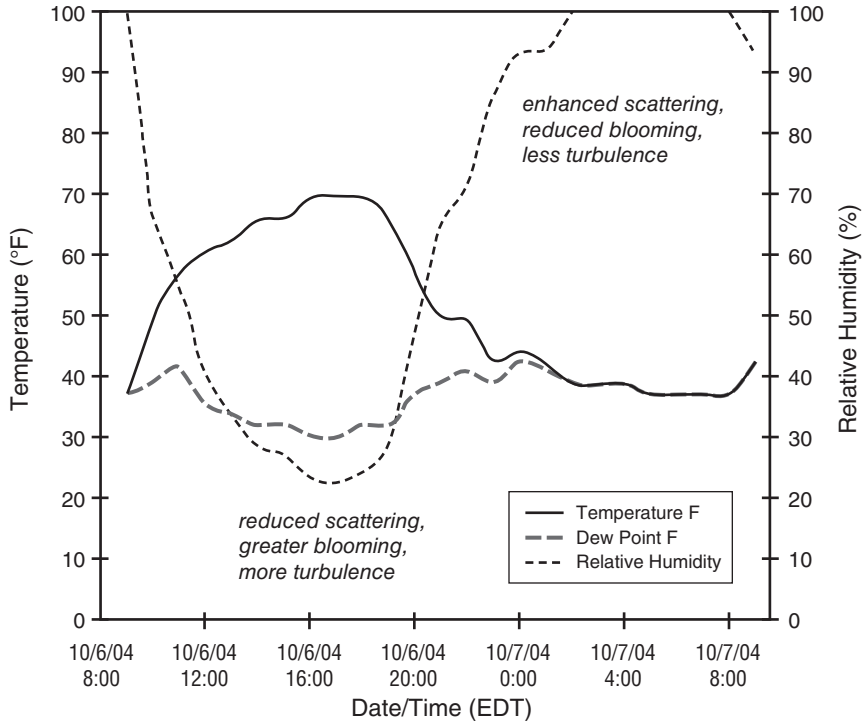

Figure 2. Variations in temperature, dew point, and relative humidity on a typical fair-weather day at a midlatitude site (Wright-Patterson AFB, Ohio, on 6–7 October 2004). Periods with lower (higher) relative humidity are noted as times with reduced (enhanced) aerosol scattering and thus greater (reduced) thermal-blooming effects. (Blooming is the effect that characterizes an intense laser beam passed through an absorbing medium [such as the air], causing the absorbed energy to produce density changes that can alter the intensity distribution of the beam and shift it away from the intended direction of propagation. Thermal blooming is an effect associated with heating the atmosphere. "The Atmosphere," Directed Energy Professional Society, High-Energy Laser Weapon Systems Short Course, sec. 6, p. 50.) Periods with greater solar heating and optical turbulence are also noted, primarily during afternoon/early evening hours.

The director of the ATL Advanced Concept Technology Demonstration program has indicated that Boeing is considering an array of potential fixed-wing platforms to carry the ATL. A COIL device was installed in a C-130H in late 2007, and during a test on 7 August 2008, the ATL aircraft fired its high-energy chemical laser through its beam-control system, which acquired a ground target and guided the laser beam to it, as directed by the ATL's battle-management system.[21]

The Air Force Research Laboratory (AFRL) has developed the Personnel Halting and Stimulation Response man-portable laser weapon, a nonlethal deterrent for protecting troops and controlling hostile crowds. The operating environment for this weapon includes the very lowest levels of the boundary layer. It uses laser light that temporarily impairs aggressors by illuminating or "dazzling" individuals, preventing them from seeing the laser source and areas near it.[22] Use of this weapon in rain, snow, or fog could have collateral, off-axis effects not yet fully quantified.

The Active Denial System (ADS), a nonlethal HPM DE weapon designed for use against per-

sonnel, uses focused millimeter-wave beams to produce an intolerable heating sensation on a person's skin. Mounted on a vehicle, the ADS operates over primarily horizontal paths in the boundary layer against ground targets. According to a media demonstration held at Moody AFB, Georgia, in January 2007, the vehicle's two-man crew located and affected targets more than 500 meters away. Full production should begin in 2010.[23] Further study is necessary to quantify the tactical impact of weather on ADS operations because many tropical locations can experience conditions that cause up to a 30 percent loss of ADS beam energy over a 1 km path. This is significant since it may force ADS operators to adjust power output based on humidity conditions.

Navy and Marine Systems and Their Anticipated Operating Environment

The Navy is focusing efforts on several requirements that DE might help to address, such as protecting the fleet. Efforts include mitigating air-sea cruise missiles, cigarette (fast-moving) boats, unmanned aircraft systems, rockets, floating mines, helicopters, fixed-wing aircraft, and other emerging threats.[24] Optimally, any system designed for use on Navy surface-warfare ships, which operate in a maritime environment heavily laden with moisture in the form of water vapor, should provide ship protection and indirect fire support to ground forces.[25] These systems direct fire from maritime surface vessels toward a land or an airborne target. If DE systems proliferate onto Navy and Marine aircraft that support ground forces or provide fleet defense, they too will often operate in the lowest, most attenuating reaches of the atmospheric boundary layer.

Marine Corps systems for large- and small-scale land engagements and close-quarters combat may prove similar to those used in tactical scenarios envisioned for the Army. Thus, some opportunities may present themselves for leveraging investments from the other services.

Weather-Support Considerations

Describing and predicting the weather may reach unprecedented levels for the proper employment of DE weapons. We cannot underestimate the need for a better understanding of the atmosphere as it relates to DE weapons. The work being done to address environmental issues must be leveraged, but much more is needed. We must also address weather requirements for DE weapons.

Accurate Characterization of the Atmosphere

DE weapons require an accurate characterization of the atmospheric path between sensor and target. The same holds true of traditional ordnance, but to a much lesser degree of accuracy since a bomb is not modified by the atmosphere at the molecular level along the path between the vehicle that transports it and the intended target. For example, wind can blow a bomb dropped from high altitude off course by a few hundred meters, but the bomb impacts somewhere on the ground. However, at every step along a DE weapon beam's intended propagation path, the atmosphere can modify its intensity, lethality, and overall effectiveness. Clearly, these types of weapons exemplify an unprecedented dependence on accurate weather characterization.

Laser weapons demand a more complete understanding of what happens to the beam along the potential engagement path than current predictive capabilities allow. Therefore, we cannot overemphasize the need for accurate characterization of a DE weapon's potential propagation path. Engagement distances and the changing environment create a need for more robust models and simulations than currently exist in the AFW inventory. Much of the present research addresses beam-control issues related to the ABL, which generally operates in the favorable environment of the middle and upper atmosphere. This same type of emphasis must occur in the boundary layer, where smaller-scale DE weapons operate. According to AFW's transformation guidance, we must "anticipate and manage

increasing model resolution, vertical domain from surface to near space, and physics requirements based on new weapon systems coming into the inventory (e.g., Airborne Laser)."[26] AFW has concerns about whether or not weather-support products are robust enough to meet anticipated requirements for the employment of DE weapons.

Leveraging the Work of Others

Army Materiel Command manages the Battlefield Environment Division, the lead DOD agency for research and development of boundary-layer weapons unique to the Army. AFW should be able to collaborate with the Army Research Laboratory to leverage the characterization of atmospheric effects on DE battlefield weapons used by the Army. This work not only could help AFW understand the effects of the atmosphere on these types of weapons, based on Army tactics, but also could help support the development of unique forecasting products for current or anticipated needs not currently being addressed.[27]

Readiness for the Operational Weather Requirements of Directed Energy Weapons

Tactics related to HEL and HPM systems will likely differ from those utilized for conventional weapon systems. What is generally considered "fair weather" for conventional weapons may not be favorable for DE weapons. Again, citing the example illustrated by figure 2, the time of day during fair weather can have a dramatic influence on the effectiveness of an engagement involving low-altitude DE weapons. A weather forecaster supporting such an engagement that includes low-altitude, tactical, high-energy, solid-state lasers would need to balance the counteracting effects of reduced aerosol extinction with greatly increased optical turbulence in the afternoon, as opposed to morning-hour conditions of relatively high aerosol extinction and much lower turbulence. Despite the quiescent weather suggested by figure 2, an accurate assessment of the dwell time necessary to produce the desired effect on an HEL engagement in the boundary layer could not be made without a high-fidelity forecast of the diurnally varying height of the boundary layer.[28] Such detailed forecasting in the apparent absence of "bad weather" differs significantly from traditional Air Force and Army weather support but is not completely unprecedented. The advent and later proliferation of infrared sensor and imaging systems in the 1970s and 1980s led to the development of electro-optical tactical decision aids for weather forecasters, based upon primitive radiative-transfer modeling algorithms used in research and development. Equipped with straightforward graphical user interfaces, they were repackaged as operational decision aids.[29] These aids saw use as, among other things, "thermal crossovers" for infrared targeting systems, helping distinguish targets by highlighting differences between hot and cold backgrounds. As HEL and HPM systems enter the inventory, we will need operational decision aids for DE weapons, based on today's sophisticated modeling, simulation, and research.

Recommendations

Various activities can be utilized right now as we begin to support DE weapons. AFW has many opportunities to tailor weather support. We must continue existing research and secure funding to help push atmospheric characterization forward. Beyond the research and funding, which are key, we must have support from the services at the highest levels.

Leveraging Current Air Force Weather Activities

AFW can begin by augmenting the education and training of new forecasters in the 335th Training Squadron at Keesler AFB, Mississippi, with a block of instruction on weather issues affecting the propagation of DE weapons. For example, a "For Your Information" document or Air Force Weather Agency Technical Note can help forecasters in the field. At most of its conferences and symposia, the Directed Energy Professional Society offers short courses in HEL propagation and HPMs taught by subject-matter experts.[30] Research modeling and simulation codes such as the High Energy Laser End-to-End Operational Simulation

(HELEEOS), developed and managed by the Center for Directed Energy at the Air Force Institute of Technology (AFIT), and the Directed Energy Environmental Simulation Tool (DEEST), managed by the AFRL's Space Vehicles directorate, provide opportunities for developing operational and tactical decision aids.[31] By attending briefings or short courses, senior leaders across the DOD can begin to understand the effects of weather. In summary, AFW can begin educating forecasters and those in leadership positions at senior levels both inside and outside the DOD. Educated leaders can help secure funding for research and development since they understand the problems associated with forecasting for DE weapons. Leveraging high-fidelity modeling codes such as HELEEOS and DEEST will assist with incorporating weather effects on DE propagation spanning from ultraviolet to radio frequencies. These available codes—candidates for decision-aid software used by the operational weather community—have been validated as modeling tools and have earned credibility in the research community.

Current Research Efforts

AFW must examine current programs sponsored by the High Energy Laser Joint Technology Office (HEL-JTO) to assess the relevance of the research in terms of assessment of atmospheric effects and prediction for operational DE weapons. Established in 2000 to manage a comprehensive approach to the development of HEL science and technology for DOD organizations, this office has had annual operating budgets in recent years in excess of $70 million, with programs sponsored across industry, academia, and government agencies.[32] Sponsored programs include research and development of the HELEEOS at AFIT and part of the DEEST development at the AFRL. Leveraging current efforts pursued by the AFRL's Directed Energy directorate (AFRL/RD), the Office of Naval Research, and the Army's Space and Missile Defense Command may also provide useful research that supports atmospheric propagation of HELs and HPMs.

Funding for Research

Funding would help support many areas of research. A key research topic would address whether today's meteorological observations support DE weapons to the degree required. We may need to develop new products, such as optical-turbulence maps, molecular and aerosol absorption maps, scattering maps, thermal-blooming maps, and others. These types of environmental inquiries will involve academia, private industry, and the DOD.

We must urge senior-level DOD and congressional leaders to understand the criticality of continuing support for research, development, and testing related to DE and environmental effects on DE weapons. Proper characterization and prediction of the environment are warranted in order to quantify environmental impacts. Benefits include speed-of-light engagement, precision strike to destroy, area strike to disable, low expended mass per engagement (deep magazine), and low cost per engagement.[33] Furthermore, US adversaries are rapidly moving ahead with the development of DE weapons (especially HELs).[34] A better understanding of how environment modifies the performance of such weapons would become an exploitable advantage even if the adversary has superior hardware.

Advocacy

AFW and the Air Force Weather Agency, through the Weather Requirements for Operational Capabilities Council, must continue to work with the acquisition community to anticipate and determine unique support needs.[35] New DE weapon-systems prediction information such as optical-turbulence forecasts, aerosol-concentration products, boundary-layer height forecasts, and so forth, will require policy support and coordination from the Air Force Weather Agency. Other products may be required to support the numerous systems under development.

Headquarters Air Force Materiel Command, Intelligence and Requirements (AFMC/A2/5) may be in the best position to address weather-acquisition concerns related to Air Force DE systems as they make the transition from the

labs to the war fighter. For the Air Force, AFMC could serve as lead command for this effort. Headquarters AFMC/A2/5 must account for these atmospheric-related concerns before any air or space system becomes operational. Close cooperation among AFRL/RD, Army Space and Missile Defense Command, Naval Sea Systems Command, acquisition professionals, and the operational community is essential.

Political considerations must become a part of this effort. Engaging the wrong target can have massive geo-political consequences, which can affect the acceptance and use of a new type of weapon that could change warfare.

Conclusions

With continued funding for research and focused advocacy by senior leaders, an already robust AFW community can transform itself into a superior support provider for DE weapons and an enhancer of employment. Funding from HEL-JTO, major military commands, and the Army can help answer how best to mitigate and/or, perhaps, ultimately exploit atmospheric effects in the employment of DE weapons. We need advocacy in various arenas as commands and agencies continue to battle for precious resources. Senior leaders must understand the potential consequences of not supporting these research and development efforts (e.g., DE weapon systems may not perform as expected due to unanticipated environmental effects), as well as the unintended strategic/political fallout that such a lack of support could have on future operations. We must encourage current research efforts that translate easily into operational decision aids for atmospheric characterization and assessment. Education and training in DE weapons are necessary for senior leaders and for people at all levels of the Air Force weather community to ensure weapons effectiveness against potential enemies. The United States' adversaries are not waiting for tomorrow; they are acting today.[36]

We anticipate no major changes in the organization of AFW. However, weather personnel may need to fill key positions in the HEL-JTO, AFRL/RD, or Naval Sea Systems Command to advocate and lead efforts to address atmospheric characterization. Collaboration with HEL-JTO, AFRL/RD, academia, and private industry is essential to keep abreast of advancements in areas related to military operations. AFIT and the AFRL should receive funding to continue the upgrading/improving of software codes such as HELEEOS and DEEST, and mission-level decision aids based on these research tools must be developed. In the current fiscal climate, increased manning is not a realistic expectation, so accurate characterization of the atmosphere through decision aids will likely be necessary—and might possibly represent the accepted solution. AFW can shape DE support and optimize DE performance for tomorrow by acting today. ❑

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Operators of Air Force Unmanned Aircraft Systems

Breaking Paradigms*

Lt Col Houston R. Cantwell, USAF

As the Air Force plans the integration of unmanned aircraft systems (UAS) into the fleet, it confronts a personnel system and culture designed for and inherently biased towards manned aviation. In this article, the author discusses the history of UAS personnel policy, training, and operations, highlighting the growing chasm between manned and unmanned flight and encouraging the reader to challenge paradigms.

The proposed UAS operator badge combines the historic pilot shield with space-operator wings, recognizing that only Airmen who physically take to the air earn the right to wear feathered wings. It symbolizes the role of these operators as "pilots" of unmanned aircraft yet recognizes that they control airpower from a console on the ground, as do space-operations professionals.

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My concern is that our services are still not moving aggressively in wartime to provide resources needed now on the battlefield. I've been wrestling for months to get more intelligence, surveillance, and reconnaissance assets into the theater. Because people were stuck in old ways of doing business, it's been like pulling teeth. . . . All this may require rethinking long-standing service assumptions and priorities about which missions require certified pilots and which do not.

—Secretary of Defense Robert M. Gates
Maxwell AFB, Alabama, 21 April 2008

DURING HIS VISIT to the hallowed halls of the former Air Corps Tactical School, Secretary of Defense Gates called upon Airmen to think critically about many of the challenges facing the Air Force, specifically questioning whether or not future operators of unmanned aircraft systems (UAS) need to be rated pilots. As demonstrated through years of policy debate, this difficult question still receives attention. Analysis of current personnel policy, opinions of noted aviators, and historical lessons reveals a growing chasm between manned and unmanned flight. Existing paradigms surrounding UAS operators require rethinking due to technological advances and the Air Force's cultural traditions.

In the Beginning . . .

Policies governing UAS aircrews have roots with Gen Ronald Fogleman, former chief of staff of the Air Force. In the mid-1990s, during the genesis of the Predator UAS, he formulated the original policies, which have changed little over the years. Recognizing that the Army had experienced operational problems with UASs, many Air Force people believed that these failures were in part due to the Army's treating these aircraft as "trucks." When the Air Force took over the Predator program in 1995, its senior leaders declared that they would "treat them like airplanes." According to Gen John Jumper, another former chief of staff, "The original notion of using pilots was because of the Army experience [with unmanned aerial vehicles (UAV)]. . . . If you treat it like an airplane, it will act like an airplane. . . . We were trying to get the accident rate down and get the operator-caused accidents down. We knew if we crashed a bunch of these things, that we weren't going to get [the program] either. That's why we insisted on pilots."[1]

Air Force senior leaders dedicated themselves to providing the necessary expertise to assure Predator's early success: "General Fogleman said as he sent non-volunteer instructor pilots to fly the Predator UAV, 'If this program fails, it won't be because of our pilots.' "[2] The decision at the onset to utilize navigators as UAS operators, provided they also possessed a Federal Aviation Administration commercial/instrument aircraft rating, increased the pool of aviators from which operators were selected.

Policies governing the management of UAS operators have had a brief but turbulent history, including issues such as the awarding of flying-gate credit and establishing eligibility for combat medals. The possibility of creating a separate career field for UAS operators has generated even more controversy.[3] General Jumper made the first such proposal, establishing a combat systems officer, followed a few years later by a second one—the "17XX," representing a new Air Force specialty code.[4] The latter proposal gained enough momentum that three volunteer test-case trainees entered the program, which, despite demonstrating potential, was abruptly cancelled on 13 December 2006, and the three officers received new assignments.[5] Initial indications from Gen Norton Schwartz, the current Air Force chief of staff, demonstrate a willingness to reopen the debate regarding establishment of a separate UAS career field.

Professional Opinion

Over the years, proponents of a separate career field have held strong convictions, pointing to the unique technical skills required to operate UASs as sufficient justifica-

tion. For example, Col Michael McKinney, former commander of the Predator Operations Group, supports creation of a new career field similar to the one proposed in 17XX, with young officers starting with Specialized Undergraduate Pilot Training and then branching into a UAS career. Operators would develop judgment about these aircraft over the course of their flying careers. He believes that alternative ways of building airmanship exist and that Airmen can learn to extract three-dimensional situational awareness from a two-dimensional screen.[6]

Col Stephen Wilson, a former assistant operations officer with Air Education and Training Command, who helped develop the 17XX syllabus, offers a pragmatic approach towards UAS training. Recognizing that the identification of key skills and the appropriate training of students helped develop the Specialized Undergraduate Pilot Training syllabus, he argues that a similar process could occur with UAS operators. The process should determine the skill sets required to operate UASs, design a training syllabus around those skills, and select the people best suited to carry out the mission—at that point, training would begin.[7]

Aside from recognizing a new set of skills required to fly UASs, Colonel Wilson's proposal also addresses a significant Air Force cultural issue relating to UAS personnel. Since Predator's genesis, the Air Force has struggled with finding enough high-quality volunteers to fly UASs. In order to explain some of the intricacies of Air Force culture, Colonel Wilson breaks an Air Force commander's personnel-ranking system into three tiers.[8] Tier-one individuals, whom the commander wants to keep in the weapon system, have outperformed their peers and have the most potential for future leadership roles. Falling just below them, tier twos generally have also done a good job with their mission but just do not have what it takes to earn first-tier status. Commanders encourage these personnel to serve in training command as flight instructors. Generally, people in tier three, who have done a fine job fulfilling the mission but are simply outperformed by their peers, normally find themselves pushed into UAS assignments—a tendency that establishment of a distinct UAS career path would negate. Additionally, Colonel Wilson recognizes that the increasing complexities of UAS missions demand dedicated personnel. Noting that manning UAS squadrons with predominantly first-assignment individuals has brought many challenges, he observes, "What if we proposed manning [F-16 or B-1] squadrons in this manner? We'd say you were crazy."[9] A new career field would bring continuity to the community.

Retired colonel Tom Ehrhard, who wrote an influential doctoral dissertation at Johns Hopkins University in 2001 on the development of UASs within the armed services, strongly supports designation of a new career field. He recognizes two fundamental pieces in its design. First, it must satisfy the technical requirements to operate UASs efficiently and effectively in both combat and in mixed-aircraft, controlled airspace. Second, and equally important, long-term success demands cultural integration. Any new career field must develop personnel who maintain professional credibility with the rest of the combat air force. In turn, these officers would form a constituency within the service to advocate follow-on systems. Ehrhard proposes opening a UAS career field to individuals not physically qualified to fly Air Force aircraft but capable of passing the Federal Aviation Administration's class-three physical examination—requirements more lenient than Air Force standards. This would open the career field to a new group of people not qualified to fly Air Force aircraft. Most importantly, these individuals would be highly motivated volunteers from the start.[10]

Colonel Ehrhard also recognizes the importance of maintaining flying credibility and developing airmanship, recommending the addition of a career-long aircrew enhancement program, which would direct that UAS operators maintain flight currencies in a companion aircraft such as the T-1, T-6, or T-38.[11] This would offer UAS pilots the opportunity to bolster their credibility and develop airmanship. Historically, such programs have supplemented aircrew training by providing additional flight hours through the use of T-37 or T-38 aircraft.

Pilots who fly the B-2 and U-2 have benefited from T-38 training due to the relatively small number of flight hours available in their major weapon system.

The final set of perspectives comes from three highly respected Air Force leaders, all of whom support (in some fashion) creation of a new UAS career field. General Jumper, who encourages implementation of the combat-systems-officer concept, recognizes the importance of putting the Air Force's UAS operators in aircraft so that they can more easily understand flight.[12] His ultimate concern involves the building of "credentialed warriors" who must fully understand how best to employ airpower and internalize the ramifications of their actions. Regarding UAS operators, he notes that "the Nintendo mentality is a detached mentality. This stuff is real. I'm taking real lives. I'm shooting real weapons. And I have to be really responsible for my actions."[13] General Jumper's concept of the combat systems officer moves away from using pilots but remains focused on the development of airmanship. Former Air Force chief of staff Gen Michael Ryan recognizes the ever-increasing levels of UAS autonomous operations and recommends reevaluating pilots' roles in them: "We shouldn't have pilots stick-and-ruddering UAVs."[14] The Air Force should keep pilots in the operational decision-making process, but emerging automated flight-control systems such as autotakeoff and autoland should permit removing them from the controls. Finally, according to Gen Richard Hawley, former commander of Air Combat Command, "I've spent time in a [UAS] control van. You don't need 500 hours of F-16 time to know how to fly a Predator. You do need to understand something about winds, weather, and the environment in which the Predator operates."[15] He recommends that the Air Force evaluate a "much truncated" program of Specialized Undergraduate Pilot Training followed by a career in UAS operations, air-battle management, and command and control. To those who argue against his proposal for a separate career path, he points out, "When I started UPT [Undergraduate Pilot Training], I was just another guy off the street. . . . When I left UPT, all I had were stick-and-rudder skills and some knowledge about weather. . . . I knew just enough to stay safe. . . . I developed airmanship over the years."[16]

Training and Operations for Unmanned Aircraft Systems

The last decade of UAS operations has refined training practices and operational procedures in the Predator, Reaper, and Global Hawk communities. Events within each have produced many lessons learned. Facing an insatiable demand for intelligence, surveillance, and reconnaissance, the Predator community has streamlined training practices to the extreme. Even in its brief history, Reaper has had its training practices shaped in a similar manner. Discussions with Global Hawk professionals identified distinct differences between skill sets used by traditional pilots and those used regularly by UAS operators. Global Hawk operators also recognized the ability to relax independent decision-making requirements, given the ability to "bring additional people into your cockpit" to help solve problems.

The last decade has identified many differences between manned and unmanned aviation in the Air Force, thus justifying noteworthy changes to training programs. The tremendous demand for Predator coverage has forced maximum operational efficiencies. To assure availability of a full complement of personnel for contingency operations, the squadrons have carefully evaluated their training programs and made important changes. Comparing such programs to those of traditionally crewed aircraft, one finds at least two noteworthy differences. First, the operational Predator and Reaper squadrons, 99 percent of whose operations are real-world contingencies, do not carve time out of their flying-hour program to meet training requirements. Second, uninterrupted contingency operations question the relevance of many of the currencies typically maintained by pilots. Elimination of takeoff and landing currencies, for instance, has caused significant changes to the Predator training syllabus.

Unending demand for Predator support, coupled with limited personnel availability, has prompted operational squadrons to eliminate continuation-training sorties. The need for personnel to fly contingency missions is so great and the supply of Predator crews so small that any effort directed away from contingency operations reduces the squadron's capacity to provide intelligence, surveillance, and reconnaissance.[17] The lack of continuation training may appear unimportant in light of the fact that most Predator flying occurs on autopilot while the aircraft collects video. However, a closer look at the types of missions flown by the 15th Reconnaissance Squadron reveals that, in addition to video collection, it flies some of the most demanding missions available. The squadron's Predators routinely conduct close air support, air interdiction, support of special forces, and killer scout missions.[18] In comparison, pilots of A-10s and F-16s maintain carefully regulated currencies and training requirements for such challenging events. Should the training of UAS operators follow suit, or is the cost of taking them off the combat-flying schedule too great?

Reaper challenges old training paradigms to an even greater extent. Its operators must employ a host of weapons, including Hellfire missiles and laser-guided bombs, in a multitude of possible scenarios. Additionally, they must collect streaming video around the clock in support of intelligence requirements. Such conflicting requirements as maintaining important training currencies and supporting contingency operations will only grow stronger as Reaper's capabilities increase.

In 2003 a significant change to Predator operations occurred with the advent of remote split operations, a concept permitting a majority of the squadron to directly support theater operations from a central location by means of networked command and control. Careful observation reveals that this capability significantly affected training. Formerly, Predator crews deployed essentially as a squadron to support contingency operations, performing every aspect of the mission in-theater, from takeoff, to mission execution, to landing. With the establishment of remote split operations, however, it quickly became apparent that operators flying the Predator from the mission control element back at Nellis AFB, Nevada, would not have to perform takeoffs or landings—flown only as line-of-sight operations (not through beyond-line-of-sight satellite communication) by personnel forward-deployed in-theater. Therefore, only the crew of the launch-and-recovery element needed takeoff and landing skills. Individuals selected to deploy forward would receive the necessary training in takeoff and landing just prior to their deployment. Many people considered this the most challenging part of Predator initial training; indeed, it occupied almost one-third of the entire syllabus.[19] Eliminating takeoff and landing from this document increased the availability of Predator operators, thereby adding to the number of combat air patrols flown in support of the war fighter.

The idea of eliminating training in takeoff and landing from the Predator schoolhouse syllabus did not sit well with some people. Lt Col James Gear, commander of the 11th Reconnaissance Squadron, initially opposed the idea because "that's where you learned how to fly the airplane. That's where you learned the stick-and-rudder skills."[20] Later, however, he came to realize that a majority of the time spent flying the Predator occurred in a mission control element on autopilot: "The bottom line is we've been successful *not* teaching people how to take off and land. . . . You've got to approach everything with UAVs and get over your paradigms."[21] In the 11th Reconnaissance Squadron, the possibility exists that an instructor pilot not qualified to land the aircraft could fly a training mission over Nevada and experience engine problems. Recognizing the risk, Colonel Gear discussed it with leaders of the 432nd Operations Group. He accepted the possibility that if engine failure occurred, the Predator operator would either call down the hallway and direct qualified personnel to take the controls as soon as possible—or might elect to try to land the aircraft himself, "giving it a shot." He recognized that in some cases, "giving it a shot" might be an acceptable answer in UAS operations.[22]

Years of Predator operations have helped identify pertinent skills. According to Brig Gen Charles Lyon, "Less than 50 percent of Predator pilots' skills rely on stick and rudder—most has to do with the operational experience that rated aircrews have from previously flying airplanes and operating in the environment."[23] As Predator becomes more automated with the addition of capabilities such as autotakeoff and autoland, the requirement for stick-and-rudder skills will further decrease. Maj Thomas Meeks, a former Predator operator, believes that "it makes sense to separate technical skills from judgment skills in UAVs."[24] Pilots of traditional aircraft must necessarily develop their stick-and-rudder skills simultaneously with judgment and airmanship (because they must always remain physically airborne to do so), but Predator operators can refine their judgment and airmanship independently of their technical skills. For the most part, the computer handles most of the stick-and-rudder challenges. Major Meeks adds that "pilots bring an initial appreciation for the medium of air, the integration of multiple air assets, and a basic understanding of the employment of airpower."[25] Time spent in the Predator continues to develop many basic airmanship skills, including how best to integrate the platform into the airspace, support troops on the ground, and ensure safe recovery of the vehicle. Development of this type of judgment can occur largely independently of stick-and-rudder skills due to the advent of more sophisticated autopilot functions. Although some similarities exist, the skills required of a Predator operator differ from those of a pilot—which differ from those of a Global Hawk operator.

The Global Hawk community has also wrestled with the task of properly determining training requirements. In a recent interview, Lt Col Christopher Jella, commander of the 18th Reconnaissance Squadron, highlighted many challenges to Global Hawk operations. The long duration of missions and high altitudes (in excess of 50,000 feet) prevent Global Hawk operators from developing skills typically associated with Airmen: interacting with air traffic controllers, transiting controlled airspace, and taking off and landing the aircraft. A typical mission of 24 hours requires only 30 minutes of interaction with controllers as the aircraft transits from the surface to 18,000 feet and back.[26] Given the rotating eight-hour shifts and mission lengths of 24 hours, Global Hawk operators typically deal with controllers only once every two months.[27] Instead, a significant amount of time spent on missions involves optimizing collection efforts. During these "ad hoc taskings," operators balance last-minute collection requests against previous taskings. Working within the chain of command, they constantly revise the collection plan to maximize results of each mission.

Global Hawk's high level of automation has introduced new challenges to the development of proper training regimens for operators. Unlike Predator, Global Hawk already uses autotakeoff and autoland capabilities instead of stick and rudder. The pilot simply monitors aircraft operations to make the system execute as directed, a concept that challenges traditional thinking about airmanship development—or even the definition of airmanship. Global Hawk pilots rely on their previous experience with major weapon systems for a great deal of their judgment. The longer their assignment to Global Hawk, the more their airmanship skills fade because the missions typically do not engage those skills.[28] According to Colonel Jella, "After a year, it's actually that our experience level is backwards—the experienced guys are the brand-new ones coming in, with airmanship and situational awareness, and they become complacent after a period."[29] Mission profiles send aircraft primarily on preplanned routes carefully monitored by the pilots. One of the greatest challenges to flying Global Hawk, unlike flying traditionally crewed aircraft, is the requirement to know the preplanned procedures for a lost-communications link, which change throughout the flight profile and require constant situational awareness. Because automated procedures and advanced autopilot controls govern basic aircraft control, the Global Hawk operator's airmanship skills rarely come into play during routine missions. Thus, when anomalies do occur, they can be hair-raising.

Although normal operations may not significantly test a pilot's airmanship, the nature of Global Hawk operations requires pilots to draw upon every ounce of airmanship they have ever developed to handle such anomalies. Compared to pilots of traditional aircraft, individuals flying Global Hawks from halfway around the world must deal with a host of additional issues when maintenance problems occur. First, assessment of the situation is more difficult since pilots cannot "feel" how the aircraft is handling. They know only the information transmitted into the ground-control station, having just their instruments at their disposal. Something as simple as air turbulence can easily be mistaken for a flight-control anomaly.[30] Next, due to the long duration of missions, no single pilot can bring continuity to a complete mission. Although pilots conduct a thorough debrief as they swap out the controls, it is impossible to completely capture the aircraft's performance across an entire mission. Brig Gen H. D. Polumbo, commander of the 9th Reconnaissance Wing, believes that "when dealing with an emergency aircraft that is operating thousands of miles away at 60,000 feet and dealing with malfunctioning critical aircraft systems . . . you had better have a great deal of airmanship in your pocket to ensure the safe recovery of the aircraft."[31] Critical, unanswered questions remain: How does the Air Force delineate the differences between manned and unmanned aviation? Can airmanship be developed solely through the remote operation of aircraft?

The final issue uncovered within the Global Hawk community relates to the development of pilots' decision-making abilities. Unmanned aviation has the unique capability to access additional expertise; that is, individuals at the controls of Global Hawk can always either call for assistance on the telephone or, in most cases, even physically bring an expert into the control center with them. Doing so, however, can create a problem in the long run. Calling on higher-level commanders to weigh in on important decisions allows us to spoon-feed young pilots through difficult decisions. Due to the physical location of the pilot, the casual observer can often have just about as much information on the situation as the pilot. During requests for help, no longer can the pilot chastise individuals on the ground, accusing them of having no idea about what is happening in the cockpit. Everyone involved can build situational awareness from the same set of information displays. Colonel Jella points out that the issue is discussed at length in seminars on the management of crew resources and that

> [squadron leaders have] to understand that they don't need the experience—the aircraft commander does. . . . So look at the situation, comprehend it, give the pilot your inputs, and walk away from the situation. . . . It's essential for the pilot's experience as a decision maker, the development of their logic trains, and their problem-solving skills, that squadron leadership does not spoon-feed pilots through decision-making processes.[32]

These examples, pulled from the operational environment of Predator, Reaper, and Global Hawk, highlight the divergence of unmanned and manned aviation. Of even greater importance to any discussion of the professional development of future UAS operators is the Air Force's proud history of manned flight.

Cultural Considerations

An investigation of perceptions of UAS assignments unveils several important issues. As an institution, the Air Force has developed cultural norms regarding pilots and their development as leaders. In turn, pilots themselves have developed career expectations as professional Air Force aviators. The introduction of UASs into the inventory contests many of these norms.

Pilots love to fly. A passage from Mark Wells's book *Courage and Air Warfare* captures the emotional bond between pilots and flight:

> The visual and kinesthetic sensations could seem almost intoxicating.
>
> The rest was wonder, a joy compounded of exhilaration, a limitless sense of freedom and reach to the very limits of the sky. How many pilots have shared this sensation which defies adequate description! The instant of knowing that the skies truly are yours in which to fly and soar, to

> glide and swoop, is truly a moment of sweetness incomparable to any other.[33]

Air Force pilots may love to fly, but they also pursue a career in aviation for societal status: "From the earliest days of aviation, airmen have been regarded as members of an elite group."[34] Today's Air Force subculture supports this perception. Pilots must undergo rigorous physical examinations and pass a demanding, year-long training regimen to earn their wings. Put simply, pilots are a select group of specialists. The advent of "unmanned flying" requires Airmen to give up the opportunity to fly, to relinquish their membership in the fraternity of pilots. For some, the opportunity to fly means even more to them than their professional military service.[35] Lt Col James Dawkins nicely sums up the cultural considerations regarding unmanned operations:

> The culture of the Air Force flying community itself added to feelings of inadequacy [in relation to UAV careers]. It is a culture where operators identify themselves with their respective airframes more so than their occupation. If you ask an aviator what he does in the Air Force, he is likely to answer with "I'm a bomber pilot" or "I'm a Viper (F-16) pilot." Some even consider themselves pilots first and Air Force officers second. But ask a Predator pilot what he flies and he's likely to say "I'm a former Viper (Eagle, C-5, B-1) pilot, but I fly Predators now."[36]

We cannot overlook the cultural perceptions of unmanned systems. Since its beginning, the Air Force has taken pride in its chivalrous nature, raising warfare out of the trenches of World War I. The personal connection between man and airplane resembles in some ways the relationship between the cavalry's man and horse. Carl Builder observes that, "when other means such as unmanned aircraft, guided missiles, and spacecraft became available, it was the aviators who revealed, by deeds more than words, that their real affection was for their airplanes and not for the concept of air power."[37] Certainly, tensions exist between young Air Force pilots who dream of slipping the surly bonds of Earth and those assigned to sit in Predator ground-control stations. The result? A continuous stream of pilots cycling through the Predator schoolhouse, completing an operational tour, and then immediately returning to their major weapon system—a cycle that has failed to fulfill the demand for Predator crews.

People who joined the service to become pilots would rather fly airplanes than UASs. The last 10 years of the Predator operators' assignment history demonstrate Air Force pilots' desire to stay in cockpits instead of ground-control stations. Pilots choose cockpits first, leaving tier-three personnel to fill the remaining UAS billets. The Air Force needs to aggressively target motivated people who will voluntarily pursue careers in UASs. A separate career field of volunteers would solve many of the challenges currently facing the UAS community. Morale and dedication to the development of unmanned aircraft would increase if, in the future, people came into the Air Force with the expectation of flying them.[38]

Implications

Over the years, a clearly defined set of technical skills and cultural associations has combined to forge the image of Air Force pilots, who must understand the physiological stresses of flight, the medium of air, and, of course, the airplane. They harbor an independent spirit, permitting them to make decisions from their often-isolated cockpits. Along with the technical aspects of being a pilot, a cultural association also accompanies the title. Pilots must pass strict physical standards and complete years of rigorous training. Associated with flying are inherent risks to life and limb. The title "pilot" thus brings cultural status.

A majority of pilots' traits do not apply to UAS operators, who require many skills not normally associated with pilots. Operators do not need to understand the physiological stresses of flight. They must know airplanes but also must understand much more than that in order to conduct unmanned operations safely. UAS operators should have a firm appreciation of the vulnerability and flexibility of the link between the ground-control station and the aircraft. Unlike a crewed airplane, an

unmanned one depends on security of particular parts of the electromagnetic spectrum for basic aircraft control.

Most importantly, cultural perceptions of pilots and UAS operators differ significantly. The fraternity of pilots shares a love of flight, enjoys a perception as an elite group of risk takers, and holds a particular social status within the Air Force. UAS operators, who do not share these traits, must build their own culture. Any reference to a "UAS pilot" only blurs what should be a clear distinction between two separate professions, each steeped in its own particular cultural norms. Clearly, a negative cultural stigma attaches to UAS operators, but as the community continues to prove itself in combat operations around the globe, operators will prove their worth and gain the respect of the rest of the war-fighting community. References to them as pilots cause only tension and confusion.

Independence—one of the hallmark traits of military aviators, is challenged by the connectivity of UASs. Gen Billy Mitchell said, "In the actual fighting of the aircraft, moral qualities are required that were never before demanded of men. In the first place, they are all alone. No man stands at their shoulder to support them."[39] Military aviation required an independence by war fighters never seen before in the battlespace. The connectivity of unmanned systems introduces a new concept to the independent aviator—the fact that UAS operators are never alone—and sets these systems apart from aircraft. On the one hand, sorties by fighter aircraft rely in large measure on the decision-making capabilities of select, highly trained aircrew members, each of whom must receive training to perform the mission successfully, from preflight to landing. On the other hand, as evidenced by Predator operations, UASs can rely on the skills of distinctly separate crews, separated by thousands of miles and sharing only a communications network and an aircraft. The difficult question becomes how to balance skill specialization with the general development of important decision-making skills and judgment—in short, *airmanship*. Computers and automated processes will continue to assume more of the responsibilities associated with pilots. The integration of automated and human-regulated processes depends upon careful evaluation of the command-and-control procedures that govern unmanned operations.

The challenge becomes identifying basic skills required of the evolving UAS operator. Emerging UAS technologies will likely make unmanned flight even more distinctive. As computers continue to assume greater responsibility for basic aircraft control, we must seek to define the responsibility of the "human in the loop." Ultimately, "flying" unmanned craft will boil down to developing processes for the effective command and control of effects delivered through the air.

A Look towards the Future

The extreme dedication to operations in Iraq and Afghanistan has pushed aside a fundamental discussion. As highlighted by Colonel Ehrhard, "The Air Force needs to reevaluate how it defines *airmanship*."[40] Instead of redefining the term, the service has made a default assumption that pilots who have at least a single operational tour possess the necessary level of airmanship to operate UASs safely.[41] However, examples from the Predator, Reaper, and Global Hawk communities already demonstrate important divergences from manned aviation. UAS operator skills and those of traditional pilots differ. New UAS capabilities, greater automation, and a wider span of mission types will bring this discussion increasingly to the forefront. The Air Force needs to formally evaluate UAS training requirements for an individual who has absolutely no aviation background, and then build an appropriate training syllabus.

Deep-seated cultural issues concerning professional Air Force pilots further complicate the discussion. The act of awkwardly forcing chivalrous young pilots out of their cockpits and into ground-control stations produces suboptimal results. Pilots are left performing jobs that do not generate the same level of satisfaction as flying. In the long run, this hurts the development of UASs because of the in-

ability to retain valuable operational experience. The Air Force's UAS personnel policy has led to an overworked community of professionals dedicated to supporting the global war on terror but eager to return to their previous jobs. Policies that focus on training nonrated, volunteer UAS crews would help provide enough people for today's fight while preparing for tomorrow's.

The Air Force's institutional push towards cyberspace offers an opportunity to combine old with new. A new UAS operator career field could nicely bridge the gap between old perceptions of Airmen (people who fly airplanes) and new ones (Airmen conducting operations in air, space, and cyberspace). Old principles of airmanship, combined with nuances of the new cyber medium, merge within the UAS community. Potentially, the UAS operator represents the new Airman. Just as the Airman of the 1920s relied on technology to take to the skies like no other war fighter of the day, so does the Airman of the twenty-first century rely on technology to create effects while remaining grounded. Determining the best doctrine, organization, and training policies to employ unmanned aircraft will continue to confront the Air Force; empowering a specific, newly defined career field offers the best way of overcoming such challenges. Proud traditions and cultural norms help define our service's greatness. They also have the potential to hinder its advance. In line with Secretary Gates's remarks, Gen Thomas White, a former Air Force chief of staff, warns that "the senior Air Force officer's dedication to the airplane is deeply ingrained and rightly so, but we must never permit this to result in a battleship attitude. We cannot afford to ignore the basic precept that all truths change with time."[42] ❑

Notes

1. Gen John P. Jumper, former Air Force chief of staff, interview by the author, 20 December 2006.
2. Thomas Ehrhard, "Unmanned Aerial Vehicles in the United States Armed Services: A Comparative Study of Weapon System Innovation" (PhD diss., Johns Hopkins University, 2001), 593.
3. Although this article focuses on the UAS operator, it should not detract from the importance of properly training enlisted UAS sensor operators. Their contribution to the accomplishment of the mission is equally important, and their struggle for recognition no less significant.
4. Gen John P. Jumper, chief of staff, US Air Force, "Chief's Sight Picture," 10 March 2003.
5. Lt Gen Carrol H. Chandler, deputy chief of staff, Air, Space, and Information Operations, Plans, and Requirements, Headquarters US Air Force, Washington, DC, memorandum for record, 13 December 2006. The program selected three candidates from a pool of volunteer applicants: 2nd Lt Leslie McPeak, Capt Thomas Bean, and Capt Oswald Bonilla.
6. Col Michael McKinney, director, Air Force Operations and Training, interview by the author, 18 December 2006.
7. Col Stephen Wilson, former assistant operations officer, Air Education and Training Command, interview by the author, 6 December 2006.
8. Ibid.
9. Ibid.
10. Col Thomas Ehrhard, USAF, retired, Senior Fellow, Center for Strategic and Budgetary Assessments, interview by the author, 20 December 2006.
11. Ibid.
12. Jumper, interview.
13. Ibid.
14. Gen Michael E. Ryan, former Air Force chief of staff, interview by the author, 19 December 2006.
15. Gen Richard Hawley, former commander, Air Combat Command, interview by the author, 3 January 2007.
16. Ibid.
17. Lt Col John Harris, former commander, 15th Reconnaissance Squadron, interview by the author, 26 January 2007.
18. Lt Col Christopher Plamp, commander, 15th Reconnaissance Squadron, interview by the author, 23 January 2007.
19. Maj Thomas Meeks, former Predator operator, 15th Reconnaissance Squadron, interview by the author, 20 January 2007.
20. Lt Col James Gear, commander, 11th Reconnaissance Squadron, interview by the author, 25 January 2007.
21. Ibid.
22. Ibid.
23. Brig Gen Charles Lyon, former commander, 57th Operations Group, interview by the author, 19 December 2006.
24. Meeks, interview.
25. Ibid.
26. Lt Col Christopher Jella, commander, 18th Reconnaissance Squadron, interview by the author, 22 January 2007.
27. Ibid.
28. Ibid.

29. Ibid.

30. Brig Gen H. D. Polumbo, commander, 9th Reconnaissance Wing, interview by the author, 22 January 2007.

31. Ibid.

32. Jella, interview.

33. Mark K. Wells, *Courage and Air Warfare: The Allied Aircrew Experience in the Second World War* (Portland, OR: Frank Cass, 1995), 92.

34. Ibid., 4.

35. James R. FitzSimonds and Thomas G. Mahnken, "Military Officer Attitudes toward the Adoption of Unmanned Systems" (paper presented at the Annual Meeting of the International Studies Association, San Diego, CA, 22 March 2006).

36. Lt Col James C. Dawkins, "Unmanned Combat Aerial Vehicles: Examining the Political, Moral, and Social Implications" (master's thesis, School of Advanced Air and Space Studies, Air University, Maxwell AFB, AL, 2005), 42.

37. Carl H. Builder, *The Icarus Syndrome: The Role of Air Power Theory in the Evolution and Fate of the U.S. Air Force* (New Brunswick, NJ: Transaction Publishers, 1994), 32.

38. Current Air Force initiatives to manage UAS operators include two nonvolunteer programs: Tactical Aircrew Management Initiative 21 and a no-permanent-change-of-station policy from Creech AFB, NV. Each highlights the institutional problems related to attracting and maintaining sufficient numbers of Predator operators. Both are short-term solutions with little long-term effect.

39. William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military* (1925; repr., Mineola, NY: Dover Publications, 1988), 163.

40. Ehrhard, interview.

41. UAS personnel policy is rapidly changing. Senior leadership recently made the decision to directly assign graduates of Specialized Undergraduate Pilot Training to Predator UASs. Also, a recently initiated experimental "Beta" program takes nonpilots directly into the UAS community.

42. Quoted in Builder, *Icarus Syndrome*, 175.

Tactical Generals

Leaders, Technology, and the Perils of Battlefield Micromanagement*

Dr. P. W. Singer

In 1999 Gen Charles Krulak coined the term "strategic corporal" (i.e., a junior member trained and empowered to make time-critical decisions in response to the dynamic ground fight). In this article, the author examines a similar phenomenon occurring among senior officers, observing that modern technology allows generals to personally engage on the tactical level from remote locations. How the military manages this phenomenon will become a core leadership question in the years ahead.

THE FOUR-STAR general proudly recounts how he spent "two hours watching footage" beamed to his headquarters. Sitting behind a live video feed from a Predator unmanned aircraft system (UAS), he saw two insurgent leaders sneak into a compound of houses. He waited as other insurgents entered and exited the compound, openly carrying weapons. Now, he was certain. The compound was a legitimate target, and any civilians in the houses had to know that it was being used for war, what with all the armed men moving about. Having personally checked the situation, he gave the order to strike. But his role in the operation didn't end there; the general proudly tells how he even decided what size bomb his pilots should drop on the compound.[1]

The Rise of the Tactical General

In *The Face of Battle*, his masterful history of men at war, John Keegan writes how "the personal bond between leader and follower lies at the root of all explanations of what does and

*This article is derived from the author's latest book, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (New York: Penguin, 2009). For further information, see http://wiredforwar.pwsinger.com.

does not happen in battle."[2] In Keegan's view, the exemplar of this relationship was Henry V, who inspired his "band of brothers" by fighting in their midst during the Battle of Agincourt.

With the rise of each new generation of communications technology, these connections between soldiers in the field and those who give them orders grew distanced. Generals no longer needed to be on the front lines with their men but operated from command posts that moved further to the rear with each new technological advance. Yet, the very same technologies also pushed a trend "towards centralization of command, and thus towards micromanagement."[3]

For instance, when telegraphs were introduced during the Crimean War (1853–56), generals sipping tea back in England quickly figured out that they could send daily plans to the front lines in Russia. So they did. With the radio, this went even further. Adolf Hitler was notorious for issuing highly detailed orders to individual units fighting on the Eastern Front, cutting out the German army's entire command staff from leading its troops in war. Even the US military has suffered from this problem. During the rescue attempt of the American cargo ship *Mayaguez* in 1975, the commander on the scene received so much advice and orders from leaders back in Washington that he eventually "just turned the radios off."[4]

These leaders of the past, though, never had access to systems like today's Global Command and Control System (GCCS). As one report describes, "GCCS—known as 'Geeks' to soldiers in the field—is the military's HAL 9000. It's an umbrella system that tracks every friendly tank, plane, ship, and soldier in the world in real time, plotting their positions as they move on a digital map. It can also show enemy locations gleaned from intelligence."[5]

This tracking system is reinforced by video feeds from various unmanned systems blanketing the battlefield. The growth in America's use of robotic systems has taken place so fast that many people seem not to realize how big it has gotten. US forces initially went into Iraq with only a handful of unmanned systems in the inventory; indeed, just one UAS supported all of V Corps. By the end of 2008, however, there were 5,331 UASs in the total US inventory.[6] In Iraq, some 700 drones supported that same V Corps just a few years later, while the sum total of Army and Air Force UASs was logging almost 600,000 annual flight hours.[7]

Rapid growth in ground robotics has occurred as well. Zero unmanned ground vehicles took part in the 2003 invasion of Iraq; a year later, 150 were in use. By 2008 the inventory in Iraq had approached the 12,000 mark, with the first generation of armed ground robots arriving that same year.[8] And the technological development is moving so fast that all of these systems are outdated the very moment they hit the marketplace and battlespace. These are just the Model T Fords and Wright Flyers compared to what is already in the prototype stage.

With these trends in play, warfare is undergoing a shift that may well parallel that which occurred in World War I. Amazing new technologies, almost science-fiction-like in their capabilities, are being introduced. (Indeed, the number of unmanned ground systems now in Iraq roughly parallels the number of tanks used in 1918.) Yet, as in World War I and the ensuing interwar years, the new technologies are not "lifting the fog of war" or ending friction, as some of the acolytes of network-centric warfare would have it. Rather, in everything from doctrine to the laws of war, they are presenting more questions than we can answer.

Issues of command leadership offer just one example of the ripple effect now under way. The combination of networked connections and unmanned systems enables modern commanders as never before, linking them closer to the battlefield from greater distances and changing the separation of space. But the separation of time has changed as well. Commanders can transmit orders in real time to the lowest-level troops or systems in the field, and they have simultaneous real-time visibility into it. Previously, generals may have been distanced, but they could never "see" what soldiers saw in the crosshairs of their rifle sights—or do anything about it. With a robotic system such as a Predator UAS or Special Weapons Observation Reconnaissance Detection System (a ground robot, the size of a lawn mower,

armed with a machine gun), commanders can see the same footage that the operator sees, at the same time, and even take over the decision to shoot or not.

Many people, especially the network-centric acolytes who surrounded former secretary of defense Donald Rumsfeld, thought this linking together of every soldier and system into a vast information-technology network would decentralize operations, enable greater initiative among the lower-level units in war, and allow frictionless operations that lifted the fog of war.[9] So far, actual experience with unmanned systems is proving to be the opposite. New technologies have certainly enabled a powerful revolution to occur in our capabilities, creating a strange new world where science fiction is fast becoming battlefield reality. But although commanders are empowered as never before, the new technologies have also enabled the old trends of command interference, even taking them to new extremes of micromanagement. Too frequently, generals at a distance use technology to insert themselves into matters formerly handled by those on the scene and at ranks several layers of command below them. "'It's like crack [cocaine] for generals,' says Chuck Kamps, a professor of joint warfare at the Air Command and Staff College. 'It gives them an unprecedented ability to meddle in mission commanders' jobs.'"[10]

Over the last few years, many analysts have discussed what Marine Corps general Charles Krulak described as the rise of the "strategic corporal"—how technology has put far more destructive power (and thus influence over strategic outcomes) into the hands of younger, more junior troops. A 20-year-old corporal can now call in air strikes directed by a 40-year-old colonel in the past. But these new technologies have quietly produced its inverse, what I call the "tactical general." Technology may have helped move senior leaders off the actual battlefield, but now it allows them to become more involved in the real-time fighting of war. What to do about this phenomenon will pose a core leadership question in the years ahead.

To Intervene or Not to Intervene

The four-star general who told how he spent two hours watching Predator footage recounted the story proudly and unprompted. He did so while trying to make a point about how he intended to assume personal leadership of operations for which he was responsible.

That a general, who can now see what is unfolding on the ground, would want to shape it directly makes perfect sense. Who better knows "commander's intent" than the commander himself? All sorts of battles have been lost when subordinates in the field misinterpreted or wrongly implemented a general's commands. A general who stays on top of an ongoing situation can also rapidly adjust to any changes that happen in the midst of battle, rather than proceed with old plans that have been overcome by events.

Unfortunately, the line between timely supervision and micromanagement is a fine one and may be quickly fading with unmanned systems. More and more frequently, generals insert themselves into situations inappropriately, and their command leadership role becomes command interference.

Examples run rampant. One battalion commander in Iraq told how he had 12 stars' worth of generals (a four-star general, two three-star lieutenant generals, and a two-star major general) tell him where to position his units during a battle. A captain in special operations forces recounted how a brigadier general (four layers of command up) had radioed him while his team was hunting down an Iraqi insurgent who had escaped during a raid. Watching live Predator video back at the command center in Baghdad, the general had orders for the captain on where to deploy not only his unit but also his individual soldiers![11] Another interviewee described how officers hundreds of miles away would tell him which roads his vehicle should take during raids in Afghanistan.[12]

As retired Air Force lieutenant colonel Dan Kuehl points out, the fact that a general now can use a "5,000-mile-long screwdriver" doesn't mean he should.[13] Besides the frustrations that such micromanagement brings subordi-

nates, there is also the question of the appropriate division of labor in command. To the general who described spending two hours watching Predator footage, this was time well spent. As the ultimate commander, he would be held accountable if the strike went awry and collateral damage ensued. So, if the technology allowed, he believed that he should make sure the operation went exactly the way he wanted.

But this comes at a cost. While this general was doing a job normally entrusted to junior officers, who was doing his job? New technologies allow him and other senior flags to make tactical decisions as never before. But the captains, majors, colonels, and so forth, whom they cut out of the chain, cannot, in turn, assume responsibility for the strategic and policy questions that the generals would have wrestled with instead.

Such generals seem more attracted to micromanagement in the kinetic realm. I liken it to the "Super Bowl" effect. That is, they have spent their entire professional lives preparing for battle and usually look back on their days at field level as the best part of their careers. So these generals don't want to miss out on "the big game" simply because they have advanced past it in their careers.

The challenge is that tactical generals often overestimate how much they really know about what happens on the ground. New technologies may give them an unprecedented view of the battlefield and the ability to reach into it as never before, but this view remains limited. For example, during Operation Anaconda in 2002, when the 10th Mountain Division took on Taliban and al-Qaeda fighters in the Shah-i-Khot valley in Afghanistan, generals back in the United States could watch a battle play out live, beamed back to them by a Predator UAS that flew above the fight. The danger, explains Maj Louis Bello, the fire-support coordinator for the division, is that the video tends to "seduce" commanders, leading them to focus on what the UAS beamed back, as if it told the whole story. "You get too focused on what you can see, and neglect what you can't see," Bello said. "And a lot of the time, what's happening elsewhere is more important."[14]

Jumping in and out of tactical issues, rather than working them day to day, senior officers also don't have the local context (nor are they usually trained for analysis). Moreover, they sometimes interpose their assumptions onto what they do see. During Anaconda, for example, American commanders viewed live video of al-Qaeda fighters moving across a mountain. Despite the footage staring them in the face, the commanders still thought they must be seeing Americans since they expected to see them there, based on their original plans.[15]

Older generations' lack of familiarity with cutting-edge technology can also heighten misunderstanding from afar. During the 2003 Iraq invasion, for example, overall commander Gen Tommy Franks reportedly became quite possessed with the "Blue Force Tracker" map, a massive electronic display that showed the exact locations and status of every US unit, as well as Iraqi units facing them. The appearance of so much information, however, proved deceiving. At one stage early in the fight, seeing that the tracking map showed no Iraqi units nearby, Franks concluded that several units in the Army's V Corps were idle, neither moving nor fighting. He reportedly flew off the handle and tracked down his land-forces commander, who then, in his words, was made to eat "a sh[--] sandwich."[16]

There was only one problem: the audience back at US Central Command saw the battles unfolding at the wrong scale. The blue icons, representing American units, may have looked alone on the large-scale map but were actually locked into one of the toughest battles of the entire invasion, fighting against a swarm of Saddam Fedayeen teams. These small insurgent units had sufficient size to give the US invasion force fits but not enough to merit their own logos on the high-tech map viewed by generals far from the battle.

Most of all, officers in the field lament what they call the "Mother, may I?" syndrome that comes with the greater use of these technologies.[17] Rather than rely on the judgment of highly trained officers, generals increasingly want to inspect the situation for themselves. This is fine if the enemy plays along and gives the general several hours to watch the video

and decide which bomb to use. But sometimes matters aren't decided on a general's schedule. An Air Force officer in the Middle East described his ultimate frustration, noting a time when even though he had information that could have saved lives, "it sat in someone's e-mail queue for six hours."[18]

Generals on Lake Wobegone

Ultimately, these problems combine to add another new problem. Or, rather, they create a new wrinkle on a venerable truism of war. As Napoléon once said, "One bad general is better than two good ones."[19]

A pyramid represents the traditional concept of a military operation, with the strategic commander on top, the operational commanders beneath, and the tactical commanders occupying the bottom layer. Aided by the new technologies, strategic and operational commanders who usurp authority from tactical commanders are erasing this structure from above. The pyramid also finds itself endangered from the sides. As one UAS squadron officer explains, the simultaneous location of reach-back operations in multiple spaces presents a major challenge to their command and control.[20] Although UASs fly over Iraq, they launch out of a base in the Persian Gulf and are flown by operators sitting back in Nevada. At each of those locales, "each commander thinks he's in control of you."[21] Even worse, everyone clamors for these high-demand assets.

This situation results in "power struggles galore," tells the squadron commander. Because operations are located around the world, it is not always clear whose orders take priority. Instead, units get "pulled in many directions because you are in virtual space. Am I at Nellis, or am I at CENTAF [US Central Command Air Forces, the air command in the Middle East]?"[22]

Moreover, by giving everybody in the command structure access to the Internet, the ability to watch what goes on and weigh in on what units should do is not limited to a unit's physical location (Nevada) or virtual location (the Middle East). During the Shah-i-Khot battle, for instance, the Predators beamed video of the fighting to bases and offices all over the world. Army major general Franklin Hagenbeck, commander of US ground forces during the battle, recalls how "disruptive" this was since officers in places ranging from Tampa to the Pentagon now felt "they were in a position to get involved in the battle." While his team tried to fight the battle in Afghanistan, "people on other staffs at higher levels would call all the way down to my staff and get information and make suggestions." In the midst of battle, some officers back in the United States even called in asking for information that they could plug into their own generals' morning briefing, pestering soldiers in combat "for details that they presumed their bosses would want to know."[23]

Each of these tasking orders is tough to ignore. Not only do they originate from senior leaders, who can make or break careers, but also they tend to come in on a "priority basis." Generals around the world tend to use a logic that humorist Garrison Keillor cites in *Lake Wobegon Days*. Every single one of them considers his or her missions and orders "of above average" importance. But not everyone can be above average. This "flattening of the chain of command," summed up retired lieutenant general William Odom, causes "constipated communication channels" and "diarrhea of the email" that distracts troops from the mission at hand.[24]

At its worst, this pattern leads to the battlefield version of too many cooks spoiling the meal. A Marine officer recalls that during an operation in Afghanistan, he received wildly diverging orders from three different senior commanders. One told him to seize a town 50 miles away. Another said to seize just the roadway outside the town. The third ordered him not to "do anything beyond patrol five miles around the base."[25]

In this case, the officer ultimately chose to seize the town. A veteran of the 1991 Gulf War, he felt confident enough to take the career risk of going with his gut on selecting the right order to follow. But the rise of virtual command from afar threatens to hollow out the experience of those who will move into these

command roles in the future. Explains one former Predator squadron commander, "You may have some general officer sitting behind four Toshiba big screens [TVs] with greater knowledge of the battlefield from the distance. And maybe it works the first time when they intervene and save the day. But my worry is what happens with the next generation. What happens when that lieutenant, who learns thinking the guys in the back are smarter, becomes a colonel or a general. He'll be making the decisions, but not have any experience."[26]

Where this trend will end, no one is certain yet. Some worry that the ability to reach into the battlefield could even prove tempting to those outside the military. Retired marine Bing West expects that "in the near future . . . a president will say, 'Why do we need these 20 links in the chain of command?'" Enhanced connections could certainly help the commander in chief become better informed about the true situation on the ground but could prove catastrophic if civilian leaders are tempted to intervene, as West puts it, "trying to play soldier."[27] Referring to how Pres. Lyndon B. Johnson often tried to influence air operations in Vietnam, former secretary of the Air Force Michael Wynne similarly warned that "it'll be like taking LBJ all the way down into the foxhole."[28]

Digitally Leading

So how must commanders—and even more, the training and development programs that create our cadre of leaders—respond to this new phenomenon that enables them in power and reach but also can enable their worst instincts? Clearly, twenty-first-century generals need to bring certain skills to increasingly unmanned wars in order to be successful. New technologies are creating an environment "where the strategic, operational, and tactical levels of war can at times be so compressed as to appear virtually as a single function."[29] The downside of this "compression" of the battlefield is that it tempts officers to micromanage (the "tactical general" problem). However, officers who have what Carl von Clausewitz called the "eye of command," who can find the right balance, will achieve what retired lieutenant general Richard A. Chilcoat once described as "simultaneous awareness."[30] This is the "sweet spot" of future generalship. It involves having a good sense of what is going on at all levels of war and making the appropriate decisions at the right levels.

Developing this skill will not be easy. All the information collected, all the real-time requests, and all the general "diarrhea of the email" threaten to flood officers with data. Much like their corporate counterparts (often thought of as drones in their office cubicles), twenty-first-century generals fighting with drones will also have to cultivate the ability to manage their in-boxes.

Our professional-development system must put more focus on cultivating an ethic of "enlightened control." Generals literally will have the entire battle at their fingertips. With the new networks and technologies, they can watch nearly every action and make every minute decision. But they still do not have an infinite amount of time. At some point, the leader has to turn matters over to subordinates. Generals who can figure out when to intervene, when to delegate, and when to empower junior troops to act with initiative will enjoy much more success than those who don't trust their force to do anything without them. Striking this balance will become the essence of strategic leadership.

Leaders must also focus on developing the mental flexibility needed to guide a "learning organization" that adapts to changing circumstances in something beyond just a top-down manner.[31] Senior leaders not only must have open minds themselves but also willingly empower subordinates to wrestle with new concepts and technologies that they don't even understand. As one colonel writes, "I speculate that the digital general some 35 years from now might not just communicate differently but will actually *think differently* from his or her predecessors, because conceptual behavior itself is evolving during the Information Age" (emphasis in original).[32]

Although a general may no longer have to be as fit a fighter as the troops, the way Henry

V or Gustavus Adolphus was considered among the best warriors in his army, new technologies do impose certain physical requirements that commanders must cultivate in wartime. For one thing, generals should develop skills at using computers, e-mail, and other information technologies (beyond the ability to make a PowerPoint presentation)—something that once seemed an almost abhorrent concept to leaders. General Chilcoat once predicted, "To the strategic commander of the Information Age, the laptop computer, or its successor, will be a natural extension of his mind, as familiar as the telephone, map, and binoculars."[33] Events in Iraq have borne out his lessons.

Likewise, the fact that generals may not need the kind of physical fitness to wield a sword or match their troops in push-up contests does not signal the return of 300-pound-plus generals like nineteenth century commander Winfield Scott. Rather, stamina—not strength—now matters. Command has always been taxing, but it is now becoming a round-the-clock job, no matter the commander's physical location. Thus, generals now need the physical and psychological endurance of a young medical student on call in the emergency room.

Some of these changes might seem immense, but they will not supplant many of the qualities that made great generals in the past. For example, the idea of enlightened control (i.e., giving just enough guidance to officers closer to the scene, so that they can best decide what to do) is nothing new. The great Prussian generals of the nineteenth century called this *Führen durch Auftrag* (leading by task) as opposed to *Führen durch Befehl* (leading by orders). Their ideal was that the best general gave his officers the objective and then left it to them to figure out how best to achieve it. The most famous instance occurred before the 1864 Prussian invasion of the Danish province of Schleswig. The commanding general so trusted his officers that, supposedly, he only ordered that he wanted to sleep in the enemy's capital within the week.

Although this may be a bit too succinct for modern war, the example set by World War II's General of the Army George C. Marshall remains an apt model for twenty-first-century leaders. New inventions like the radio and teletype may have given him the ability to instruct from afar, but Marshall chose to set the broad goals and agenda. He had smart staff officers write up details of the plan but ensured that everything remained simple enough that a lieutenant in the field could understand and implement everything.[34] Similarly, Marine general James Mattis's guidance to his troops before the 2003 invasion of Iraq was just as brief, understandable, and worthy as a guide: "Engage your brain before you engage your weapon."[35]

General 2.0

But the questions of leadership don't just stop at the issue of how much leash commanders give their subordinates. Every decision in a military operation, be it the corporal in the field deciding whether to pull the trigger or Gen Dwight Eisenhower deciding whether to give the "go" for the D-day invasion, can be broken down into four basic parts, known in the military as the observe, orient, decide, act (OODA) loop. One gathers information, figures out the situation, issues orders, and takes action. Then, the whole cycle begins again.

But technology has shrunk the time inside this decision cycle. Because massive amounts of data come in faster, decisions have to be made quicker. This, for example, led to our turning over the defense against mortars and rockets at major bases in Iraq to the Counter Rocket, Artillery, and Mortar (C-RAM) automated gun system. Humans just couldn't fit into the shorter OODA loop needed to shoot down incoming shells and rockets.

Shortening of time in the decision cycle is not just for the trigger-pullers. The shrinking OODA loop is working its way up the chain to the generals' level. Marine general James Cartwright, former commander of US Strategic Command, predicted that "the decision cycle of the future is not going to be minutes. . . . The decision cycle of the future is going to be microseconds."[36]

Thus, many people think that one last, fundamental change may occur in the role of commanders at war. If the first step of technology's effect on command and control is to force officers to learn how to lead troops fighting from afar, and if the second is to require generals to figure out when to intervene directly in the battle or not, then the final may be figuring out just what command roles to leave to humans, and which to hand over to machines.

The world is already awash with all sorts of computer systems that we use to sift through information and decide matters on our behalf. Artificial intelligence (AI) in e-mail programs filters out junk mail, and AI systems trade billions of dollars on the stock market, deciding when to buy and sell based only on algorithms.

The same sort of "expert systems" is gradually being introduced into the military. The Defense Advanced Research Projects Agency, for example, created Integrated Battle Command, a system that gives military officers what it calls "decision aids"—AI that allows a commander to visualize and evaluate plans, as well as predict the impact of a variety of effects.[37] The system can help a command team building an operational plan to assess the various interactions that will take place in it. The system sees how changing certain parameters might play out in direct and indirect ways so complex that a human would find them difficult to calculate. The next phase in the project involves building an AI that plans an entire military campaign.

Real-Time Adversarial Intelligence and Decision Making, the military-intelligence-officer version of this system, is an AI that scans a database of previous enemy actions within an area of operations to "provide the commander with an estimate of his opponent's strategic objectives."[38] Similarly, "battle management" systems exist that not only provide advice to human commanders on actions an enemy might take, but also suggest potential countermoves, even drawing up the deployment and logistical plans for units to redeploy, as well as creating the orders an officer would have to issue.[39] The Israeli military is fielding a "virtual battle management" AI whose primary job entails supporting mission commanders but can also take over in extreme situations (e.g., when the number of incoming targets overwhelms the human).[40]

Developers behind such programs argue that the advantage of using computers instead of humans is not only their greater speed and processing power, but also the absence of human flaws—they lack our so-called "cognitive biases."[41] Because searching though reams of data and then processing it takes too much time, human commanders without such aids must filter which data they want to look at and which to ignore. This inevitably leads them to skip information they don't have time to cover. Humans also tend to give more weight in their decisions to the information that they see first, even if it is not representative of the whole. This produces something called a "satisficing" result—a satisfactory, though not the optimal, answer. One Air Force officer planning air strikes in the Middle East, for example, describes how each morning he received a "three-inch-deep" folder of printouts with that night's intelligence data, which he could only skim quickly before he had to start assigning missions. "A lot of data is falling on the floor."[42]

Emotions also can shape decisions, even the most major command decisions in war. Recent neurological findings indicate that emotions drive our thought processes, including leaders' political decisions, to a greater extent than previously recognized.[43] That is, our idealized concept of how decisions are made in war and politics—rationally weighing the evidence to decide how and when to act—does not tell the full story of how human leaders' brains actually work.

Studies have shown how two underrated factors frequently shape strategic choices in war.[44] The first—powerful emotional experiences that leaders had in the past—often steered their decisions, sometimes decades afterwards, including even decisions on whether to go to war. The second factor concerns how body chemistry affects one's state of mind. People with high levels of testosterone, for instance, are more likely to exhibit aggressive behavior and risk taking; Gen George Custer

and Gen George Patton seem classic examples. By contrast, those with low levels of serotonin are more prone to depression and mood swings, typical of both Hitler and Pres. Abraham Lincoln.[45] As these examples show, emotions can shape a leader's decisions both for better or worse, so to pull emotions out of the equation could yield widely divergent results.

Setting aside the worry that such artificial decision systems are what enable robots' takeover of the world in sci-fi movies like *The Terminator*, machine intelligence may not be the perfect match for the realm of war for the very reason that it remains a human realm, even with machines fighting in it. "The history of human conflicts is littered with examples of how military forces achieved results that no algorithm would have predicted," according to an Air Force general.[46] And he is right. Command may seem just like a game of chess to some, but war doesn't have a finite set of possible actions and a quantifiable logic of zeros and ones. Instead, "in war, as in life, spontaneity still prevails over programming."[47]

Even so, the Pentagon's work on such programs continues. Few see robot generals anytime soon, but many do think that the most likely result for future command and control in the decades ahead is a parallel to the Department of Defense's "war fighter's associate" concept, which is becoming a part of the Army's Future Combat Systems plans. The latter call for US units to have mixed teams of soldiers and robots fighting together in the field. We may soon have to wrestle with a situation in which their future commanders back at the base may have a staff that mixes advice from human officers and AI as well. Retired colonel James Lasswell of the Marine Corps Warfighting Lab thinks that the various technological decision aids will likely evolve into an AI "alter ego" for the commander. A sort of artificial aide-de camp to future generals, this technology would "automatically send and collate information for him to have at his beck and call."[48] As with the issue of tactical generals, even though this outcome may enable leaders, it also opens up a whole new array of questions that once seemed science fiction but may well lie in our not-too-distant future.

Robot Conclusions

When exploring the future role of machines in war, people often want to focus on the obvious issues of whether a robot should be armed or how much autonomy should be given to keep the "man in the loop." But it is a far more complex world that we are entering.

By providing generals insight into the front lines—something they have lacked since the age of gunpowder and telegraphs—new technologies like unmanned systems are lifting many of the burdens of command. But in giving newfound reach and visibility to the commander, they also add many new challenges. Most importantly, these technologies present a serious test for simultaneously managing an amazing array of possibilities and information while resisting the temptation to micromanage subordinates.

But the trend doesn't stop there. Human commanders and their staffs may even one day face a challenge to their own role as the pace and complexity of war continue to grow.

In short, where the ever-expanding role of machines in war will one day take us is a question that used to only be suitable for science-fiction conventions. Today's technologies, however, are bringing this question to our real-world battlefields. ❑

Notes

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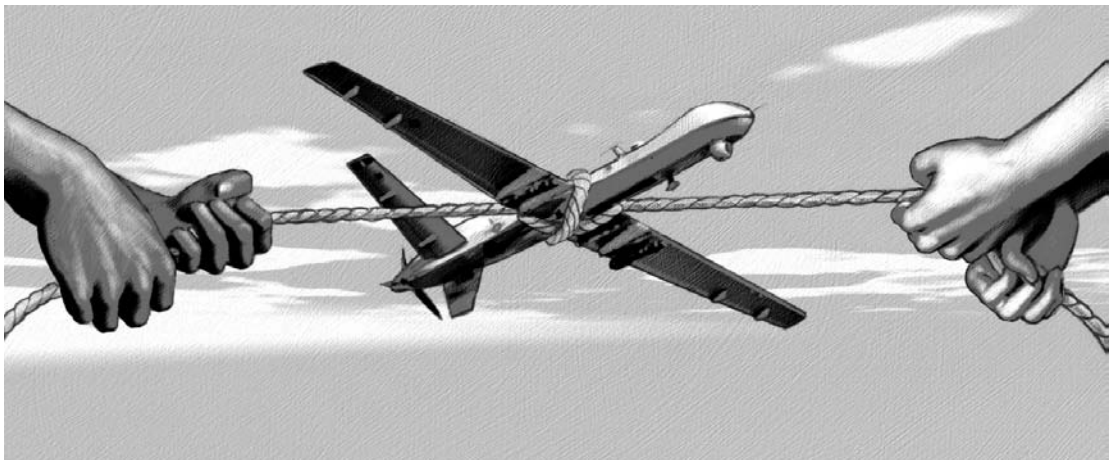
The Army's "Organic" Unmanned Aircraft Systems

An Unhealthy Choice for the Joint Operational Environment

Maj Travis A. Burdine, USAF

The rapid increase in demand for long-duration intelligence, surveillance, and reconnaissance assets, coupled with the Air Force's inability to meet that demand, has caused the Army to initiate procurement of its own extended-range, multipurpose, armed, "organic" unmanned aircraft systems (UAS) that will operate independently from the joint force air component commander's centralized control or tasking authority. The author discusses the Army's decision to parcel out these assets to division commanders and questions whether organic Army UASs provide the joint force commander the best solution for achieving US military objectives.



"Grunt 21, this is Cyclops 55, ready for check-in," says the pilot of the US Air Force Predator unmanned aircraft system (UAS) over the radio.

Grunt 21, an Army ground unit in the combat zone, replies, "Cyclops 55, this is Grunt 21. Go ahead with check-in."

The pilot, located in a ground control station in Las Vegas, Nevada, says, "Cyclops 55 is a single MQ-1B Predator, currently overhead at 12,000 feet, armed with two Hellfire missiles, 21 hours of playtime, with infrared-pointer and laser-designator capability. Sensors are on the target house, ready for situation update."

"Cyclops 55, Grunt 21 copies all. Situation update is as follows: the ground commander has been waiting two days to get Air Force UAS support over this target house. We plan to execute a raid in two hours. We are looking for a high-level insurgent commander and a weapons cache."

"Cyclops 55 copies all."

Just prior to the planned raid, the UAS crew hears a call for help from Alpha 6, an Army special forces team located 15 miles away from Grunt 21. "Alpha 6 is being engaged. Multiple friendlies killed in action. Requesting immediate CAS [close air support]!"

Knowing that troops in contact (TIC) are the joint force commander's (JFC) highest-priority objective, the UAS crew immediately conveys the TIC information to the combined air and space operations center (CAOC) and the special forces operations center. The CAOC informs Cyclops 55 that, at three minutes away, it is the closest asset.

The CAOC immediately directs the crew to support the CAS request. Cyclops 55 informs Grunt 21 that it is leaving its station to respond to a TIC and calls the airspace controller to request immediate clearance at 12,000 feet to the coordinates of Alpha 6.

"Cyclops 55, request denied. Army restricted operating zone [ROZ] Charlie is active directly in your flight path, surface to 25,000 feet."

"Cyclops 55 is unable to stand by. We are responding to a TIC with US casualties. Need immediate clearance at any altitude!"

"Unable to clear you for that airspace at this time. I do not own that airspace. It was chopped to the Army earlier this morning, and the status is unknown. We are trying to contact the Army on a separate channel. Meanwhile, I will arrange a longer alternate route."

While working the airspace problems, Cyclops checks in with Alpha 6 for a situation update. With gunfire in the background, Alpha 6 reports, "We hit a roadside bomb and were ambushed by an unknown number of insurgents. We are taking fire and need immediate CAS!"

After 13 minutes of working airspace issues, Cyclops 55 finally declares "on station" and receives the target information from Alpha 6.

"Cyclops 55, this is Alpha 6. You are cleared hot. Danger close!"

"Weapons away! Sixteen seconds to impact."

As the missile destroys the target, the Predator liaison officer in the CAOC receives a message from the original Army unit that was supposed to have Predator coverage all day: "Cyclops 55, there is an Army colonel on the phone with the joint force air component commander [JFACC], screaming about how you botched the entire operation by leaving his unit without his permission. He cancelled his entire ground operation because you failed to support him by departing your orbit . . . again."

THIS SCENARIO HIGHLIGHTS UAS challenges in the joint operational environment. The rapid increase in demand for long-duration intelligence, surveillance, and reconnaissance (ISR) assets, coupled with the Air Force's inability to meet that total demand, has caused the Army to initiate procurement of its own extended-range, multipurpose, armed, "organic" UASs that will operate independently from the JFACC's centralized control or tasking authority.

Is the Army's decision to parcel out theater-capable UASs to division commanders the correct way to apportion the limited supply of these high-demand assets? Do organic Army UASs provide the JFC the best solution to achieve

US military objectives? The Army's decision to develop and field organic theater-capable UASs is not in the best interest of the US military; however, there are ways to integrate these Army UASs into the joint operational environment.

Background

UASs give the JFC the ability to gain situational awareness of the battlefield and simultaneously project power. According to one key document, "information is the key enabler to today's joint warfighter," and ISR is still the number-one Department of Defense (DOD) priority for combatant commanders.[1] UASs deliver real-time, full-motion video and signals intelligence directly to tactical users and strategic decision makers, while "maintaining a degree of covertness."[2] These aircraft have the unique ability to sustain long-duration missions (in excess of 21 hours) by changing crews in the middle of a sortie. They provide "unrelenting pursuit" of the enemy while reducing the time required to prosecute "actionable intelligence."[3] The JFC can wield this capability without air-refueling tankers or support from combat search and rescue. Additionally, most Air Force Predator crews conduct operations from the United States via remote split operations (RSO).

The Air Force's MQ-1 Predators and MQ-9 Reapers fly 24-hour combat air patrols (CAP), supporting the JFC in US Central Command's area of responsibility. Each CAP provides armed reconnaissance with full-motion video at a fraction of the cost of manned assets. According to the 432d Wing at Creech AFB, Nevada, Predators and Reapers in 2007 and 2008 launched 247 Hellfire missiles (95 percent direct hits), dropped 71 bombs, supported 834 TICs, and provided armed ISR during 2,509 raids on enemy compounds in both Operation Iraqi Freedom and Operation Enduring Freedom, while burning less than four gallons of fuel per hour.[4] As demonstrated in the scenario that began this article, long-duration, centrally controlled, theater-capable UASs can also be dynamically retasked to higher-priority objectives within seconds. From proactive events (raid support, target development, direct attack) to reactive events (TICs, detection of roadside bombs), the demand for UASs continues to grow.[5]

Growth

The number of requests for UASs is staggering. In a memorandum to all his commanders, Gen T. Michael Moseley, former chief of staff of the Air Force, mentioned "a continued and apparent[ly] insatiable demand for our UAS capabilities," before outlining his plan to increase the Air Force's UAS capacity.[6] Predators have flown over 500,000 total hours since 1995, currently fly over 16,000 hours per month, and support the JFC with 31 CAPs in Central Command's area of responsibility.[7] To put this in perspective, three additional CAPs are the equivalent of building an entire fighter squadron's worth of aircrews.[8] Annual requests for full-motion video have increased by 300 percent.[9] According to the Air Force UAS Task Force, it took 12 years for Predator to reach the first 250,000 flight hours and only 20 months to reach the second 250,000 hours.[10] Although the Air Force's UAS capacity is doubling every two years, it still cannot keep up with current demands from war fighters (fig. 1).[11] Effective integration of emerging capabilities and systems into the joint operational environment for UASs is vital to the future success of US joint combat operations.

MQ-1B Predator versus MQ-1C Sky Warrior

The Air Force and the Army have developed two distinctly different constructs for operating essentially the same airframe. Both systems are theater-capable, medium-altitude, armed, multirole unmanned aircraft manufactured by General Atomics Aeronautical Systems (fig. 2). Both have two lasers (one for guiding munitions and one for illuminating targets at night), infrared cameras (for night operations), and electro-optical cameras (for color daytime video); moreover, both aircraft fly either line of sight or beyond line of sight with a satellite link, and both appear almost identical. The Air Force has flown Predators since 1995, while the Sky Warrior is still in develop-

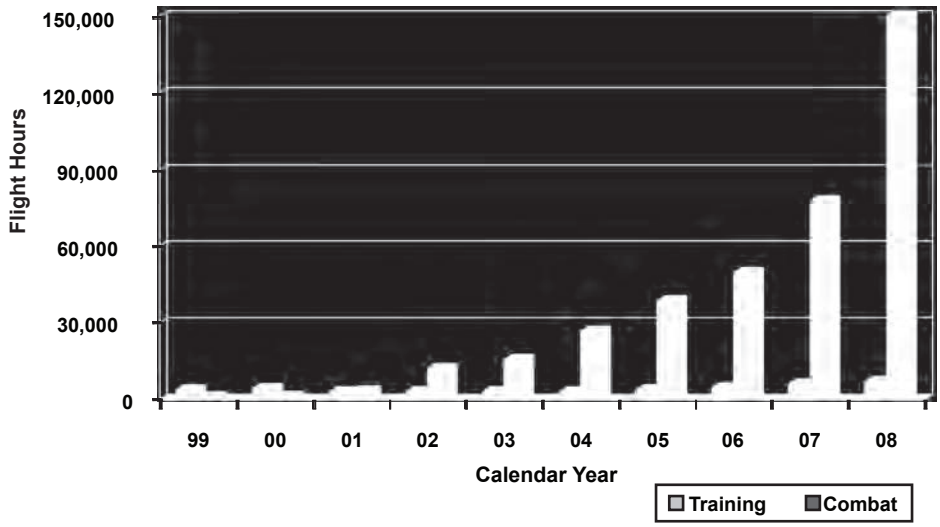


Figure 1. Growth of UASs: The MQ-1B Predator's flight hours. (From information provided by Headquarters Air Combat Command/A8U1.)

Capability	Predator (Fielded)	Sky Warrior (Preproduction)
Length	27 ft.	28 ft.
Wingspan	55 ft.	56 ft.
Weight	2,300 lb.	3,200 lb.
Endurance	40 hrs.	30+ hrs.
Max Altitude	25,000 ft.	29,000 ft.
Max Speed	120 knots	135+ knots
Max External Weight	300 lb.	500 lb.
Weapons	2 Hellfire Missiles	4 Hellfire Missiles
Payloads	- Electro-Optical/Infrared (EO/IR) Cameras - Synthetic Aperture Radar (SAR) Capable	- EO/IR Cameras - SAR - Signals Intelligence - Communications Relay
Fuel	Aviation Gasoline	JP-8 Heavy Fuel
Auto Takeoff/Landing	No	Yes
Ground Control Station (GCS)	Common between MQ-1/9	Army Universal GCS

Figure 2. Comparison of Predator and Sky Warrior. (From information available at General Atomics Aeronautical, http://www.ga-asi.com.)

ment. Sky Warrior, however, can carry two extra missiles and fly 4,000 feet higher than Predator (see fig. 2).[12]

Service Perspectives

The Air Force and Army have contrasting views of UAS employment. Department of Defense Directive 5100.1, *Functions of the Department of Defense and Its Major Components*, defines the functions of the services according to Title 10, *US Code*.[13] The functions of the two services are clearly different by design. However, the need for ISR, coupled with the advent of UASs, has blurred the boundaries between those functions.

Air Force

The Air Force has over 60 years of experience flying theater-capable medium-to-high-altitude manned aircraft, as well as over 14 years and half-a-million hours of Predator flying time. The Predator, the "Wright Flyer" of UASs, became the first production UAS in the Air Force's inventory. The Air Force and Federal Aviation Administration (FAA) use only rated pilots (or navigators with civilian commercial instrument ratings) to operate the larger theater-capable UASs because the skill set required to fly them in the joint operational environment is nearly identical to that required of pilots of manned assets.[14] Skilled pilots mitigate the risks associated with flying UASs in complex, crowded airspace and dropping precision weapons in close proximity to friendly forces.

To meet the overwhelming demand for ISR while decreasing the need for constant deployments, the Air Force developed the RSO concept to enable aircrews to perform theater operations from their home station. RSOs reduce the expeditionary footprint by enabling the pilot to control the aircraft via satellite link.

Air Force doctrine states that centralized control of limited airpower assets is essential to maximize aviation's strengths of range, speed, mass, and lethality.[15] In a memorandum to the chief of staff of the Army, the former chief of staff of the Air Force remarked that "interdependence has become the standard for joint operations and is a major priority for the Air Force."[16] Air Force doctrine calls for the theater air control system, operated through the CAOC, to manage the air war.[17] Centralized control of the entire airspace and all theater-capable assets provides massed "airborne ISR and firepower anywhere across the battlefield in minimum time."[18] The Air Force model responds to the theater commander's priorities by optimizing range, speed, and payload to deliver theaterwide effects. However, this construct often poses serious challenges for ground commanders.

Army

The primary purpose of Army aviation is to support ground-maneuver commanders and their objectives.[19] The Army has struggled to fulfill ever-growing demands for ISR following the terrorist attacks of 11 September 2001. In September 2007, Gen David H. Petraeus told Congress that "unmanned aircraft have proven invaluable in Iraq."[20] As the Army transformed into a lighter, more technologically reliant force, the capabilities that UASs bring to the ground fight became vital.

Simultaneously, the Air Force historically has failed to meet the Army's growing UAS and ISR needs, due to both a lack of assets and the necessity of fulfilling higher-priority requests such as special operations and TICs. Army colonel James G. Rose, commander of the Army Intelligence Center, observed that "current and envisioned non-Army UAV [unmanned aerial vehicle] systems are limited in their ability to provide responsive support to various requesting ground-maneuver units based on limited assets." Furthermore, he noted that "when units were successful in requesting UAV support, communications problems, delays in data receipt, and retasking procedures/authority decreased the effectiveness and responsiveness of the UAV system."[21]

In 2004 the Army decided to solicit bids for an extended-range/multipurpose UAS to replace the aging Hunter UAS and fulfill division commanders' requirements for dedicated, reliable, and organically controlled ISR. It did so partly because limited UAS support "is mul-

tiplied by the supporting units' lack of direct control and direct tasking authority over the UAV asset."[22] The Army contends that only UASs controlled by the division commander will be immune from last-minute, higher-priority taskings. It also strongly believes, based on success with smaller tactical UASs, that enlisted "operators" should fly these systems. Therefore, the only way to ensure that it has them is to own and control them.

Issue Analysis

To find solutions to the contrasting Air Force and Army UAS perspectives, one must review the following five contentious issues from both points of view. Additionally, it is important to acknowledge the change in environment over the past five years, particularly the growth in the Air Force's UAS capacity and the increased experience of both services.

Command and Control

According to Air Force doctrine, centralized control and decentralized execution are critical to the employment of airpower because they have "been proven over decades of experience as the most effective and efficient means of employing air and space power."[23] The CAOC weapons system, as part of the theater air control system, "provides operational-level C2 [command and control] of air and space forces" capable of coordinating thousands of sorties per day.[24] Historically, there has never been enough airpower—including UASs. To gain maximum capability from limited air assets, a single Airman—the JFACC—should be responsible to the JFC for all such assets capable of operating throughout the joint operations area.

The Army intends to give operational control of Sky Warrior to the joint force land component commander, who will delegate tactical control to division- and brigade-level commanders. Operational and tactical control of Predator, on the other hand, resides with the JFACC for centralized tasking. The Army's current plan calls for each Army division commander to receive 12 Sky Warrior aircraft.[25] This level of control explicitly prohibits the JFACC from using these assets for integrated JFC objectives, effectively mitigating the positive attributes of mass and maneuver for dynamic situations.

After reviewing the current UAS situation, retired Army general Barry R. McCaffrey wrote, "We are confusing the joint battle space doctrine. Air Component Commanders should coordinate all UAVs based on Combatant Commander situational war-fighting directives."[26] Air Combat Command (ACC) and the Army Training and Doctrine Command recently developed a "Predator and Sky Warrior UAS Enabling Concept" outlining how the JFC will employ these two similar aircraft. It allows the JFACC to manage most assets for air-centric campaigns, giving the organic Army assets back to the joint force land component commander for predominantly ground-centric operations.[27] This concept is a positive sign that the Army and Air Force can employ a joint, interdependent solution that best meets the needs of the JFC.

Military leaders since World War I have tried various constructs to manage limited airpower assets—each with varying degrees of success. In the North African battle at Kasserine Pass during World War II, the Germans decimated American ground forces. Army doctrine at the time tied airpower, as an auxiliary force, to the corps commanders. Airmen commonly used the phrase "penny packets" when referring to "the improper subdivision and parceling out of airpower to ground forces," a procedure that failed miserably.[28] While German planes attacked Gen George Patton's troops, "some fighters and bombers were not even tasked" to help out. The few Allied aircraft that did fly were unable to coordinate their efforts. British air marshal Arthur Coningham declared that "the strength of airpower lies in its flexibility and capacity for rapid concentration."[29] Airpower did not arrive when ground commanders needed more air help than they could organically provide themselves. The ground commander's inability to coordinate and mass airpower over the enemy caused the death of many US soldiers. Air Marshal Coningham added, "It follows that control must

be centralized in an air commander and command exercised through Air Force channels; and air forces must be concentrated in use and not dispersed in penny packets." Within three weeks of returning from Africa, the War Department published Field Manual 100-20, which declared that "the inherent flexibility of airpower is its greatest asset. . . . Control of available airpower must be centralized and command must be exercised through the air force commander if this inherent flexibility and ability to deliver a decisive blow are to be exploited."[30] The success of the major combat phases of Operations Desert Storm and Iraqi Freedom demonstrated the lethality of joint airpower managed by a single Airman. The Army has a penchant for lessons learned, so it would be a travesty if it had to relearn past lessons by penny packeting the Sky Warrior to division commanders.

Rated Pilots versus Operators

The most apparent divergence between the Army's and Air Force's UAS models is the Army's plan to fly the Sky Warrior with enlisted "operators." The Air Force contends that only officer rated aviators should fly Predators. General Atomics has committed to incorporating new technology into Sky Warrior that will reduce the Army's need for traditional pilots. These advances include an automatic takeoff-and-landing system, an automatic sense-and-avoid capability to help prevent midair collisions, and an improved, user-friendly ground control station. Simultaneously, to get more capacity out of its existing platforms, the Air Force is pushing increasingly complex upgrades, such as advanced weapons and the operation of multiple aircraft by one pilot. The Air Force uses the skill and experience of fully qualified pilots to safely fly UASs within 1,000 feet of manned aircraft, a feat regularly required by the current operational environment.[31] As the joint community continues to demand greater coverage and increased capabilities from UASs, we must have well-trained "pilots" flying them. The Air Force stood up the first UAS Weapons School at Nellis AFB, Nevada, in September 2008 in order to continue to push the upper limits of UAS capabilities so vital to the service's core mission requirements.[32]

Although we can accept risks in combat airspace, major legal issues exist for nonpilot operators flying UASs in both US and international airspace. According to the FAA, "a person may not act as pilot in command or in any other capacity as a required pilot flight crew member of a civil aircraft of the U.S. registry, unless that person has a valid pilot certificate." Furthermore, "because the FAA has determined that UAS are civil aircraft . . . [they] must be operated by a pilot."[33] The rules are the same in foreign airspace. Annex 13 of the International Civil Aviation Organization Convention states that "UASs are aircraft," thereby subject to the same rules and regulations as manned aircraft.[34] For example, to fly above 18,000 feet in the United States (the altitude varies by country), pilots must have an instrument rating. All Air Force pilots maintain an instrument qualification, allowing them to fly above 18,000 feet. The former chief of staff of the Air Force cited the requirement for all of the Air Force's UAS pilots to be "credentialed" to fly anywhere in the world as one of his reasons for cancelling the first Predator nonpilot test program.[35] Both the FAA and International Civil Aviation Organization have declared that the rules applying to manned aircraft are the same for UASs. The DOD and JFC should comply with these regulations. A midair collision between a large UAS and a civilian airliner would have strategic repercussions for the joint fight, especially if nonpilot operators were involved.

Airspace Control and Deconfliction

UASs make airspace control and aircraft deconfliction significantly more difficult in the joint air domain. High-flying, long-loitering, and organically controlled Army UASs vastly complicate the JFACC's limited and crowded airspace dilemma.

The airspace control plan for the Army's organic UASs degrades the combat effectiveness of the joint force. The Air Force's theater air control system and the Army's airspace C2

systems meet at a horizontal plane in the joint air domain called the "coordinating altitude" (fig. 3). Recent combat operations have placed that altitude at approximately 3,000 feet above the ground.[36] All aircraft above the coordinating altitude must fly in a more centralized, positive-control manner, falling under the procedures and special instructions set by the JFACC.[37] The newer, more capable Army UASs (like Sky Warrior) operate at much higher altitudes than that service's traditional aviation assets. The Army's desire to fly its noncentrally managed aircraft in the JFACC's centrally managed airspace (above the coordinating altitude) is one of the major contentious issues degrading the effectiveness of joint combat.

The Army solution to this airspace-coordination issue calls for creating a restricted operating zone around the UAS. As depicted in figure 3, the ROZ is typically a large cylinder of airspace, from the surface to an altitude safely above the UAS, that excludes other airspace users. This allows the Army to fly without using centralized positive-control procedures. The disadvantage of this model is that it uses airspace inefficiently, preventing airspace controllers from maintaining situational awareness within the ROZ and making it difficult for other air assets to navigate through the joint airspace. According to joint doctrine, "efforts should be made to integrate UAVs with manned flight operations to enable a more flexible and adaptable airspace structure."[38] Using the ROZ as a UAS airspace-control measure represents a step backwards towards independent and deconflicted operations, which lack the synergy that properly integrated airpower should bring to the joint fight.

Many of the Army's organic UASs fail to integrate into the JFACC's airspace plan, making air defense difficult. Historically the JFACC (or CAOC) has little situational awareness of air operations below the coordinating altitude or inside the ROZs. The Army's organic aviation assets such as helicopters and UASs take off, land, and fly at the discretion of the ground-maneuver commander. This disconnect with the JFACC fails to provide a common operational picture, making air defense virtually impossible—historically not a problem due to US air supremacy. In Iraq, improvised explosive devices (IED) have killed more ground soldiers than any other threat—over 60 percent of the total—and the enemy, no doubt, will convert inexpensive UASs into airborne IEDs.[39] To support the joint fight, the

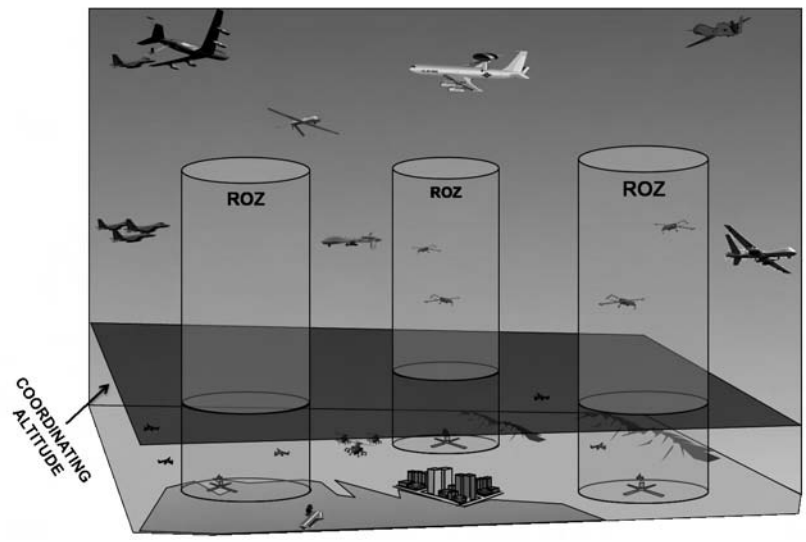


Figure 3. The restricted operating zone and coordinating altitude

JFACC, as the designated area air defense commander, must be able to integrate all airborne assets into one system.

Service Interdependence

Joint interdependence offers the best solution to allow the United States to win future wars in an environment of significantly constrained resources. Lt Gen David Deptula highlights the progress thus far: "Goldwater-Nichols helped move the American military from the independent, barely deconflicted operations of the early 1980s to the sustained interoperability that has proved so effective [today]."[40] But it is time to make the next step to interdependence.

The JFC cannot afford to have two independent and barely deconflicted airspace control systems or two redundant, separately developed weapons systems. Joint doctrine states that "joint interdependence is the purposeful reliance by one Service on another Service's capabilities to maximize complementary and reinforcing effects."[41] According to Army Field Manual 1, "joint interdependence allows each Service to divest itself of redundant functions . . . [and] reduces unnecessary duplication of capabilities among the Services . . . [to achieve] greater efficiencies in their respective domains."[42] The current diverging plans for Predator and Sky Warrior do not follow joint interdependent principles.

The Air Force's repeated failure to meet the needs of the Army has reduced trust between the two services. Consequently, the Army is scheduled to spend $1.02 billion to research, develop, test, train, and field the Sky Warrior UAS—a capability that already exists in the Air Force.[43] Meanwhile, the Air Force simultaneously develops, trains, and fields a temporary force of Airmen to augment the Army by performing traditional Army functions, such as guarding prisoners, driving convoys, and conducting civil affairs, having deployed over 22,000 Airmen since 2004 to perform such Army functions.[44] Congress has already initiated a comprehensive review of service roles and missions to determine if it is in the best interest of the country to have the Army build an air force while the Air Force builds a small land force. Only a proactively designed interdependent system will allow American service members to deliver the efficient combat performance that American technology promises to deliver.

Deployment Footprint

An integral part of service interdependence lies in achieving greater efficiency by optimizing the expertise of each service.[45] Flying theater-capable UASs from the United States offers the best example of how the Air Force's lessons learned from a fielded system promote efficiency through centralized control. According to ACC, remote split operations represent a force multiplier that provides a 200 percent increase in armed ISR capability to the JFC with almost no extra manning or aircraft. For example, without RSOs, it takes 240 total aircrew members (pilots and sensor operators) to sustain four CAPs in-theater—80 deployed, 80 in garrison, and 80 in preparation for deployment. With RSOs, ACC maintains four CAPs indefinitely with only 86 total aircrew members—80 flying combat missions (while in garrison) and six deployed.[46] RSOs allow over 85 percent of trained crews to support the JFC indefinitely.[47]

The Army system dedicates a combat aviation brigade, including a Sky Warrior company, to each division in the traditional deployed manner—with only one-third of the force deployed at a time.[48] According to the Air Force's UAS Task Force, the JFC would receive an almost 100 percent increase in CAPs by applying the Air Force's RSO model to the planned Army Sky Warrior program. The current Sky Warrior plan would provide 21 CAPs to Central Command. By applying the RSO model, that number increases to 40 long-term, sustainable CAPs.[49]

Army leaders argue that organic CAPs of Sky Warriors supporting the division commander will be more effective than RSO CAPs. An Army publication notes that "dedicated UAS at brigade level will increase effectiveness of operations by providing more responsive and more detailed reconnaissance."[50] The Army contends that requesting UAS support in the

Air Force's method of centralized control is too slow and carries too much risk of having the asset diverted to other priorities. It also believes that RSOs negatively impact effectiveness due to the communication degradation caused by the 8,000 miles between crews and ground commanders. Finally, the Army argues that in order to fight as a cohesive unit, the aircrew needs to deploy with the units it supports, so as to "feel" the intensity and tempo of the day-to-day fight.[51]

These concerns are warranted; however, it is unlikely that the ground commander will be colocated with the UAS crews due to Sky Warrior's runway-length requirements. The Army will use UAS communication methods similar to those the Air Force uses today, such as radio, chat, phone, and e-mail.

Recommendations/A Solution: The UAS Capability Envelope Model

It is time for a comprehensive review of airpower management in the joint operational environment. The rapid proliferation of theater-capable UASs has brought this issue to a point that requires action. Realistically, the Army will not abandon the Sky Warrior program. Despite the negative effect on the joint operational environment, Sky Warrior and other (non–Air Force) theater-capable UASs will proliferate. The secretary of defense must convey to the joint community a clear and achievable system that addresses the five contentious issues highlighted above. Only then will the DOD maximize taxpayer dollars in a truly joint, efficient, and effective plan that meets the needs of both the Army and the JFC.

UASs will continue to provide increased combat capabilities. Both the Army and the Air Force should develop their theater-capable UASs as fast as possible, with their respective sights set at opposite ends of the UAS complexity envelope (fig. 4). The Army should develop its UAS force, focusing on the higher-demand tasks found at the lower end of the complexity spectrum (e.g., small-unit situational awareness, battlefield awareness, communications relay, and rotary-wing teaming/target acquisition). The Air Force should concentrate its efforts on the requirements aligned with its core function found at the upper end of the complexity envelope (e.g., air superiority, global precision attack, combat search and rescue, C2, and global integrated ISR). Additionally, the Air Force should continuously expand its end of the envelope with the addition of highly complex UAS tasks such as suppression of enemy air defenses, air-to-air engagement, and airborne forward air control. This interdependent model would provide maximum capability to combatant commanders while capitalizing on the strengths of the respective services. In order to build this UAS capability envelope, we must first resolve the five contentious issues, discussed previously.

Implementing the following recommendations would help resolve the contentious issues:

1. We must treat theater-capable Army UASs the same as other similarly capable fixed-wing manned aircraft (regardless of service). Systems such as Sky Warrior must operate under the same nonorganic centralized control system as the JFACC's other air assets. The Army will still operate the systems and regularly support its own ground commanders' taskings, but the JFACC would have situational awareness and retain retasking authority to capitalize on the strengths of centrally managed airpower. The division commanders can retain their smaller, less capable assets but would have to compete for the theater-capable assets with the rest of the joint community. Centralized control of all theater-capable aircraft is feasible if the Army can clearly articulate its required baseline requirements to the JFC.

2. To resolve the "pilot" versus "operator" issue, we must ensure that all personnel who control UASs are pilots in the traditional sense. At a minimum, the Army's UAS training plan must include training equivalent to that required to earn a basic civilian pilot's license. In addition, Army pilots would need an instrument

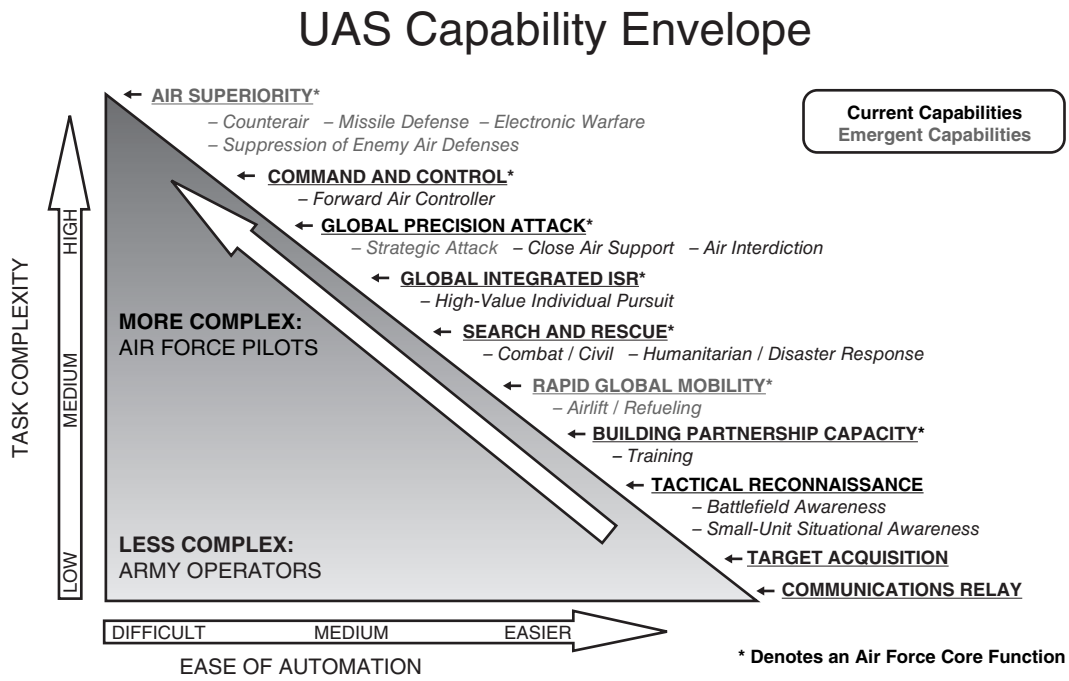


Figure 4. Air Force and Army UAS interdependence model

rating to fly at high altitude or in clouds. This policy would assure that all aircraft flying in the joint operational environment are legal and safe, as was the case prior to the advent of Army UASs.

3. Rather than protect high-flying Army UASs (like Sky Warrior) in the highly inefficient ROZs, we must see to it that airspace controllers actively manage those aircraft. ROZs dedicate an inordinate amount of airspace to each aircraft and drastically complicate the JFACC's airspace plan. The joint community must make ROZs the exception instead of the rule.

4. We must realize that the effective way to solve the Army's demands for UASs in-theater involves placing more of them in the joint fight through the RSO model. Flying UASs from the United States via the RSO system has tripled the number of the Air Force's theater-capable assets available to the JFC. The Sky Warrior system should adopt the RSO model and thus provide the greatest capability to the joint environment.

The Army's adoption of the preceding recommendations will result in service interdependence. If the two services focus their efforts on their respective ends of the UAS capability envelope, then a truly interdependent system will prevail. Only then will aviation assets in the joint operational environment be able to satisfy the JFC's aviation-related objectives.

Conclusion

Airmen and soldiers alike must put service rivalries aside, think creatively, and work together to solve today's problems. The current UAS C2 system is not capable of handling a significant number of theater-capable UASs flown by "operators" in a decentralized man-

ner in airspace that excludes other air assets. To fully utilize the potential of this new technology, the DOD must develop a single interdependent system capable of maximizing the joint operational environment. The day the enemy starts flying remotely operated flying IEDs will mark the first time in over 50 years that the Army will need to worry about enemy threats from the air. It would be tragic if the United States lost air superiority due to the services' unwillingness to agree on one seamless model for the joint air domain.

Joint doctrine tells us that "the synergy that results from the operations of joint forces maximizes the capability of the force."[52] The Army's proposed Sky Warrior model does not capitalize on jointness. We must resolve the five issues dealing with the joint operational environment, highlighted by comparing the Air Force's Predator to the Army's Sky Warrior. The joint battlespace is starting to suffer, and matters will only get worse. The Army and the Air Force can no longer "agree to disagree" on the UAS issue because risks to the joint fight are too high. The secretary of defense must make the tough decision that "going organic" with theater-capable Army UASs is unhealthy for the joint operational environment. ❑

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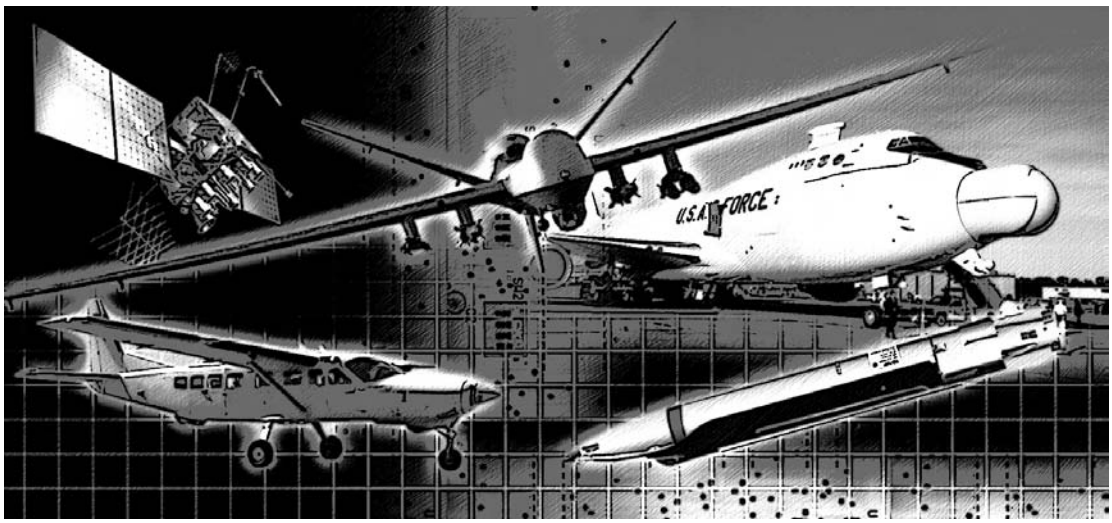
Airpower Trends 2010

The Future Is Closer Than You Think

Col John D. Jogerst, USAF, Retired

The author examines the state of airpower in the near future by addressing three broad areas in which radical change has already occurred. First, he shows that close air support has undergone a revolution in efficacy by improving networked coordination, using simpler delivery systems, and developing one-shot-per-target capabilities. Second, he examines advances in unmanned aircraft systems and discusses the impact of these platforms. Third, the author notes that airborne laser systems and other directed energy weapons stand poised to deliver near-instantaneous effects from unparalleled standoff distances. Ultimately, he argues that these systems are alternatives to, not additions to or adjuncts of, the manned force.



Technologies in place today have produced unmanned systems capable of replacing manned aircraft. Will we react to the challenge or act on the opportunity?

THE AIR FORCE has always seen itself as the force of the future. We live in a future that our predecessors built—with jet aircraft, missiles, operations from space, precision munitions, and, now, cyberwarfare. However, our record of innovation in using those technologies is less impressive. Jet fighters fought like fast biplanes of World War I vintage until Col John Boyd developed the fundamentals of energy maneuverability in the 1960s. Even then, it took another decade for Colonel Boyd's supporters—his fighter

mafia—to implement the concepts throughout the Air Force.[1] Practical precision munitions, introduced during the Vietnam War, initially offered nothing more than a way to destroy fixed targets without the 1,000-plane raids of World War II. Col John Warden's revival of the strategic-web targeting theory in his book *The Air Campaign: Planning for Combat* (1988) explicitly set out the revolutionary nature of this capability. The debate continues today with the (ongoing) development of the theory of effects-based operations.

Tactics in the field lead institutional innovation. This traditional path makes for good doctrine but is slow—glacial in peacetime—and seldom anticipates change. There is much truth to the saying that doctrine is about fighting the last war. Faced with the challenge of a new conflict, our young airmen (as well as soldiers, sailors, and marines) are adept at solving problems with the tools and technologies at hand. Eventually, these innovations may find their way into service doctrine. The pace of doctrinal change seems locked to generational changes in Air Force leadership. Must we wait for today's captains and majors fighting in Iraq/Afghanistan to be promoted before we come to grips with the future?

Technologies now reaching the flight line or already in combat can radically alter the way we fight. This article briefly explores three broad areas that not only represent better ways of doing business but also may transform the business itself. Not the stuff of science-fiction scenarios or nanotech warfare, these capabilities are on the ramp today.

Precision Munitions and the End of Close Air Support As We Know It

A transformation in close air support (CAS) is occurring through the combination of a common precision frame of reference for the entire joint force provided by the global positioning system (GPS), broadband communication linkages (tactical Internet), and cheap processing power that controls maneuverable weapons. The proximity of forces in contact puts a premium on situational awareness and accuracy, thus making CAS a demanding mission. The "close proximity to friendly forces" and "detailed integration of each air mission with the fire and movement of those forces" define CAS in Air Force doctrine.[2] Consequently, in the past, CAS aircraft had to fly over the battlefield to clearly identify enemy and friendly positions. Once oriented, the pilot then had to maneuver close to the target to deliver weapons. Close proximity offered the only way of attaining sufficient accuracy to destroy the enemy without collateral damage to friendly forces. Overflying the battle required that the CAS platform be maneuverable and tough. Technology in the field today, however, radically changes this equation.

The availability of real-time intelligence, observation, and targeting referenced to GPS coordinates has eliminated the need for CAS aircraft to overfly the battlespace for situational awareness. The lengthy coordination among joint headquarters, ground observers, and pilots can now take place in seconds over tactical networks. The ground-force commander can provide the current disposition of his or her forces, specify exactly where fires are needed, and deliver that information anywhere on the battlefield.

Precise locations of friendly and enemy forces delivered directly to an aircraft supply the necessary battlefield orientation, permitting near-immediate weapons release. Guidance on board the weapon then maneuvers it to impact. The aircraft no longer has to close with the target to ensure accurate delivery. In turn, the fact that CAS aircraft can now stand off from the battlefield reduces the need for maneuverability.

Furthermore, avoiding the immediate battlespace keeps these aircraft out of the threat envelopes of small arms, antiaircraft artillery, and small surface-to-air missiles, further relaxing the performance requirements for CAS systems. Lower performance means that simpler, cheaper systems can carry out the mission.

Precision targeting also reduces the weapons yield necessary to destroy a target. In principle, precision allows delivery of every munition within feet of the point designated by a

tactical commander. Concentrating the weapon's effect on the target reduces the yield needed for target destruction as well as the number of weapons per objective; it also allows for delivery of fewer, lighter weapons by smaller systems, which can be much less complex since the detection and aiming tasks have effectively moved from the delivery platform to the network and the munition, respectively. Moreover, the supported ground force's surveillance systems or other parts of the intelligence, surveillance, and reconnaissance "cloud" over the battlefield can put immediate poststrike observation of a weapon's effects on the network.

Because precision weapons' one-shot, one-kill capability reduces the number of weapons required per target, we can place more weapons on existing platforms or use smaller platforms as effectively as today's CAS aircraft. We can already see both ends of this spectrum in use. At the high end, B-52 and B-1 "bomb trucks" are releasing single precision weapons from their capacious bomb bays to strike individual targets on call. At the light end, Reapers (and, very soon, Cessna Caravans) are delivering Hellfire missiles.[3] This ability to kill more targets with the same number of weapons reduces the number of aircraft required to perform CAS.

Opposing this trend toward fewer CAS platforms is an increase in the utility of—hence, the demand for—CAS.[4] Smaller weapons yield drastically shrinks the scope of collateral damage and allows weapons delivery closer to friendly forces, expanding the usefulness of CAS to those forces and lowering barriers to its use. Significantly, not all of this demand need be satisfied from above, though airborne CAS will likely remain the most responsive option. Guided munitions for artillery and mortars can provide similar precision from small, unit-portable weapons.

The combination of networked coordination, simpler delivery systems, and one shot per target makes lower-echelon control of CAS feasible, pulling it out of the central air and space operations center (AOC) and moving it down to the ground force's tactical operations center. We see this today in the air tasking orders in Iraq and Afghanistan. During the author's tenure commanding the Joint Special Operations Air Component in 2005, the majority of CAS sorties launched without a target as "XCAS," tasked in the air to meet immediate needs of the ground force. The AOC had largely become a logistical node, providing and sustaining armed aircraft on call for ongoing operations. The detailed coordination called for in CAS doctrine shifted from the joint headquarters level to the ground tactical operations center, where network-linked overhead sensors supplied the battlefield overview directly to the CAS platform, air liaison officer, and troop commander. This trend is also evident in the development of the joint air-ground control cell concept discussed in Air Force Doctrine Document 2-1.3, *Counterland Operations*.[5]

In combination, these factors also diminish the logistical-support footprint for CAS, allowing both control and basing of delivery systems to move forward to lower echelons of the tactical force. A moveable complex of light unmanned and manned aircraft supported by a distributed intelligence, targeting, and control network can replace a squadron of A-10s at a fixed airfield—witness the Army's Task Force ODIN (observe, detect, identify, neutralize) in Iraq. Combined within an Army combat aviation brigade are manned and unmanned sensor aircraft as well as manned and unmanned light aircraft and helicopters. Traditional linkages to artillery support, itself capable of delivering precision munitions, also remain. A networked surveillance and targeting system supports the tactical force commander, who now controls a package of systems offering an overview of the battlefield, target detection, and immediate firepower. Though initially designed to prevent the emplacement of improvised explosive devices on Iraqi roads, Task Force ODIN has all the capabilities needed to support troops in contact with the enemy—in short, to do CAS.[6] Of course, today's fight in Iraq and Afghanistan is as unique as any other conflict; however, the above logic holds up well across the range of military operations.

Large-scale, mechanized (conventional) conflict does not change the CAS equation for the tactical commander. If anything, it expands the

need for speed and precise effects. Primary changes include an increase in the intensity of the ground threat to CAS aircraft, potential airspace congestion over the battle, and growth in the size and complexity of the fight.

Unmanned systems in use today would prove effective in a conventional fight. Standoff delivery of precision weapons from outside the range of enemy defenses makes more intense air defenses irrelevant since the delivery platform would rarely come within reach of those defenses.[7] In addition, smaller delivery platforms present a smaller detection signature. The visual, infrared, and radar signature of a low-powered, composite Predator-type platform is significantly less than that of traditional CAS aircraft—stealth on the cheap. Large numbers of low-cost platforms can also saturate defenses or make losses tolerable.

Similarly, in situations requiring airpower, the greater effectiveness of each precision weapon negates the increase in enemy forces in a conventional fight. Each CAS platform can destroy large numbers of targets using individual munitions or precision area weapons such as the CBU-105 (sensor-fused weapons in a wind-corrected munitions dispenser).[8] Rather than building a wall of fire across the battle front, massed CAS changes to become the massed effect of numerous small explosions directly on each battlefield target.

We must still contend with the perennial problem of operating multiple types of systems in constricted airspace over the battle. We are addressing the problem (painfully) today in the skies over Iraq as AC-130 gunships, helicopters, fighters, Predators, and other sensor platforms regularly operate in support of a single operation—so far without an actual collision. Deconfliction in a less permissive environment would pose even more of a problem—but only if we need to operate multiple platforms directly above the fight. Covering a given number of targets with fewer platforms standing off from the fight would diminish the need to operate in congested airspace over a conventional battlefield.

Large-scale, mechanized combat not only increases the physical size and scope of the battle across multiple tactical engagements but also calls for more coordination across the theater. Existing information networks already distribute tactical information around the globe. Adding capacity to these linkages presents a logistical problem of securing sufficient bandwidth—not just a technical one. Moving the information where it is needed allows us to focus command and control at any given level—from tactical to theater strategic. We can synchronize multiple tactical engagements centrally, with execution decentralized to appropriate network nodes. Of course, this need for bandwidth to move information and commands remains a major vulnerability for all operations in a large-scale conflict.

Ultimately, these trends will push toward a smaller/simpler Air Force CAS force, a smaller "combat" role for the AOC in the CAS fight, and more control of the CAS mission by tactical commanders. By 2010 a typical call for CAS might resemble this scenario:

> A company-level commander in the fight locates targets from an intelligence picture that synthesizes everything from ground-platoon reporting, overhead visual images, infrared sensors, radar, and radio-intercept information uploaded to a tactical network. The commander "points and clicks" to designate specific targets and to upload precision coordinates to the tactical net. Personnel designate mobile targets by type to specify seeker settings for appropriate weapons. They also determine no-fire areas from reported GPS locations of friendly units, and go online to calculate frag patterns for collateral damage.
>
> Once placed on the net, the information is available to all weapons within range of the fight—anything from mortars and artillery to unmanned and manned aircraft. Orbiting outside the battle area, these might include a few large aircraft, each with many weapons, or a large number of manned/unmanned light aircraft, each with fewer weapons. Weapons-delivery systems "bid" for targets based on their capabilities, each system making specific targeting assignments, and then fire weapons that converge on the battlespace. Detailed flight-path coordination is unnecessary since only the weapons, not the delivery systems, enter the area. Intelligence, surveillance, and reconnaissance systems from the supported ground force and theater-level assets put strike results on the net.

> The AOC carries out its role of launching manned and unmanned CAS aircraft, directing them to holding orbits. It also monitors the status of fuel and weapons, keeping the orbits resupplied by managing tanker support and launching replacement CAS aircraft. The AOC has little to do with the tactical fight.

Unlike many forecasts, this is not speculation about new technology but observation and synthesis of trends in current equipment and tactics used today, taken to their logical conclusion. Still missing is a comprehensive machine-to-machine interface to share existing information and allocate weapons to targets.

Our challenge lies in accommodating this reality. What force structure does the CAS mission require? How many A-10s, F-16s, and F-35s can MQ-9s replace? Do we lead this charge or cede the mission area and funding to ground forces?[9] The revolutionary impact of the GPS, communications, and computer power on CAS comprises one aspect of a broader application to airpower.

Unmanned Aircraft Systems: Pilot Chips instead of Wings

The evolution of unmanned aircraft has been constrained by the need to respond to the complex aerodynamic and navigational requirements of controlled flight. Moreover, the tactical aspects of combat missions demand immediate human decisions and control. Nevertheless, capabilities developed and deployed in the last two decades now allow UASs to conduct some combat missions effectively.

UASs are as old as flight itself. The first flying machines were unmanned models and gliders built to investigate the fundamental principles of flight. Development then turned to putting a man into the machine. Shortly after the Wright brothers' first successful powered flights, however, certain military missions required removal of the man from the aircraft.

The Kettering unmanned aerial torpedo of 1917—the Bug—was the first practical military UAS.[10] A preset system of electrical and pneumatic controls flew this aircraft and released its payload—hopefully, on the target. Although World War I ended before the Bug saw action, this unmanned system set the tone for future UAS development. The challenges of making a successful powered takeoff and landing limited UASs to single-use systems launched by catapult, air, or track—that is, flying bombs. In situations that precluded the launching of the UAS—for example, World War II's Aphrodite systems, which employed modified heavy bombers stuffed with explosives—a pilot flew the takeoff and then parachuted from the explosives-laden aircraft, at which point a following aircraft took over by radio control.[11]

Some previous unmanned aircraft could be recovered and used again if equipped with a parachute-recovery system, but their complexity and the inevitable damage that occurred during the process prevented a quick turnaround for aircraft-like operations.[12] We developed recoverable systems when we needed to limit costs (target drones) or retrieve recorded information (reconnaissance drones).

In the 1970s, a better understanding of aerodynamics and the availability of computers to execute control algorithms solved the problems of taking off and landing safely. Not developed for unmanned systems, the capability grew from the continued refinement of autopilot systems for commercial aircraft. Driven by safety requirements and a need to operate more reliably in poor weather, avionics companies developed systems that could use an aircraft's autopilot to fly a coupled precision approach. A logical extension of this capability was the addition of radar-altimeter information to bring the aircraft all the way to the landing flare. Economics drove acceptance of the technology, allowing airlines to provide more reliable service in poor weather.[13]

A corresponding economic need, this time to save fuel costs, led to the concurrent development of autopilots that could control engine power settings as well as aircraft attitude and flight altitude. The autothrottle optimized the engines' power setting and aircraft climb rate to save fuel. It was only a short step to add logic that could extend this control from aircraft brake release to touchdown.

Accurate navigation remained a problem. Autopilots could guide an aircraft along an airway or approach path but could neither "see and avoid" obstacles nor determine a precise position without external navigation aids. Either inertial navigation systems or complex automatic star trackers could provide aircraft position but not with the precision needed for flexible operations outside a well-defined route structure.

The development and deployment of terrain-following radar systems coupled to an aircraft's autopilot (F-111) added obstacle-avoidance capabilities. The problem of avoiding other air traffic is yielding to cooperative aircraft-transponder networks, with aircraft sharing precise information about position and velocity.[14] Finally, the level of accuracy provided by the GPS enables aircraft to determine their position to any practical level of precision.

Together, these developments have given us aircraft like the Global Hawk, able to operate autonomously from initial takeoff to subsequent landing at another airfield anywhere in the world. Now that pilots possess an airplane capable of flying itself, the toughest task remaining for them on a routine flight involves navigating the ground traffic between the parking ramp and the runway.

We have solutions in hand to get unmanned systems from takeoff to a destination—more than enough capability for straightforward missions like cargo delivery. No technical reason prevents us from deploying an unmanned tactical cargo air bridge by 2010. Equipping a constellation of QC-27 aircraft with the brains from Global Hawk would do it. Farfetched science fiction? Not at all: the 17 November 2008 issue of *Aviation Week and Space Technology* reported that the US Army has tested an "optionally piloted" Cessna Caravan for "utility transport in routine, but sometimes dangerous, battlefield and area-of-interest reconnaissance and patrol missions."[15]

We seem to have the practical capabilities for routine operations in hand—but not the doctrine and attitudes. However, it is instructive to note that commercial airline operations are adopting autotakeoff/pilot/land systems in the name of increasing flight safety. Resistance to unmanned operations usually centers on safety, specifically the problems of dealing with emergencies or nonroutine operations.

Actually, executing emergency procedures is one of the easier problems to solve. Generations of thought and experience have given us very good algorithms to deal with emergencies—specifically, the emergency-procedure checklists in every flight manual. For each potential problem, we have a step-by-step procedure to analyze problem indications, take action, observe the results of the action, and take further action if necessary. Autonomous implementation simply requires that the problem indications be available to the UAS's controlling computer and that the various controls, switches, and circuit breakers be activated by that computer.

We also have a model for dealing with unusual or intractable emergencies. Currently, a pilot declaring an in-flight emergency quickly receives support from a team of experienced aircrew, leadership, and engineering personnel. We can gather the same team for a UAS, but that team now determines additional actions to transmit to the remote aircraft.

The remaining problem—making nonroutine tactical decisions required in combat—represents our present justification both for the continued use of manned aircraft and the close manned supervision of UASs. Today's solution is to keep the human in the loop, even if the loop stretches through a satellite linkage to Nevada. This demands plenty of bandwidth to pass the information needed to maintain the remote operator's situational awareness. The communication linkage also imposes a time delay as the signal travels from the UAS to the operator and back. Global operations using a satellite relay incur one-way transmission delays of at least a quarter of a second.[16] A total round-trip delay of half a second may not sound like much, but the lag is more than enough to cause problems during rapid aerodynamic maneuvers. Routine delays may be much longer, depending on details of the transmission route and any required computer processing of information or commands.

To deal with nonroutine mission operations, a UAS must have some ability to detect a

change to the preplanned mission and then develop and implement a solution. En route, the problem becomes how to maneuver the UAS around unforeseen obstructions, whether terrain, weather, threats, or other aircraft. Detecting them requires either an appropriate sensor—mapping radar, threat-warning receiver, or collision-avoidance system—or information provided by off-board sensors through a network. None of these is new technology; all are available today.

After detecting the obstruction, the UAS must replan its route to avoid the obstacle. Once again, we already have the solution in the field: automated software for route planning and in-flight replanning. Today's UASs, and some airliners, are not "flown" during the en route portion of their flight but are directed by changing the desired routing for the autopilot—using a mouse click instead of the control stick. For UASs, moving implementation of the software from the control cab to the aircraft themselves represents just a small step. Determining the need to revise a route involves only the incorporation of software to allow the UAS to update its internal map autonomously, replan its route as required by traffic or threats, and update any relevant airspace controllers.

Once in the target area, a UAS must detect and locate its objective, release weapons, and conduct any required offensive/defensive maneuverings. How close are we to pushing these decisions forward to the UAS?

Detecting and locating targets is already a heavily automated task. We deploy a network of sensors across the battlespace and analyze the resulting information with a series of computer tools. Today, we manually transfer this information to the flight crews, who then manually enter it into their aircrafts' systems. Transferring the information directly from a targeting cell in the AOC to the UAS only simplifies the process.

Striking fixed targets, whether preplanned or designated by a ground/airborne observer, is straightforward. The UAS simply transfers the provided coordinates to an onboard weapon and maneuvers to the weapon's release box.

Moving targets are more demanding because we must search the area to locate them. They impose more demands on the UAS's sensors, or they require more detailed external direction. However, we have already deployed or demonstrated solutions to this problem with existing missile seekers, like that of the imaging infrared Maverick, and with the laser Joint Direct Attack Munition.[17] The key is recognition of targets—and friendlies—an area in which we may require human intervention for some time yet.

In the target-rich environment of high-intensity combat, truly autonomous UAS operation is now feasible. Existing sensor-fused weapons and other precision munitions can both find and strike conventional targets. More ambiguous combat environments, such as counterinsurgencies and urban fights, will need to maintain a human in the decision loop to designate targets and approve weapons release. Assuming adequate bandwidth, this is how we do business today.

Although the problem of offensive and defensive maneuvering remains, we can make some general observations. The fight beyond visual range should remain within the capability of today's UAS since the problem is essentially limited to target detection and weapons release. For a close-in fight, the UAS is probably not yet ready. This mission would likely require much more complex control laws than we now use. Existing logic for maneuvering an air-to-air missile to an intercept would probably not prove sufficient to solve the more complex problem of maneuvering for a missile or gun shot while preventing the target, and other enemy aircraft, from attaining a firing solution on the UAS. Using a human in the loop would run up against the previously mentioned time-delay problem as well as require excessive bandwidth to provide the remote controller with situational awareness. Development of a practical air-to-air-fighter UAS will depend on future improvements in both framing the maneuvering problem and creating the artificial intelligence to solve it.

Defensive maneuvering against ground threats poses a less difficult problem. Due to high cockpit workloads and the need for short

reaction times, existing countermeasures suites generally operate automatically, once armed. A UAS could arm/disarm its countermeasures, based on known threats, onboard threat detection, or mission profile.

One argument maintains that incorporating all these capabilities will drive up the size and cost of a UAS, negating any advantage over a manned system. The flaw in the argument is that, to put a UAS in combat, we don't need hardware as much as we do software and computing power. Making a bigger, smarter "brain" takes grams of silicon—not pounds of aluminum. Furthermore, the UAS does not require the volume, protection, and environmental systems needed to carry an aircrew.

Additionally, many of the technologies that enable UASs are not carried on the airframe. Precision GPS navigation and targeting information from the network harness a huge infrastructure with minimal equipment on board the UAS. Of course, relying on off-board support highlights the major UAS vulnerability today—bandwidth. Limited capacity and vulnerability to electronic attack make this the UAS's weakest link. Increasingly autonomous UAS operations should render this problem more tractable by reducing the amount of external information needed by the aircraft.

That said, if UASs are so capable, why are we not fielding them in greater numbers? Ultimately, it comes back to resources. The demands of maintaining and updating the inventory of manned aircraft already exceed available funds in the Air Force budget. With every dollar spoken for, the Air Force still needs more F-22s, new tankers, a new combat search and rescue platform, and more airlift, as well as repairs and upgrades for the existing fleet. There are simply no resources to increase the inventory with a large number of UASs—and we are unwilling to trade U-2s for Global Hawks or A-10s/F-16s for Reapers. Despite the UAS's demonstrated operational capability, we do not seem to have reached a tipping point in our attitudes.

As with the adoption of the Predator and its successor combat UASs, we are seeing field utility and the troops' creativity advance the mission—not service leadership or the acquisition community.[18] Another revolutionary capability is emerging from a similarly long and difficult saga of development and acquisition.

Directed Energy Weapons: Revenge of the Battle Plane

In late November 2008, the YAL-1 airborne laser (ABL) completed the first ground test of the entire weapon system integrated aboard the aircraft, generating and directing the beam onto a simulated target and thereby preparing the way for flight tests in 2009.[19] What are the implications of an operationally useful directed energy (DE) weapon? The designed mission of the megawatt-class laser on the ABL is to destroy missiles at ranges in excess of 200 miles.[20] However, like the creative operators who placed a 105 millimeter howitzer in a C-130, the developers of the ABL are already discussing the weapon's effectiveness against air-breathing targets.[21]

Speed-of-light/line-of-sight weapons like the laser on the ABL are fundamentally different from kinetic weapons. Line-of-sight precision ensures one-shot, one-kill effectiveness. Speed-of-light response ensures that the target has no warning to make evasive maneuvers or employ countermeasures.[22] If the technology proves practical and affordable, a DE weapon will provide a near-instant kill of targets detected within its effective range. Echoes of Giulio Douhet's combat plane able to clear its way through the skies with superior firepower can be heard as the ABL takes flight.

At its maximum range, the ABL weapon is designed to weaken a target's structure enough to cause aerodynamic and acceleration forces to break it up. Elementary physics assures that the laser beam's power becomes substantially more destructive as the range decreases. At shorter ranges, the beam will have less spread and less atmospheric absorption. We can expect a laser that can kill a relatively thin-skinned target at 200 miles to have much more capability at 50 miles—solidly in the medium-air-to-air-missile range.

At first glance, the ABL would seem the ultimate fighter on offense or defense, able to

kill any detected aircraft or missile coming within range. Countering the ABL would place a premium on stealth (preventing detection and targeting), avoidance (remaining outside the laser's effective range), numbers (saturating the engagement area), or weather (operating below weather the laser cannot penetrate). However, a more serious threat to the ABL's effectiveness is its own vulnerability to other DE weapons. Weight and volume requirements may preclude fighter-sized aircraft from carrying long-range DE weapons, but those requirements are greatly relaxed for ground-based systems.

Operation from the high ground represents a major factor in the ABL's effectiveness. High-altitude operations provide the line of sight needed for extended range and put the weapon above much of the atmosphere and associated weather, reducing beam distortion and attenuation. That same high ground, however, also puts the ABL in the line of sight of DE weapons on the ground. Speed-of-light propagation makes for a formidable ground weapon despite the limitations of atmospheric attenuation and the horizon on a ground weapon's range and line of sight. Overcoming atmospheric effects to extend the effective range of a ground weapon may prove as simple as scaling up its size or deploying an array of weapons to focus multiple beams on a distant target. Once a target is in range, the effectiveness of a ground-based DE weapon depends only on detection and aiming since the weapon's effect is essentially instantaneous over usual ranges.[23] Using networked information from sensors that can see over the horizon to cue the weapon should allow an assured kill as soon as the target breaks the horizon.

The deployment of practical laser weapons raises fundamental questions for Airmen. Can any aircraft operate within range of a DE weapon? Is the F-22 the "last-generation" fighter? How do we attack a weapon that can destroy incoming missiles and warheads? How do we achieve air superiority against an enemy with ground and airborne lasers? The task of rolling up enemy air defenses remains, but the individual targets are now much tougher.

We have no experience with these weapons in combat—only questions. However, we would do well to remember past revolutions in weapons technology: "distance" weapons (English longbows) against "contact" weapons (French mounted knights) at Crécy and Agincourt, and machine guns against unprotected cavalry and infantry in World War I. Tactics and doctrine adjusted to accommodate these changes, but it wasn't pretty.

2010 Is Today

The changing nature of CAS, autonomous combat UASs, and DE weapons do not change the fundamentals of warfare. They do, however, provide new tools that we must learn to use or counter. The key is not the system itself—but what we can do with the system. We are seeing rapid advances in UAS operations driven by the pressure of combat in Iraq and Afghanistan. Without that pressure, and without their successful debut over Kosovo in the 1990s, UASs would likely remain curiosities confined to the lab or occasional field experiments.

With each new technology comes a fundamental question—what can we do with it? The metric for the answer is simple but context dependent: for what missions or situations is the new technology better, and when is it just different?

Our challenge today is more traumatic than the decision to embrace an "all-jet" Air Force. We are not merely swapping a spinning propeller for a tail of fire. As UASs and other new weapons demonstrate capability, they become alternatives—not additions to or adjuncts of the manned force. Much of the stress on the current budget comes from the cost of maintaining the old capability (whether through extending the service life of old systems or developing better versions) while beginning to acquire the new. At some point, we must reduce our reliance on horse cavalry (the A-10/F-35?) and embrace the mechanized brainpower of a UAS force. ❑

Notes

1. See Grant T. Hammond, *The Mind of War: John Boyd and American Security* (Washington, DC: Smithsonian Institution Press, 2001).

2. Air Force Doctrine Document (AFDD) 2-1.3, *Counterland Operations*, 11 September 2006, 6, http://www.fas.org/irp/doddir/usaf/afdd2-1-3.pdf.

3. Robert Waal, "Keeping Watch," *Aviation Week and Space Technology* 169, no. 18 (10 November 2008): 53.

4. For a discussion on the current demand for CAS, see Rebecca Grant, "Armed Overwatch," *Air Force Magazine* 91, no. 12 (December 2008): 40, http://www.airforce-magazine.com/MagazineArchive/Pages/2008/December%202008/1208overwatch.aspx.

5. AFDD 2-1.3, *Counterland Operations*, 58.

6. Jeffrey Kappenman, "Army Unmanned Aircraft Systems: Decisive in Battle," *Joint Force Quarterly*, issue 49 (2nd Quarter 2008): 20–23, http://www.ndu.edu/inss/Press/jfq_pages/i49.htm.

7. The system's range exceeds 40 nautical miles. See "GBU-39B Small Diameter Bomb Weapon System," US Air Force fact sheet, http://www.af.mil/factsheets/factsheet.asp?fsID=4500 (accessed 15 December 2008).

8. The wind-corrected munitions dispenser, extended range, has a range of 40 miles, providing standoff precision delivery for this weapon as well. See Susan H. H. Young, "Gallery of USAF Weapons," *Air Force Magazine* 91, no. 5 (May 2008): 158–59, http://www.airforce-magazine.com/MagazineArchive/Pages/2008/May%202008/May2008.aspx.

9. John A Tirpak, "Washington Watch," *Air Force Magazine* 91, no. 11 (November 2008): 12, http://www.airforce-magazine.com/MagazineArchive/Pages/2008/November%202008/1108watch.aspx. In September 2008, the Army and Air Force reached an agreement on a joint concept of operations for unmanned aerial vehicles (UAV), which gives the Air Force control of all high-altitude operations while allowing the Army to control tactical operations below 10,000 feet. The Army operates Sky Warrior UAVs—armed variants of the basic Predator, similar to the MQ-1. Details should be finalized in early 2009, but the basic principle clears the way for the Army to extend its organic CAS capability from helicopter gunships to include UAVs.

10. Kenneth P. Werrell, *The Evolution of the Cruise Missile* (Maxwell AFB, AL: Air University Press, September 1985), 16, http://handle.dtic.mil/100.2/ADA162646 (accessed 15 December 2008).

11. Ibid., 32.

12. Lt Col E. J. Kellerstrass, "Drone Remotely Piloted Vehicles and Aerospace Power," *Air University Review* 24, no. 6 (September–October 1973): 44–54, http://www.airpower.au.af.mil/airchronicles/aureview/1973/sep-oct/kellerstrass.html (accessed 31 January 2009).

13. "From the A300 to the A380: Pioneering Leadership," *Airbus*, http://www.airbus.com/en/corporate/innovation/ (accessed 15 December 2008). The European Airbus family of aircraft had an autoland capability as early as 1977.

14. "30 Years of Aerospace Technology," *NASA Tech Briefs*, 1 October 2006, http://www.techbriefs.com/component/content/article/901?start=1b (accessed 15 December 2008). Airbus's latest aircraft, the A380, is equipped with an Autopilot Traffic Collision Avoidance System, linking this function to the autopilot and "Brake-to-Vacate" technology. This allows pilots to select an appropriate runway exit when landing and regulate the aircraft's speed and deceleration accordingly.

15. Guy Norris, "Pilot Optional—US Army Quietly Tries Caravan UAV Out for a New Defense Role," *Aviation Week and Space Technology* 169, no. 19 (17 November 2008): 38.

16. Twenty-two thousand miles up to and 22,000 miles down from geosynchronous orbit + some distance of surface relay / 186,000 miles per second (speed of light) = .24 seconds one-way signal travel time. Two-way transmission will take twice that amount of time plus the time for the operator to react to the information.

17. MSgt Joy Josephson, "The 'Hog' Drops in on History," *Air Force Link*, 14 November 2008, http://www.af.mil/news/story.asp?id=123124172&page=3 (accessed 15 December 2008).

18. For an excellent overview of the Predator acquisition saga, see Michael R. Thirtle, Robert V. Johnson, and John L. Birkler, *The Predator ACTD: A Case Study for Transition Planning to the Formal Acquisition Process*, RAND Report MR-899-OSD (Santa Monica, CA: RAND National Defense Research Institute, 1997), http://www.rand.org/pubs/monograph_reports/MR899/ (accessed 15 December 2008).

19. "Boeing Airborne Laser Team Fires High-Energy Laser through Beam Control System," news release, Boeing, 1 December 2008, http://www.boeing.com/news/releases/2008/q4/081201a_nr.html (accessed 15 December 2008).

20. "Since the weapon system was designed to shoot down theater ballistic missiles, will it have enough power to shoot down the longer-range missiles? Yes. The COIL [chemical oxygen iodine laser] is a megawatt-class laser, which means in its current configuration of six modules it is designed to generate a million watts or more of energy to destroy a target at a distance of more than 200 miles." Airborne Laser System Program Office, Office of Public Affairs, "The Airborne Laser: Frequently Asked Questions," US Air Force fact sheet, 24 March 2003, http://www.kirtland.af.mil/shared/media/document/AFD-070404-024.pdf (accessed 15 December 2008).

21. David A. Fulghum, "Gates's Opening: Defense Secretary Turns to Procurement Cleanup," *Aviation Week and Space Technology* 169, no. 22 (8 December 2008): 26.

22. The ABL system uses a tracking laser to aim the weapon's beam, potentially allowing for some warning before a shot. More conventional surveillance and targeting radars that may be needed for other DE weapons can also provide some warning of attack. However, this warning would be orders of magnitude shorter than the time between detecting a missile's guidance lock-on or launch and the arrival of that missile at the target.

23. Another simple calculation shows that at light speed—186,000 miles per second (300,000 kilometers per second)—the beam reaches a target 200 miles away in .001 second.

Air Domain Development in Africa

A Reasonable Proposition

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In light of the recent stand-up of US Africa Command, we should consider innovative ways to apply airpower in Africa. We traditionally think of airpower performing combat or humanitarian-relief roles, but with regard to many developing regions of the world, we should think in terms of building aviation capacity—or what we call air domain development (ADD), based on beneficial interaction and cooperation between a nation's civil- and military-aviation organizations.[1] ADD emphasizes the building of a national air domain by enhancing air safety and expanding trade through development of civil-military partnerships while working towards control of sovereign airspace. Combined, these elements increase a state's presence throughout its geographic borders.

When considering the roles that ADD might play within an African context, we must remember that one size does not fit all. The presence of 53 African countries with over 2,000 spoken languages on a continent three times the size of the United States produces a great variety of experiences and contexts. Further, we must note the differences in regional dynamics between the five states comprising North Africa and the 48 states in sub-Saharan Africa, the latter area the object of our focus.

We need to develop a framework to guide our strategy and ensuing operations on the continent. ADD can enhance economic growth and political stability on a continent plagued with fragile states and instability, yet the great variety of the African experience precludes a single template. For example, Somalia, a state struggling to control a neighborhood within its capital, faces different challenges than a more stable and prosperous Ghana.

The United States Government Aviation Community can strongly contribute to a partner nation's ADD. Given the challenges faced by many African countries, the community can help partner nations increase their capacity to govern and promote regional stability while strengthening connections between urban and rural populations. However, two issues confront sub-Saharan Africa.

Two Central Challenges

Many states in this region find themselves hard-pressed to project a meaningful governmental presence outside their capitals. Just about every African state must deal with a significant scarcity of resources. Many do not have sufficient budgets to meet basic social

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needs, nor do they have adequate infrastructure and resources for power projection across a vast territory. Many states struggle to effectively control their own borders and provide security to their populations. This goes to the very definition of a state, which emphasizes a government's capacity to monopolize the legitimate use of force within its territory.[2]

The second challenge concerns the military's need to control that territory effectively and act as a visible agent of the state in remote areas. From a narrow military perspective, we must realize that many national militaries have limited interaction with the population and, due to resource constraints, have difficulty maintaining presence in remote regions. This situation is of particular importance if states want to sustain a presence, exert control, and effectively counter any potential rebellion or criminal activity that might form beyond their reach. Nor can we ignore the general lack of security services afforded to rural populations so far removed from government-controlled urban centers. A correlation exists between a state's ability to project military force in remote areas and citizens' security. Domestic force projection strengthens links between citizens and their state—especially if the people see the military as providing a service by protecting them from unsanctioned violence and by defending sovereign territory.

We find such challenges, for example, in the Democratic Republic of the Congo. About as large as that part of the United States east of the Mississippi River, this country has fewer than 1,737 miles of paved roads and contains large areas of difficult terrain, complicating government access and movement of goods and services. In contrast, France—roughly the size of Texas—boasts 590,914 miles of paved roads.[3] ADD could help the Congo overcome these obstacles by enabling the state to promote economic activity, government presence, and security throughout its far-flung territory. A host of complex, additional issues affect continental stability and development, yet the two mentioned above are particularly urgent.

Benefits of Air Domain Development

In view of these challenges, ADD can best benefit African states through its ability to project central authority and influence to remote areas while improving capacity and support for the military among the general population. The question then becomes how to establish ADD despite a scarcity of resources.

First, ADD gives states the mobility to access territories despite inadequate transportation infrastructure. Small-to-medium-sized transport planes would enable states to establish a presence in regions that would otherwise remain difficult to access via ground vehicles. Selection of the particular aircraft would depend upon the situation, but use of the right technology for the given environment is the most important consideration.

Second, dual-use ADD would benefit both civilian and military interests, enhancing the overall safety and security of the air system. For instance, air traffic control requires basic navigational aids and air routes that would enable the safe movement of passengers and goods as well as help secure borders. Thus, the state could train pilots to fly transport planes across its territory, delivering both military and civilian cargo.

The military's needs would take priority, but its planes and runways could transport other people and goods when space is available, thus helping develop the urban-rural connections often missing in today's limited-capacity states. Further, the state could project forces, have a tailored presence in remote areas, and respond quickly to threats, disasters, or other emergencies—whether civil or military.

Third, this program would help ensure proficiency training for pilots. Many African states simply lack the resources to provide sufficient flight time to their pilots, although some countries circumvent this dilemma by allowing their pilots to accumulate hours by flying aircraft in the national airline. In a context of resource scarcity, such a policy would drastically cut the costs of maintaining pilot proficiency.

Finally, offering a service to the population would reflect favorably on the military, help-

ing promote security and stability for all citizens. The United States engages in similar activity with the Air Force's C-17 aircraft. This fleet gives the US government great opportunities to utilize the most advanced carrier of military cargo in the world to supply medical and logistical support to relief efforts for humanitarian or natural disasters worldwide.

Obstacles and Benefits

As with any endeavor, we must contend with obstacles, such as lack of funding, internal conflict, and a dearth of technical expertise to operate an air traffic control system—just to name a few. Yet, potential benefits far outweigh the obstacles, the former including greater state access to remote areas, the nurturing of vital links between urban and rural regions, state oversight of its outlying territory, regular use and maintenance of aircraft, increased aviation training and proficiency, revenue-generation possibilities such as landing fees, increased economic and trade opportunities, stronger civil-military ties, and professionalization of the military through regularized training and operations.

Recommendations

ADD represents exactly the type of innovative, long-term, sustainable capacity development that Africa Command, in concert with other agencies, should promote. Seeking to conduct "sustained security engagement through military-to-military programs," the command finds itself uniquely postured to initiate and lead this truly joint civil-military effort.[4] By partnering with the United States Government Aviation Community in working with African states to promote ADD, Africa Command would help address critical challenges in sub-Saharan Africa, especially by promoting dual-use air-transportation systems that enable African states to reach all their territory. ❑

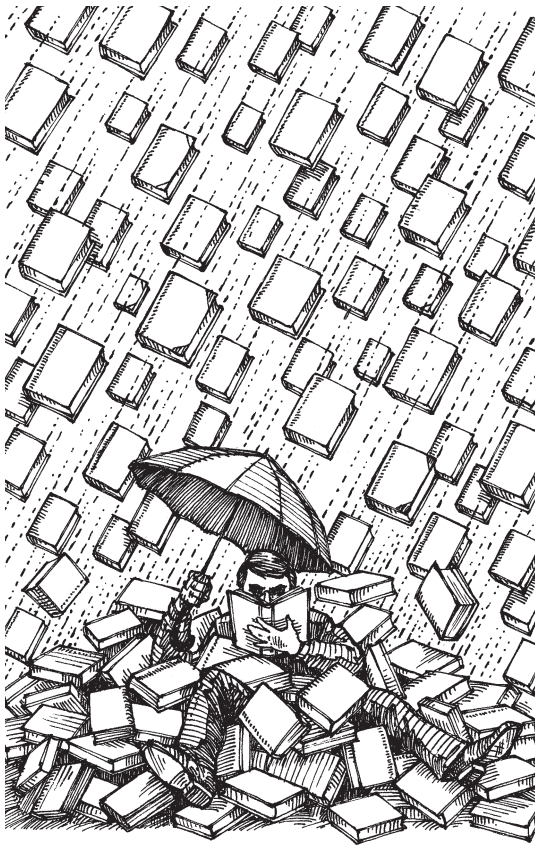
Notes

1. See Maj William "Chris" Robinson, "Air Domain Safety and Security," working paper (Hurlburt Field, FL: USAF Special Operations School, 20 August 2008). Students in the Special Operations School's Irregular Warfare Seminar have begun to explore this idea and its real-world implications.

2. Hans Heinrich Gerth and C. Wright Mills, eds., *From Max Weber: Essays in Sociology* (Oxford, UK: Oxford University Press, 1958), 78.

3. Central Intelligence Agency, *The 2008 World Factbook* (New York: Skyhorse Publishing, 2008), https://www.cia.gov/library/publications/the-world-factbook/geos/cg.html (accessed 5 November 2008).

4. "AFRICOM Mission," United States Africa Command, http://www.africom.mil/AboutAFRICOM.asp (accessed 5 November 2008).



ARVN: Life and Death in the South Vietnamese Army by Robert K. Brigham. University Press of Kansas (http://www.kansaspress.ku.edu), 2502 Westbrooke Circle, Lawrence, Kansas 66045-4444, 2006, 250 pages, $29.95 (hardcover).

The Army of the Republic of Vietnam (ARVN) never became a fully legitimate arm of the government of Vietnam because of misguided policies, poor leadership, and a failure to create a Vietnamese army with origins in and connections to Vietnamese culture and history. Robert K. Brigham makes his case convincingly in this welcomed post-revisionist monograph on a maligned army. He does so, not with recycled English-language sources but with documents from the Vietnamese Archive in Ho Chi Minh City, Vietnamese-language books and memoirs, and dozens of interviews of ARVN veterans. Indeed, Brigham only used oral histories he could corroborate with other sources.

Among the strengths of this book are the author's analyses of ARVN conscription and the relationship among the draft, morale, and family life. Conscription was nothing new to Vietnam, but historically it had been molded to the rhythms and requirements of family and agricultural life through terms not exceeding one year. When the ARVN increased the term to two years in pursuit of a stronger army, village agriculture and family life suffered severely from the loss of the backbone of the labor force. Consequently, the government prevented soldiers from fulfilling obligations to their families, forcing them to behave in a way that is shameful within that culture. Morale plummeted. By the late 1960s, soldiers brought their families with them to encampments or shantytowns so they could care for each other.

Army life discouraged the soldiers because they did not receive adequate weapons and combat training prior to field operations, and the government made no effort to explain in political and cultural terms the reasons why they needed to sacrifice and fight for the government and idea of South Vietnam. This was the policy of Ngo Dinh Diem and his successors. They feared that a nationalistic, patriotic, and motivated ARVN might someday hold them accountable for corruption, failed policies, and the like. The ARVN was notorious for a high desertion rate, but Brigham points out that perhaps "only 20 to 30 percent of the soldiers listed as deserters actually were" skirting their duties out of fear or malice (p. 48). Over half of the deserters actually served in units to which they were not assigned. Many deserted to see their families and eventually returned to their units. Brigham thus accomplishes one of his goals: dispelling ill-founded conclusions with sound analyses.

In analyzing why the ARVN soldiers fought—in spite of poor training, poverty-level pay, and abject facilities—Brigham arrives at several inferences. Because training and training facilities were so substandard, a conscript initially experienced alienation. He would be away from his family for years, and the ARVN lacked the spirit to function as a substitute family. Interviewees asked, "How can you build a nation without a well-trained army that knows why it is fighting and then gets to fight?" They also as-

serted that they did not fight for their buddies because the ARVN's small units lacked closeness and cohesion. Brigham concludes that soldiers fought on behalf of their families.

He observes that the ARVN displayed better fighting skill, endurance, and effectiveness than it is commonly credited for. The discussion of the Battle of Ap Bac is excellent, and Brigham notes a couple of battles in which the ARVN fought very well, one of which Military Assistance Command-Vietnam called "a brilliant performance" (p. 94). Unfortunately, the author devotes only 28 pages to an assessment of the army's abilities in combat. Although he defends the South Vietnamese performance during Tet, that offensive receives only two pages. Brigham scarcely mentions Lam Son 719 (a single sentence), and the 1972 Easter Offensive gets two paragraphs of coverage. Although he did not intend to analyze specific battles or the ARVN's performance in battle, a fuller coverage of battle would have strengthened his thesis that by the early 1970s, soldiers fought to keep their families together. Armies exist to fight. The topics of this book—conscription, family life, morale, training, and politics—all influenced the fighting effectiveness of the ARVN. An analysis of its battle performance would have completed his social history of the ARVN by more thoroughly tracing the connections between society and culture and the army's deeds in war. The historiography of the Vietnam War still awaits the definitive history of the Army of the Republic of Vietnam. Perhaps Professor Brigham will satisfy this need with a second edition of his most recent work.

Glaring defects are rare in this book. Brigham states that "from 1969 until 1973 the Nixon administration launched one of the most massive air campaigns in history" (p. 100). Actually, that air campaign did not become "massive" until March of 1972. Only 2,107 "attack" sorties occurred over North Vietnam from 1969 to 1971, in contrast to the 41,057 in 1968 and the 21,496 in 1972 (Wayne Thompson, *To Hanoi and Back: The U.S. Air Force and North Vietnam, 1966–1973* [Washington, DC: Smithsonian Institution Press, 2000], 304). He also claims that "most modern armies in a time of war" are not "built on the draft" (p. 7), a surprising assertion, given the reliance of armies on conscription during both world wars.

Aside from its contribution to our understanding of an understudied aspect of the war, *ARVN* is especially relevant to the US military's current effort to upgrade its understanding of non-Western culture and language. Americans equate combat skill solely with functions they can engineer, such as training in weapons and tactics, and materiel support, like equipment and firepower. *ARVN* reveals the existence of a straight line from cultural underpinnings to a unit's combat effectiveness. Brigham provides an example of the consequences of ignoring familial values, priorities, concepts of honor and responsibility, family obligations, and political training for an armed force expanding during wartime. I recommend *ARVN: Life and Death in the South Vietnamese Army* to scholar and policy maker alike.

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New Heavens: My Life as a Fighter Pilot and a Founder of the Israel Air Force by Boris Senior. Potomac Books (http://www.potomacbooksinc.com), 22841 Quicksilver Drive, Dulles, Virginia 20166, 288 pages, $20.76 (hardcover), $13.56 (softcover).

Boris Senior grew up as the son of a prosperous farmer and businessman who immigrated to South Africa to escape Russia's oppression of Jews. As a young man, he had only a casual knowledge of his religious heritage and very little appreciation of the worldwide oppression exacted upon Jews. When World War II erupted, Senior's older brother joined the South African Air Force as a fighter pilot. He soon followed in his brother's footsteps.

As a fighter pilot flying for the Royal Air Force, Senior attacked targets throughout Italy. On one mission, he was shot down over the Adriatic, but a US Army PBY (patrol bomber) plucked him out of the freezing water in a daring rescue. The war enlightened Senior to the plight of his fellow Jews and stirred his sense of Zionist nationalism. Afterward he surreptitiously joined forces with the Irgun and later the Haganah to set the stage for establishment of the Jewish state of Israel.

After the United Nations mandate of 1948, which created an independent Israel, he became one of the founding members of the new air force, serving as an Israeli pilot and eventually retiring with the rank of colonel. *New Heavens* is Senior's memoir of experiences throughout these turbulent times. One would expect that such a book would be a must-read for anyone interested in the infancy of what has become one of the most respected air forces in the world. Unfortunately, the book fails to live up to expectations.

As a memoir, *New Heavens* is adequate. As history it is seriously lacking in substance. It reads like a

travel book—interesting and entertaining but hardly enlightening. Senior, who passed away shortly after he finished the book, wrote in a very engaging, personal style. His anecdotes, such as the detailed account of his rescue at sea, are thrilling. But that is as far as it goes. After reading the book, one will know no more about the political or military strategy or tactics of the Israeli Air Force than before. The stories herein are those of a participant and sometimes an observer of events, but they reveal nothing regarding the shaping or leadership of these events. The author's lifetime of service is certainly worthy of respect, but it makes one wonder if he was truly a "founder" of the Israeli Air Force. A deeper discussion of the historical events would have erased all doubt in this regard.

Additionally, considering the times in which we live, Senior's breezy description of his terrorist activities in Europe and South Africa made this reviewer a little squeamish. His easy transition from Allied fighter pilot to terrorist operating in England draws an uncomfortable parallel to the very real possibility of terrorist cells operating in our own nation today. Neither my support of Israel nor the fact that Senior proved inept as a terrorist failed to mitigate a growing nausea in the pit of my stomach as I read these passages. History should not be denied, but the author's free and unapologetic admissions may make the reader uncomfortable. All in all, *New Heavens* is an easily forgettable book that, unfortunately, fails to live up to its potential.

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Go for Launch! An Illustrated History of Cape Canaveral by Joel W. Powell with Art LeBrun. Apogee Books / Collectors Guide Publishing (http://www.apogeebooks.com), 1440 Graham's Lane, Unit no. 2, Burlington, Ontario L7S 1W3, Canada, 2006, 320 pages, $29.95 (softcover).

The history of space activities at Cape Canaveral, Florida, America's spaceport, is as interesting as it is varied. *Go for Launch!* seeks to tell this story—already available in both scholarly and popular as well as illustrated and textual forms—with an emphasis on illustrations. At a fundamental level, the "Cape," as it is universally known by those in the space community, may be as much a state of mind as it is a physical place. With high-technology enterprises resting side by side with a wetlands refuge, it is an eerie location—what Anne Morrow Lindbergh ironically referred to as the abode of both the "heron and the astronaut."

Go for Launch! attempts to capture the 50-year history of this place as the central space-launch site in the United States. There are three central components to the Cape's space-access efforts. The one best known is the Kennedy Space Center, the National Aeronautics and Space Administration installation that serves as the site for the preparation and launch of the nation's human-spaceflight effort. The Mercury, Gemini, Apollo, and space shuttle launches have all taken place there. The military also has a huge presence at the Cape, with Air Force and Navy facilities engaging in all manner of test and evaluation at the Eastern Test Range, extending into the Atlantic Ocean. Finally, recent years have seen a major effort to establish commercial space operations in the area, and a growing number of nongovernmental launches have flown from the Cape. The first rocket took off with the launch of Bumper 8 on 24 July 1950, establishing a precedent that has endured more than 50 years.

Divided into three major parts, *Go for Launch!* devotes the first part, nearly half of the book, to the period from 1950 through the Sputnik crisis of 1957. It relates in words and photographs the history of the military's effort to establish a launch capability at the Cape and to undertake research and development on a range of missiles and research rockets. These included ballistic missiles so well known in history—the Atlas, Titan, Minuteman, Polaris, Trident, and Poseidon—as well as cruise missiles such as the Matador, Snark, Bomarc, and Navaho. This part also covers scientific rocket launches and the construction and operation of facilities that supported them. The authors have done a good job of locating and printing unique and interesting photos of these activities, many of them not familiar to the public. Indeed, a number of pages are essentially photographs with captions.

The second section relates the story of the orbital space-launch era from the flight of the first orbital spacecraft, *Explorer 1*, launched from the Cape atop a Juno rocket on 31 January 1958, through the loss of the space shuttle *Challenger* on 28 January 1986, 73 seconds into its flight. Again, the authors found interesting imagery to illustrate the work. Dealing with the more recent era, the third section focuses on the return to flight after the *Challenger* accident and the development and flight of various types of expendable vehicles launched from the Cape.

The imagery is quite adequate overall, but the reader should be aware that the vast majority of it is in black and white with only a small color section

added to the book. Accordingly, readers seeking the splashy design of a coffee-table book will assuredly be disappointed. A better work of that type is David West Reynolds's *Kennedy Space Center: Gateway to Space* (Firefly Books, 2006), even though it does not treat in any detail the military aspects of the story and has several glaring errors of fact. What *Go for Launch!* does is collect in one place a large number of interesting and helpful photographs of more interest to the specialist, perhaps, than the casual reader. Additionally, if one seeks a complex historical analysis of the history of space-launch facilities at the Cape, this is not the best book. Instead, one may find a superb analysis in *A History of the Kennedy Space Center* by Kenneth Lipartito and Orville R. Butler (University Press of Florida, 2007). *Go for Launch!* fills a key niche in the effort to understand the history of the Cape but does not stand alone as the only work on the subject that interested readers will want to consult.

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Enduring the Freedom: A Rogue Historian in Afghanistan by Sean M. Maloney. Potomac Books (http://www.potomacbooksinc.com), 22841 Quicksilver Drive, Dulles, Virginia 20166, 2006, 320 pages, $22.00 (hardcover), $15.16 (softcover).

A military historian with a degree from Temple University, Dr. Sean M. Maloney, who served as a Canadian army officer, currently teaches in the War Studies Program of Canada's Royal Military College. In the spring of 2003, he traveled to Afghanistan to study operations of the International Security Assistance Force (ISAF). In *Enduring the Freedom: A Rogue Historian in Afghanistan*, he documents his time with the ISAF in Kabul and with US forces in Bagram and Kandahar.

For the most part, *Enduring the Freedom* is a well-written, enjoyable account that provides the reader with a great deal of insight into the largely unreported story of US and allied operations in Afghanistan after the fall of the Taliban. By far the best part deals with the author's time in Afghanistan with various national forces. A good storyteller, Maloney uses his eye for detail to vividly describe the Afghan countryside and his ear for dialogue to recount conversations with soldiers, bureaucrats, and others in a way that rings true. The stories about his time on patrol give the reader a real appreciation for and insight into the mission in Afghanistan. For example, Maloney recounts going on patrol with a squad from a German battalion of *Gebirgsjaegers* (mountain hunters). As they drive through Kabul, an Afghan taxi strikes one of their vehicles. Although the taxi receives only a tiny scratch, the driver immediately draws a crowd by loudly demanding compensation from the Germans and pushing at members of the patrol. The German leader, a junior noncommissioned officer (NCO), quickly takes charge and tells the driver that he must accompany the patrol to the local police station to discuss compensation. Upon arrival, the taxi driver is taken to a back room and soon returns to apologize to the Germans. The German NCO declines to accept the apology because of the driver's insincerity. After another trip to the back room, the Afghan offers a more acceptable apology, and both he and the German patrol return to work. This episode illustrates the difficulty of the mission in Afghanistan, which requires junior officers and NCOs who can think quickly, understand political implications, and realize cultural differences, all the while keeping themselves as safe as possible. *Enduring the Freedom* makes this very clear. Dr. Maloney also has few qualms about indulging in a little gossip, recounting a couple of meetings in the Afghan countryside with intrepid war correspondent Geraldo Rivera as well as encounters with a famous, though unidentified, European reporter.

The book is not without its weak points though. A section that offers historical background to the conflict in an attempt to explain how Afghanistan became the primary target after the terrorist attacks of 9/11 simply tries to do too much in too little space. In only 21 pages, Dr. Maloney covers the relationship between Afghanistan and Pakistan, the development of radical Islam, the Afghan-Soviet war, Western support for the mujahideen, the rise of the Taliban, the effect of the collapse of the Soviet Union on Central Asia, and the rise of al-Qaeda and its operations against the West, culminating in the 9/11 attacks. I was almost out of breath at the end. In addition, the author's personal biases become evident throughout the book. He has nothing complimentary to say about the Canadian government, academicians, or the media, and his affection for the soldiers with whom he patrols is obvious—they seem to have his unqualified support. But these biases are a double-edged sword, enhancing the quality of the memoir because they reveal his true feelings but raising the reader's suspicion that he may have omitted some unflattering stories about these patrols in order to protect the soldiers.

Nevertheless, I strongly recommend *Enduring the Freedom* if for no other reason that there simply

isn't much written about the day-to-day operational environment in Afghanistan. Dr. Maloney tells his story well, drawing readers into the action and, as clichéd as it sounds, making them feel as if they are there with him. In many ways, this book reminds me of some of the better Vietnam memoirs. The activities described may comprise only a small part of the overall operation, but at the end of the story, we have a better understanding of the whole and a greater appreciation for the young men and women who serve there.

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LeMay, Great Generals Series, by Barrett Tillman. Palgrave Macmillan (http://www.palgrave-usa.com), 175 Fifth Avenue, New York, New York 10010, 2007, 224 pages, $21.95 (hardcover).

Curtis Emerson LeMay was a straightforward, combat-proven aviator and one of the most controversial officers ever to serve in the US Air Force. Both revered and reviled, he is one of our most misunderstood military leaders, often depicted as an uncaring, driven individual who wanted to bomb enemies "back to the Stone Age."

Barrett Tillman's excellent, albeit concise, biography *LeMay* paints a much different picture of this aviation legend, one that dispels many of the myths about him. A great deal shorter than Thomas Coffey's *Iron Eagle: The Turbulent Life of General Curtis LeMay* (1986), Tillman's text covers the essential periods of LeMay's life, from seeing his first airplane in flight (at age eight), through his retirement in 1965, to his death in 1990.

The author illustrates how LeMay's formative years laid the foundation for greatness. The oldest of six children, LeMay was a hard-working young man, an avid hunter, and a mechanically inclined individual who built his own radios. After leaving the ROTC program at Ohio State University for financial reasons, he entered the National Guard, eventually moving on to flight training and receiving his commission as a fighter pilot in October 1929. Assigned to the 27th Pursuit Squadron, he immediately sought opportunities to refine his aviation skills, mastering celestial navigation as well as instrument flying and becoming an instructor. All of the skills honed his airmanship, preparing him for the maelstrom of the Second World War.

Tillman effectively explores the highlights of LeMay's wartime exploits, including his rise as one of the most innovative leaders in the European theater of operations, his transfer to China, and his performance in the Mariana Islands, which helped bring Japan to its knees. The author also documents LeMay's work at the start of the Cold War—as commander of US Air Forces in Europe—including his efforts to sustain an entire city by air during the Berlin airlift. Chapters about his leadership of Strategic Air Command illustrate the general's well-known attributes, such as his insistence on relentless training, excruciatingly high standards, grueling inspections, and rewards for combat readiness (e.g., the "spot promotion").

However, Tillman exposes a bit more of LeMay in subsequent chapters, using refreshing prose that illuminates a different aspect of the man. Indeed, the author highlights his subject's determination to obtain better living facilities, additional recreational activities, and better pay for his Airmen. Granted, LeMay had an intense capacity for focusing on the mission, but these more human aspects show his dedication to the people who served under his command. In his later years, the general and his wife, Helen, founded the Curtis E. LeMay Foundation, which, to this day, provides financial aid to spouses of Air Force retirees—a tribute to the compassion this leader felt for the men and women of our service.

Tillman does not shy away from the controversial elements of LeMay's life, discussing the implications of the firebombing of Japan as well as the decision to drop the atomic bomb. Furthermore, he explores the antagonistic relations between LeMay and Defense Secretary Robert S. McNamara over weapon-system development (including the TFX and XB-70 Valkyrie aircraft) and the war in Vietnam. Additionally, he discusses the alienation that LeMay felt in the "Camelot" of the Kennedy administration, which prized politics and posturing over combat ability and sound military advice.

The author also touches upon LeMay's strange bid for the office of vice president in 1968, running on the same ticket with segregationist governor George Wallace of Alabama. Although the general maintained that he simply wished to keep Hubert Humphrey from winning the election, this ill-fated attempt at politics further degraded his reputation. Tillman also reveals that LeMay never refuted the "bomb them [the North Vietnamese] back to the Stone Age" quotation attributed to him. Although no evidence exists that he ever uttered those words, he remains linked with them nonetheless.

In the book's last chapter, Tillman reflects on his subject's accomplishments as well as his mistakes, highlighting not only LeMay's enduring legacy but

also—and more importantly—the traits that make him a leader worth emulating, especially his drive to become the best aviator possible and to know all aspects of his craft. How may senior leaders today take on the "tough missions"? By demanding accountability, cultivating subordinates, and emphasizing teamwork. LeMay exhibited such traits by word and deed.

In the final chapter, Tillman's analysis addresses all aspects of his subject—the good and bad qualities of the driven, demanding commander who seeks the best for all of his subordinates, down to the newest and lowest-ranking Airman. In the final pages, the author asks the reader to think about what makes a good soldier and apply those criteria to Curtis LeMay. *LeMay* does indeed answer that question, bringing to light unknown facets of this illustrious yet often misconstrued warrior.

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Rattler One-Seven: A Vietnam Helicopter Pilot's War Story by Chuck Gross. University of North Texas Press (http://www.unt.edu/untpress), P.O. Box 311336, Denton, Texas 76203-1336, 2004, 248 pages, $27.95 (hardcover), $14.95 (softcover).

Over three decades have passed since Americans last saw combat in Vietnam, and we might suppose that the supply of first-rate, first-person memoirs by those who fought there had dried up. Wrong! Interest in the Vietnam War remains strong, and the erosion of antiwar editorial bias has led to the release in recent years of some remarkably frank and gripping personal accounts, the work under review among them. *Rattler One-Seven*—the title comes from the author's personal call sign—is about author Chuck Gross's one-year tour of duty as a warrant officer UH-1 "Huey" pilot assigned to the Chu Lai–based 71st Assault Helicopter Company of the Americal Division, beginning 15 May 1970, prior to his 20th birthday.

Time tends to smooth memory's rough edges, and the value of Gross's account is greatly enhanced by frequent reference to his letters home—letters that preserve an emotional intensity and authenticity of language that otherwise would have been lost. The book is well illustrated with photographs taken by the author and his fellow aviators (the incredible youth of the warrant-officer pilots and their crews is striking), and these surely enhance the intensity and authenticity as well. Gross also makes good use of the testimonies of comrades who served with him. His style is spare and straightforward, and his account modest and direct, unsparing in his assessments of himself and others. His observations on leadership, good and bad alike, are compelling. After returning from Vietnam, the author embarked on a career in aviation—at the time he wrote this book, he worked as a captain for American Airlines, flying Boeing 757s and 767s. He knows his flying, and it shows. In the reviewer's perhaps biased opinion (I flew Air Force HH-3E and HH-53C "Jolly Green" rescue helicopters in Southeast Asia in 1965–66 and 1975), *Rattler One-Seven* is one of the most authentic pilot's memoirs to come out of Vietnam—and surely *the* best by a helicopter pilot.

Gross takes the reader with him from his decision to join the Army, through his experiences with helicopter training, to the long flight from McChord AFB, Washington, to Vietnam. Arriving as a "newby," he undergoes the trials and tribulations of learning the operational environment and aircraft while gaining acceptance from his unit's experienced pilots. Gross preferred to fly "Slicks"—UH-1 D and H troop transports—as opposed to UH-1G Cobra gunships, though he had friends in his brigade's attack-helicopter company and draws extensively on their experiences in his narrative. We follow along as he grows in skill and experience, finally earning election (yes, election—very different from Air Force procedures!) as senior aircraft commander at the tender age of 20. Gross flew a variety of missions, ranging from being on night flare-ship alert, standing by to help beleaguered outposts; hauling ground commanders and their staffs; spraying Agent Orange; and inserting special operations groups into Laos as well as extracting them. His account of a night extraction of a compromised patrol from a minuscule landing zone (LZ) in south Laos had the hair standing up on the back of my neck!

The author logged the bulk of his missions in the assault role, hauling mostly troopers from the Army of the Republic of [South] Vietnam (ARVN) into combat (US line infantry was being withdrawn when he arrived in-theater). This was mostly routine—but not entirely. The climax of the book comes with the participation of Gross's unit in Operation Lam Son 719, the ARVN's drive west from Khe Sanh to cut the Ho Chi Minh Trail by land in February–April 1971. One of the most ill-conceived operations of the war, Lam Son 719 was hamstrung by a congressional edict prohibiting the use of US ground forces in Laos. Consequently, the ARVN battalions went in without their American advisers and, lacking English-speaking forward air control-

lers, had no access to close air support. That became a matter of life and death—mostly the latter—when they found themselves heavily outnumbered by North Vietnamese regulars backed by tanks and antiaircraft artillery.

The congressional ban did not apply to US aviators, and the results were not pretty. The beleaguered ARVN infantry depended totally on US Army helicopters for insertion and extraction, and the assault-helicopter companies depended on Huey gunships for fire support, affording what protection they could against North Vietnamese .51-caliber heavy machine guns and, on occasion, 23 mm and 37 mm antiaircraft artillery and tanks. Gross's gripping account of the LZ Lolo fiasco of 3 March (because the author did not fly that day, he depends on his friends' eyewitness accounts) alone is worth the price of the book. The vision of over 100 Hueys going into a single-ship LZ in trail formation under constant fire, uncertain as to just who controlled the LZ, made my blood run cold. In the end, the courage, skill, and determination of the Army aviators salvaged something from defeat, but at a heavy price: 107 helicopters destroyed and battle damage to an additional 618 (pp. 179–80). The devil, of course, is in the details, and Gross handles them well. The Army helicopter side of the Vietnam War has been poorly served in the literature, but this fine account goes far in making good the deficiency.

Lt Col John F. Guilmartin Jr., USAF, Retired
Columbus, Ohio

Globemaster III: Acquiring the C-17 by Betty R. Kennedy. Office of History, Air Mobility Command, Scott AFB, Illinois, 2004, 298 pages (softcover).

The ideal military airlifter would have high speed and global range. It would operate from short dirt airfields and air-drop cargo as well as paratroopers. The airplane would be big enough to carry every type of equipment and vehicle used by the US Army and US Marine Corps yet still fit on the runways, taxiways, and ramps of austere airstrips. It would cost relatively little to develop, manufacture, operate, and maintain; furthermore, it would move quickly from concept to operational service.

Needless to say, such an ideal airlifter is a physical impossibility; like all weapon systems, the C-17A Globemaster III represents a compromise based on trade-offs. In *Globemaster III: Acquiring the C-17*, Betty R. Kennedy, former Air Mobility Command historian, traces the C-17 program from its origin to its important role in the global war on terror. The program had its roots in the desire of Tactical Air Command to replace the C-7 Caribou and C-123 Provider intratheater transports that had seen use in Vietnam. By the mid-1970s, this desire had morphed into the Advanced Manned STOL [short takeoff and landing] Transport program, which produced two technology-demonstrator aircraft (the Boeing YC-14 and McDonnell Douglas YC-15), more oriented toward replacing the C-130 Hercules. By the late 1970s, airlift requirements had shifted to a need for more intertheater airlift, so the Air Force initiated the C-X program. McDonnell Douglas won the competition with a design that essentially called for a larger and longer-ranged YC-15; this aircraft became the C-17. But the C-17 program still had to face many obstacles, including advocates of such alternatives as acquiring additional C-5 Galaxies (which did occur [the C-5B]) and Boeing 747 freighters (which did not occur).

Clearly the author sifted through an enormous number of documents and conducted many interviews in this well-researched history, as reflected in the voluminous and thorough endnotes. However, she does not appear to have consulted the detailed technical reports produced by the Air Force Flight Test Center; doing so would have provided additional, valuable insight into the many technical challenges that the program encountered. Kennedy explains the many twists and turns of the program—from the initial statement through operational service—as it was buffeted by changing threats and national strategies, congressional direction, debates over interservice roles and missions, multiple layers of the Air Force organization, competing business interests, and technical challenges. One is left impressed by the enormous complexity of conceiving, planning, and executing the acquisition of a major weapon system. This well-written book reveals the many problems experienced during the program. Although painful and protracted, it did eventually produce an excellent aircraft. The detailed appendices and color photographs add much to the book's usefulness.

The reader will encounter several small but annoying errors. For example, the last name of Senator Nancy Kassebaum (R-Kans.) is misspelled, and designations of US Army vehicles are frequently incorrect. Also, the author erroneously states that the C-135 is the military designation for the Boeing 707 airliner. In fairness, these minor points do not detract from the value of the book.

One should also note that Kennedy deals with the C-17 program, not the airplane itself. Readers who want a thorough and well-illustrated description of the C-17 should consult *Boeing C-17A Globemaster III* (North Branch, MN: Specialty Press, 2001) by Maj Bill Norton, USAF, retired, who was a flight-test engineer in the program. His book effectively complements Kennedy's.

Globemaster III offers an outstanding case study for anybody interested in America's modern military-acquisition process. I also recommend it to people who operate, maintain, and support the C-17. They will benefit from an appreciation of the enormous effort it took to bring their weapon system into service.

Kenneth P. Katz
Longmeadow, Massachusetts

1776 by David McCullough. Simon and Schuster (http://www.simonsays.com), 1230 Avenue of the Americas, New York, New York 10020, 2005, 400 pages, $32.00 (hardcover); 2006, 400 pages, $18.00 (trade paperback).

David McCullough's *1776* is an absolute delight to read. Well researched and fully referenced for serious historians, the book will also appeal to members of the general public interested in details about the first year of the American Revolution. The winner of two Pulitzer prizes (for *Truman* and *John Adams*), McCullough again demonstrates his ability to create a narrative that provides historical accuracy while presenting personal insights with vivid detail.

The book has a relatively simple premise. It begins with the debate in October 1775 in the British Parliament over the "desperate conspiracy" and "open revolt" taking place in America (p. 10). At the end of the debate, the House of Lords and House of Commons voted overwhelmingly to support King George III's plan to deliver a decisive blow to the riotous rebels of America. Four months earlier on the other side of the Atlantic, the Continental Congress had unanimously appointed George Washington the new commander in chief of the army. John Adams, who had nominated Washington, remarked that the appointment "will have great effect in cementing and securing the union of these colonies" (p. 43). The remainder of the book describes the clashes between British forces and the Continental Army during 1776. These occurred in three different places: Boston, New York City, and New Jersey. McCullough describes the American successes in Boston that compelled the British forces to evacuate, the British successes in New York City that forced the American troops to evacuate, and the American triumph in New Jersey.

The strength of the book, however, does not lie in the historical description of these clashes although they are quite adequate, especially for non-historians. Rather, one finds the real strength—and most interesting part—of *1776* in the rich detail that McCullough provides about warfare and the people involved in it, including the effect of the weather, knowledge of terrain, morale, leadership, training, sickness, and chance. By utilizing multiple sources, especially diaries and personal letters, the author makes the stories come to life. As Thomas Paine wrote in *The Crisis* after the withdrawal from New York City, "These are the times that try men's souls. The summer soldier and the sunshine patriot will, in this crisis, shrink from the service of their country; but he that stands by it now, deserves the love and thanks of man and woman" (http://www.ushistory.org/Paine/crisis/singlehtml.htm).

McCullough's *1776* shows the tenuousness of the situation in the first full year of the American Revolution. It also demonstrates how good fortune, providence, and the exceptional leadership of George Washington preserved the cause for freedom. This book is a must-read for military professionals.

Dr. Jack D. Kem, Colonel, USA, Retired
Fort Leavenworth, Kansas

Space as a Strategic Asset by Joan Johnson-Freese. Columbia University Press (http://www.columbia.edu/cu/cup), 61 West 62nd Street, New York, New York 10023, 2007, 320 pages, $45.00 (hardcover).

Dr. Joan Johnson-Freese, professor and chair of the Department of National Security Decision Making at the Naval War College, is an expert on the political aspects of space as an important military and commercial environment in which the United States has a critical national-security interest. Her book *Space as a Strategic Asset* offers a wonderfully insightful account of the necessity of managing US forays into this region. It addresses the political goals of the United States, Russia, China, and Europe as well as the roles played by NASA, the National Reconnaissance Office, and the Department of Defense concerning the following space systems: Helios, Clipper, Columbus, Apollo, Galileo, Ariane,

International Space Station, Soyuz, Global Navigation Satellite System, Shenzhen, and the global positioning system.

The book has the right focus for discussing the political, commercial, and military interests of space as a region of national interest. Not filled with technical equations about raising a platform into low Earth orbit, it instead clearly explains why various countries desire to utilize such a platform. Moreover, the author points out the shortcomings of some American political operatives who fail to grasp the importance of space unless it involves an immediate and direct increase in jobs (read votes) for the constituents in their congressional districts.

Johnson-Freese explores the nuances of the international space race, including several interesting discussions on issues underlying the military use of space, manned and unmanned space systems, and the complexities of dual-use technology. Written in a pithy manner, this study is chock full of information regarding commercial, political, and military space issues.

Space as a Strategic Asset will appeal not only to all serious students of political science, including officers attending the nation's war colleges, but also to armchair tacticians who want to expand their understanding of the political and military aspects of space rather than its technical aspects. I certainly recommend this well-written, well-organized, and informative book, which exposes the reader to salient issues related to space as a region of worldwide concern.

Col Joseph J. McCue, USAF, Retired
Springfield, Virginia

Frontline Pakistan: The Struggle with Militant Islam
by Zahid Hussain. Columbia University Press (http://www.columbia.edu/cu/cup), 61 West 62nd Street, New York, New York 10023, 2007, 256 pages, $24.95 (hardcover).

If any air warriors in the readership of *Air and Space Power Journal* need convincing that the US foreign policy in the Islamic world is complex and dangerous, they can get a good view of it in *Frontline Pakistan*. Although readers accustomed to English will have difficulty with the Pakistani personal and place-names therein, the labyrinth of politics and religion in a region that hovers near anarchy will persuade just about anybody of the dilemmas facing decision makers everywhere.

Zahid Hussain appears well qualified to attempt to give us a picture of the situation. A journalist providing materials to the *Times* of London, *Newsweek*, and the *Wall Street Journal*, he has a good writing style and is an expert on the region, having had access to some hard-to-get-at sources. He organizes his work in topical chapters and in a more-or-less chronological order. The political landscape is cluttered with military, religious, power-seeking, nuclear-smuggling, and drug interests that yielded an almost impossible problem for former president Pervez Musharraf, who tried to survive in the midst of a number of mutually hostile domestic groups and the pressures of international politics.

I fear that the reader seeking a coherent picture of Pakistan and Afghanistan is doomed to frustration. Both countries have long seemed ungovernable, partly because the central governments have had very limited powers over regional and local interests. I suppose that the main idea of the book is that trouble probably looms ahead for the United States because of Pakistan's status as a principal ally during the global war on terror—largely because President Musharraf sided with America, a position that goes very much against the tide in his own homeland. That cannot continue forever, according to Hussain, and I suppose that he thinks the only possible solution lies in allowing real democracy in Pakistan. However, given the strength of the local warlords and the growing power of radical Islam, that *would* be a miracle. Atop that, Musharraf faced a tough problem of nuclear proliferation. Pakistan followed India into the elite group of nuclear states, but its control of nuclear secrets has proved defective, and its people have been involved in serious underground nuclear proliferation. If that were not enough, he also was utterly dependent upon the loyalty of his military—a little shaky because the latter has an affinity for some of the radical Islamic groups, and they oppose secular government. Hussain does not address the character of the "liberal" Pakistani groups who advocate secular rule, but it appears that radical Islam and military rule are completely antithetical to them. Moreover, Musharraf faced the perennial issue of the dispute with India over Kashmir. Although he managed to contain that to a certain degree, it remained fully capable of boiling over into a disaster for him—and for the United States. Because our campaign in Afghanistan against the remnants of the Taliban and al-Qaeda greatly depends upon our relationship with the Pakistani government, that means trouble.

Few Americans know much about Pakistan and its surrounding region, and *Frontline Pakistan* will

certainly not make one an instant expert on the subject. However, it is readable and will serve as a useful introduction to the problems of the area. I therefore recommend that it occupy a moderately high place on your reading list.

Dr. David R. Mets
Maxwell AFB, Alabama

War Bird Ace: The Great War Exploits of Capt. Field E. Kindley by Jack Stokes Ballard. Texas A&M University Press Consortium (http://www.tamu.edu/upress), John H. Lindsey Building, Lewis Street, 4354 TAMU, College Station, Texas 77843-4354, 2007, 224 pages, $29.95 (hardcover).

Author Jack Stokes Ballard has written a biography of Field E. Kindley, a high school dropout who ended his combat career as the fourth-ranking American fighter ace of World War I. Not only an ace, Kindley became a leading flight and squadron commander in the American air forces. Ballard's book also offers a good introduction to the war in the air over the trenches, highlighting the introduction of the airplane to armed forces in combat.

During his time as a flight commander, Captain Kindley worked out his priorities, implementing practices to bring the pilots in his flight home after the war. He remained in Europe as part of the occupation forces, tasked to contribute to the compilation of lessons learned, particularly those concerning the deployment and operation of air units. Kindley's fame became such that he testified before Congress regarding the needs of the Army's aviation branch in both training and equipment.

He continued his Army career following the war, entering a number of races to show off the art of aviation. Although he didn't win any of them, his efforts proved instrumental in the life of Army aviation, keeping it in the limelight and thus alive. Unfortunately, Captain Kindley perished in an accident while practicing for a live-firepower demonstration. Noticing that several people had entered the target area, he buzzed the location in an effort to get them to leave, but as Kindley returned to his flight, he apparently turned too sharply. The accident board concluded that he had either unintentionally stalled the airplane or that the aircraft's aileron control had failed. The attempt to clear the target area reflected his consideration for others.

Although the writing can become somewhat tiresome in places, the book is an easy read, well documented with both footnotes and a bibliography. The final chapter provides a good summary. Who was Capt Field Kindley? What made him the person he was and the aerial leader he turned out to be? By reading *War Bird Ace*, we discover the personal characteristics that served one man well in becoming a leader as well as a commander in any military organization. We would do well to emulate them.

Lt Col Raymond F. Hain III, USAFR, Retired
Wilmington, Delaware

American Generalship: Character Is Everything: The Art of Command by Edgar F. Puryear Jr. Presidio Press (http://www.randomhouse.com/rhpg/category/military), Random House Publishing Group, 1745 Broadway, New York, New York 10019, 2001, 400 pages, $17.95 (trade paperback).

In *American Generalship*, Edgar F. Puryear aims to define and explain leadership as practiced by general officers from George Washington to Colin Powell. He builds a useful and highly readable leadership primer filled with historical examples and anecdotes that enable the reader to "hear" top commanders discuss their own experiences.

Puryear's premise is that military members can learn effective leadership skills and techniques from studying what has made great generals successful and what has characterized their styles and philosophies. Military-management studies frequently compare business practices to military ones and try to distill applicable lessons. Uniquely, this book provides hundreds of concrete examples of military officers exercising leadership in situations with which every officer and noncommissioned officer will identify. The author proudly mentions that he has gathered over 10,000 pieces of correspondence and interviews with more than 1,000 general and flag officers, including 100 four-stars. Among those he has interviewed are legends such as Dwight Eisenhower, Omar Bradley, Matthew Ridgway, Carl Spaatz, Jimmy Doolittle, and Curtis LeMay, granting rare insight into their decision making—not only on major issues of war and peace but also on matters they faced as junior and field-grade officers. Puryear's ability to weave highlights from these discussions into his narrative is compelling, and he relates them in an engaging manner. In addition, he cites examples from Civil War memoirs and great American soldiers who lived before he began his study. He does not deal in esoteric management

theories but repeatedly strikes his target with practical examples of military officers confronted with the real challenges of leadership. Most of what his subjects cite is neither battlefield bravado nor the genius many of them displayed as combat leaders, but the hard decisions made by commanders at every level and by program directors as well as section chiefs, doing the everyday work of the military.

As his subtitle indicates, "Character Is Everything," and in these pages the reader finds officers making the "right" choices. Puryear points out that great leaders gain authority from their "strength of character" because "there is absolutely nothing as important in successful leadership as character" (p. 1). He states that several principles are common among great leaders. These include selflessness, decisiveness, willingness to hear opposing views, study of one's profession (and related issues), mentoring, and having sufficient trust in subordinates to delegate authority. All of these are essential to success and growth within the military profession and are real expressions of the Air Force's core values. None are always easy, yet all are crucial to success in command or in any leadership role. One unique aspect of this book is its touch on intangibles, such as a sixth sense in decision making (a feel for morale, conditions, and situations) and consideration for others. Although both are essential to any leader, neither is easily defined. In describing them, Puryear provides a reminder that much of what we do as leaders is undefined but indispensable. A leader who is trusted will be able to use these indescribable qualities more freely than one who is not.

The interviewees' frequent references to their own mistakes is a valuable feature of the book. Many authors show us success and say "do this." The candor shown by Puryear's subjects humanizes them and makes this study more interesting. He relates a story from Maj Gen Lunsford E. Oliver, a commander under Patton. As Oliver's division became increasingly ensnarled with other units on French roads, he was summoned to headquarters. General Patton opened the meeting with the statement "We are in a hell of a mess and it is my fault" (p. 289). These words eased a conscientious subordinate's mind, and he was able to continue with his duties, knowing that he still had his commander's support and that blame would not be pushed down the chain. A story told by Air Force general T. R. Milton presents the view from the perspective of "I personally made a mistake." He recounts an ineffective bombing mission over Germany and how Gen Curtis LeMay had the discernment to see that the mistake was an honest one (p. 290). We should heed the epigraph quoting Gen George Marshall at the beginning of this chapter: "Fix the problem, not the blame" (p. 285). A leader has the vital task of judging when people have made that honest mistake and when they have violated trust or procedure. One is a failure of training or learning; the other is willful or critical. One requires understanding; the other discipline. We can learn as much from failure as from success. It is imperative that leaders exercise this level of sensitivity and judgment.

Furthermore, the personal recollections of World War II leaders prove fascinating. We sometimes forget that officers in that great conflict faced limited resources, operational demands, and the typical pressures we confront daily in the military profession. Too often we place these legends in a pantheon, as if they were destined for greatness, forgetting that they were officers trying to do a job while coping with insufficient data, competing requirements, and incredibly difficult taskings, not to mention career issues such as assignments, training, promotion, family needs, and the uncertainties of life. Yet, in tying the experiences of these renowned generals to men such as Ulysses S. Grant, William T. Sherman, and John J. Pershing, as well as leaders of our own time—H. Norman Schwarzkopf, Colin Powell, and Charles Horner—Puryear builds historical unity in these principles, validating their timeless nature and memorably reinforcing them by scaling these heroes in human proportions.

American Generalship gives us an opportunity to learn from leaders worthy of emulation and to ponder the way they coped with situations not too different from those with which we deal every day. Many authors give us bits that we can put in our leadership toolbox, but Puryear provides a rich resource for all military professionals who expect to face the challenges of leadership.

Col James M. Pfaff, Ohio ANG
Columbus, Ohio

Mission Debrief

Air and Space Power Journal, the US Air Force's professional journal, is published in English, Spanish, Portuguese, Arabic, French, and Chinese. Each version is independent and has an editor—a native speaker of the particular language and an expert in the region of coverage—who selects its content. We're always looking for good, thought-provoking articles up to 5,000 words in length, written in any of our published languages. All submissions will be edited in accordance with the standards set forth in the *Air University Style and Author Guide* (available online at http://aupress.au.af.mil/Resources/style/austyle_guide.pdf). For details, please see our guidelines for submitting articles at http://www.airpower.au.af.mil/airchronicles/howto1.html. You can contact us by e-mail at aspj@maxwell.af.mil; regular mail at *Air and Space Power Journal*, 155 North Twining Street, Maxwell AFB AL 36112-6026; phone at DSN 493-2949 (commercial [334] 953-2949); or fax at DSN 493-5811.

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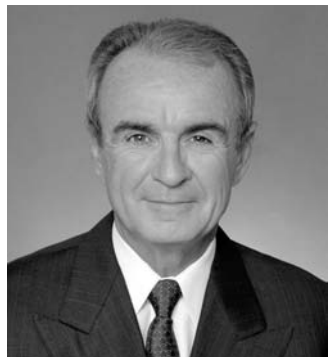
The Editor

OUR CONTRIBUTORS

Air Vice-Marshal Prof. R. A. Mason, Royal Air Force (RAF), retired, CB, CBE, MA, DSc, Hon. FRAeS, DL (DSc, University of Birmingham), holds an honorary chair in the Department of Political Science and International Studies at the University of Birmingham, England. For many years, he has spoken and published books, articles, and papers internationally on airpower and related defense subjects. He has contributed to studies for the RAF and United States Air Force (USAF), as well as the air forces of Australia, New Zealand, Germany, Sweden, the Netherlands, Switzerland, Norway, Oman, India, Thailand, South Korea, and the Republic of China. A graduate of the RAF Staff College and the USAF Air War College, he is a former director of the Centre for Studies in Security and Diplomacy at the University of Birmingham and a specialist air force adviser to the United Kingdom House of Commons Defence Committee. He is a frequent commentator on defense issues to the media. In 2007 Air Vice-Marshal Mason was appointed an Honorary Fellow of the Royal Aeronautical Society.



Col Jeffery Barnett, USAF, retired (AB, College of the Holy Cross; MS, Troy State University), is a senior consultant with Toffler Associates. He recently drafted the Strategic Plan for the Air Force Intelligence, Surveillance, and Reconnaissance enterprise; the Air Force Reserve Strategic Plan; and a competitive analysis of the global air and space industry (for a corporate client). The author of *Future War* (Air University Press, 1996), now in its seventh printing, as well as numerous articles in professional journals, he served for 27 years in the United States Air Force in a variety of flying, command, and planning assignments. Colonel Barnett is a graduate of the Air War College.

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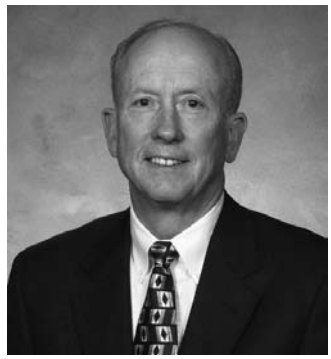
Col Richard Szafranski, USAF, retired (BA, Florida State University; MA, Central Michigan University), is a partner in Toffler Associates. His consulting portfolio includes advising chief executive officers and senior executives on managing change, creating growth, and remaining competitive in the future. He serves on a number of industry advisory boards and was a member of the Defense Science Board's 2007 summer study. He is a member of the International Institute for Strategic Studies. His Air Force career included command at the wing, base, and squadron levels. The author of many writings on military strategy and operational art, he continues to lecture at the intermediate and senior levels of national and international educational institutions for civilian, government, and military professionals. Colonel Szafranski is a graduate of Air Command and Staff College and Air War College.

Maj Travis A. Burdine (USAFA) is the functional manager and subject-matter expert for Predator and Reaper systems on the Air Force Unmanned Aircraft System (UAS) Task Force, assigned to the Air Staff, Headquarters US Air Force, Washington DC. A senior pilot with over 2,500 flying hours in the E-3 AWACS and over 750 hours in the MQ-1B Predator, he served as the first chief of Group Standardization and Evaluation for the United States Air Force's first UAS wing—the 432d Wing at Creech AFB, Nevada. Major Burdine is a graduate of Air Command and Staff College, Maxwell AFB, Alabama.

Col Sung-pyo Hong, Republic of Korea Air Force (PhD, University of Hull), is a professor at the Korean National Defense University, where he teaches defense policy, military strategic planning, future warfare, and airpower strategy. A pilot, he previously worked in the Planning Department of Headquarters of the Air Force, the Military Strategic Planning Department of the Joint Chiefs of Staff, and the Office of Revolution in Military Affairs of the Ministry of National Defense, Republic of Korea (ROK). He did postdoctoral research study at the RAND Corporation in 1996. He has translated two books into Korean—*Future War* (Air University Press, 1996) and *A League of Airmen* (RAND, 1994)—and has written numerous articles, including "Prospects on the US-ROK Alliance," *Military History* (December 2005), and "The Future of the USFK," *New Asia* (January 2006).

Dr. Peter Warren Singer (AB, Princeton University; PhD, Harvard University) is Senior Fellow and director of the 21st Century Defense Initiative at the Brookings Institution, Washington, DC. He is the youngest scholar named Senior Fellow in Brookings's 90-year history. He has worked for Harvard University, the International Peace Academy, and the Office of the Secretary of Defense. In his personal capacity, Singer served as coordinator of the Obama '08 campaign's defense-policy task force. Singer is the author of the book *Corporate Warriors* (Cornell, 2003), which introduced the study of private military firms, and *Children at War* (Pantheon, 2005), which explored the rise of another new force in modern warfare—child soldier groups. His latest book is *Wired for War* (Penguin, 2009), which explores the implications of robotics on the battlefield. For further information, see http://www.pwsinger.com.



Dr. Raymond Shulstad, Brigadier General, USAF, retired (BS, University of Alabama; MS, PhD, Air Force Institute of Technology), is an independent consultant to industry and government for a broad range of topics, including organizational management and leadership, research and development, and systems engineering and acquisition. In 2006 he retired as the senior vice president and general manager of MITRE's Center for Air Force Command and Control Systems. Prior to joining MITRE in 1999, he was the director of Strategic Planning for Surveillance and Battle Management Systems for Northrop Grumman Corporation. General Shulstad retired from the Air Force in 1994 after a distinguished 28-year career. His final assignments included vice-commander of the Aeronautical System Center at Wright-Patterson AFB, Ohio (1993–94), and vice-commander of the Electronic Systems Division, Hanscom AFB, Massachusetts (1991–93). His publications include *Peace Is My Profession* (National Defense University Press, 1986), a book that deals with the moral dimensions of US nuclear policy.

Col John D. Jogerst, USAF, retired (USAFA; MS, University of Arkansas), has served as a C-130/MC-130 navigator and has commanded deployed theater special operations aviation components for Operations Provide Comfort, Enduring Freedom, and Iraqi Freedom. He has served as a squadron commander, commandant of the USAF Special Operations School, and a member of the faculty at the Air War College as Special Operations Forces Chair to Air University. Colonel Jogerst is a graduate of Squadron Officer School, Air Command and Staff College, and Air War College.

Lt Col Houston R. Cantwell (BS, University of Virginia; MS, George Washington University; MMOAS [Master of Military Operational Art and Science], Air Command and Staff College; MAAS [Master of Airpower Art and Science], School of Advanced Air and Space Studies) serves as an operational planner at Headquarters Third Air Force, Ramstein AB, Germany. He is an F-16 instructor pilot, having flown at Osan AB, South Korea; Moody AFB, Georgia; and Misawa AB, Japan. While assigned to the Pentagon, he worked in several offices, including the Office of the Deputy Secretary of Defense, the Office of the Secretary of Defense for Personnel and Readiness—Military Personnel Policy, and on the Air Staff for the Air Force chief of safety. At Air University, he wrote several papers on the advance of unmanned aircraft. Colonel Cantwell flew in support of Operation Southern Watch and recently served on the headquarters staff, 1st Armor Division in Operation Iraqi Freedom and on the staff of the air component coordination element in Operation Enduring Freedom.

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Air Force Future Operator Symposium

Defining and Developing Future Air Force Operators in Air, Space, and Cyberspace

21–23 July 2009
Maxwell AFB, Alabama

Sponsored by Headquarters Air Education and Training Command (AETC) and hosted by the Air Force Research Institute (Air University)

Mission Statement

The mission of the Future Operator Symposium is to determine the future operator's competencies in air, space, and cyberspace; and to make specific recommendations regarding the development, education, and training of operators.

Overview

The Air Force Future Operator Symposium, part of the Air Force Symposium Series, will bring Airmen together to discuss future Air Force operators by exploring developmental, educational, and training issues the Air Force may face in the next seven to 10 years.

Through workshops and breakout sessions, symposium attendees ultimately will make recommendations on developing operators who are technically proficient in their weapon systems yet at the same time able to operate effectively in a cross-domain environment (air, space, and cyberspace). The symposium will also address topics relating to operators of unmanned aircraft systems, especially requirements/realities (rated versus nonrated) and career development. The overall objective is to make recommendations on how the Air Force should develop, educate, and train future operators while supporting Air Force cultural acceptance and recognition of emerging career fields for operators.

Who Should Attend

The symposium seeks the participation of Airmen/operators of all ranks (officer and enlisted) who have experience either in the air, space, or cyberspace domains or in the cross-domain/joint environment. Sister-service personnel are also welcome. Attendees should be interested in, and committed to, determining how the Air Force should develop future operators.

For more information, contact the Air Force Research Institute, Maxwell AFB, Alabama, by e-mail at

afsymposiumseries@maxwell.af.mil