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Sea-Land Basing of Air Refueling Forces

A Concept for Resiliency and Efficiency

Dr. Robert C. Owen

This discussion proposes a serious look at an old concept in a new application—providing sea-based support of US Air Force air refueling forces at forward land bases in the face of modern antiaccess/area-denial (A2/AD) threats. Given the proliferation of robust A2/AD capabilities in the hands of potential enemies, this con-

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cept offers theater commanders the possibility of operating air refueling forces efficiently and with resilience.[1] It would do so by freeing some of those forces from dependence on large, fixed, and heavily defended air bases. Put another way, sea basing could transform tanker aircraft and support elements from predictable targets waiting for the next shot to peas in a fast-moving shell game—one presenting difficult-to-impossible detection and targeting challenges for enemy command systems.

To set it apart from the many other versions of sea basing discussed in the literature of national defense, the article refers to this notion as sea-land basing (SLB). Essentially, SLB is a concept for the *agile disaggregation* of air refueling forces among austere military and civil airfields possessing minimal support facilities for large aircraft other than runways. The signature characteristic of SLB would be the dedicated integration of at least one "missionized" base ship with an expeditionary air refueling unit of up to about 20 aircraft. This ship would house the command, logistics, maintenance, personnel, and other elements needed to support dispersed expeditionary air refueling operations at several airfields simultaneously. At a given time, one or two of those airfields would serve as forward operating locations (FOL) able to service and protect aircraft and crews assigned to the SLB unit and/or those transiting through from bases or aircraft carriers located further to the rear. In addition to the FOLs, an SLB ship would service a small number of "hide" airfields, providing protection and limited services only. The main difference between FOLs and hides is that the former would offer robust, expeditionary aircraft refueling support while the latter would not. Otherwise, both types of base would be manned and resourced on a minimal and highly mobile basis, capable of being disembarked and set up or packed up and reembarked in just a few hours.

As a preliminary and largely qualitative examination of SLB, this study argues two salient points. First, it asserts that SLB offers enough potential advantages in operational capacity and resilience to justify

robust study and experimentation on behalf of one or more geographic combatant commands. Second, this article maintains that the present Air Force air refueling program-of-record fleet—what it has and what it plans to acquire—is not structured to exploit the full potential of SLB. Getting the most from SLB in the face of robust A2/AD capabilities likely will require adjustments in the planned air refueling force structure. These discussions begin with a little history.

History

The long history of sea basing speaks to the practicality and potential value of SLB. As early as World War I and for decades thereafter, the US Navy employed seaplane tenders to support reconnaissance and bombing operations at remote locations. During World War II, the Navy, Marine Corps, and Army Air Forces made extensive use of ships in support of land-based air operations. The Army Air Forces' Project Ivory Soap, for example, consisted of 6 Liberty and 18 smaller ships to serve as floating warehouses and heavy maintenance depots for B-29 and P-51 groups in the Pacific.[2] In the 1960s, the Navy employed the USS *Tallahatchie County* (AVB-2) as an advanced aviation support base in the Mediterranean.[3] Presently, the Ready Reserve Fleet includes two ships, the USS *Wright* (T-AVB-3) and USS *Curtis* (T-AVB-4), that serve as advanced logistics and maintenance support bases for Marine aircraft.[4] Their exercises include the use of T-AVBs in support of ashore aircraft ranging from attack helicopters to C-130s.[5]

The USS *Tallahatchie County* experience provides a particularly relevant analog to SLB since it involved the prolonged integration of an amphibious base ship and rotating squadrons of P-2 Neptune patrol aircraft. The Navy redesignated the *Tallahatchie*, originally built as a 6,000-ton landing ship tank (LST 1154), as an advance aviation base support ship in early 1962. In that role, the ship was modified to house the supplies, maintenance shops (engines, avionics, sheet metal, etc.), and crew complements (the ship's, air crew, and aviation support) needed to keep up to nine Neptunes in operation for months. The sup-

port divisions sent ashore were housed in 19 service trailers stored on the ship's vehicle deck while under way. These included command, communications, meteorology, crew briefing, flight-line maintenance, medical, galley, and others. Upon arriving at a forward location, the AVB would beach, lower its ramp, and disgorge two-and-one-half-ton trucks towing the service trailers to the forward base, carrying tentage and supplies for a cantonment area. With experience, the ship's personnel could begin ashore operations at a coastal airfield less than four hours after the ship beached, breaking down and reembarking the unit in as little time.[6] Once deployed, the P-2 squadron commanders were integrated into the ship's company, serving as chiefs of the *Tallahatchie*'s aviation division but taking their operational orders from the theater-level commander of the Anti-Submarine Warfare Force Sixth Fleet.[7]

The Antiaccess/Area-Denial Threat to Air Refueling Forces

Although the United States is no more likely to go to war with China than with other potential enemies that wield substantial A2/AD capabilities, Chinese military forces offer a useful standard for assessing basing options. For over two decades, China has been "pursuing a variety of air, sea, undersea, space and counterspace, and information warfare systems and operational concepts . . . moving toward an array of overlapping, multilayered offensive capabilities extending from China's coast into the western Pacific."[8] Further, Chinese strategists have identified mobility forces, including tankers, as key and vulnerable targets in the event of a conflict with the United States.[9]

China's A2/AD order of battle is robust, multilayered, and increasingly capable. It begins with an array of land-based, airborne, and satellite-based intelligence, surveillance, and reconnaissance (ISR) systems capable of searching the globe episodically and the western Pacific more or less continuously.[10]

To exploit these capabilities, China fields 1,900 combat aircraft (600 of which are modern); over 1,000 short-range ballistic missiles (SRBM);

a "limited but growing" fleet of DF-21C and D medium-range ballistic missiles (MRBM); and hundreds of DF-1, -2, and -3 cruise missiles.[11] All of these weapon systems can deliver precision-guided ordnance. The DF-21 and cruise missile elements are particularly important to any considerations of air refueling force basing since they can reach all established US air bases in Korea, Japan, and the so-called first and second island chains in the western Pacific. Further, unclassified documents estimate that these systems have average impact accuracies (circular error probable) of 10–50 meters.[12] In other words, if fired at known or predictable locations of tanker aircraft and not stopped or deflected by US defenses, these missiles likely will hit their targets.

Given the growing sophistication and weight of Chinese A2/AD capabilities, most analysts presume that basing large aircraft within their range would court disaster.[13] The large size of tanker aircraft and their extensive support requirements make them vulnerable to long-range strikes, even by "shots in the blind" at predictable aircraft parking locations. Constructing costly shelters for air refueling aircraft could improve their survivability at forward bases, but, as more than one strategist has pointed out, "no matter how good a HAS [hardened aircraft shelter] might be, a penetrating projectile can be built to defeat it."[14] Consequently, many studies would agree that US tankers and other large aircraft "should be operated from bases out of range of China's conventional ballistic missiles."[15]

However, there is reason to think that China's long-range strike capabilities will not be a "coordinated whole" anytime soon. The Chinese military is neither well versed nor structured to practice the art and science of coordinating joint ISR and strike forces in high-tempo operations. China is searching for a "Chinese model" for joint command and control, of course, but its quest is hampered or at least constrained by a host of national economic, social, and political circumstances beyond its control.[16] Important among these are the potential political consequences of transforming the Chinese officer corps into a culture of nationalism, professional skill, and integrity in the service of a ruling

political elite characterized by self-serving, faux communist orthodoxy; nepotism; and corruption.[17] Until those competency problems are solved, therefore, the Chinese military will remain capable of launching effective operations in the preplanned opening gambits of a conflict but potentially uncertain and slow in dealing with unfolding events in the face of the fog and friction of war and competent enemies fighting back.[18]

Furthermore, the weight and persistence of Chinese attacks will decrease over distance and in the face of counterstrikes. Because of China's limited air-to-air refueling capabilities and lack of experience with establishing expeditionary air bases, its ability to project all-capabilities "gorilla strikes" against US bases will be restricted to about 400 nautical miles (nm) from its mainland—the approximate operational radii of weapons-laden fighter aircraft.[19] Fighters and China's small fleet of H-6 bombers will supply the weight of "gorilla ring" strikes, augmented by missiles and perhaps special operations forces (SOF). Missile augmentation will drop drastically beyond about 350 nm since that is the range limit of China's SRBMs, which comprise the majority of its missile magazine.[20] Further, beyond 400 miles, the scale of the Chinese aircraft attacks would be limited to the H-6 fleet and whatever fighter packages could be supported by its small air refueling force. Consequently, outside the gorilla ring, missiles will become the main threat to US air bases. Missiles are dangerous, but a few hundred MRBMs and cruise missiles will not match the power and persistence of attack possible inside the gorilla threat ring. Moreover, the outer boundary of the "missile ring" would be limited to the approximately 1,000 nm range of the DF-21 MRBMs and HN-3 land-based cruise missiles. Chinese naval ships and submarines could launch cruise missile strikes against bases deeper into the Pacific; however, the weight of their attacks would be relatively limited, and they would be exposed to US and allied detection and counterattacks.

Advantages

These considerations of Chinese command and strike capabilities suggest an opportunity to operate tanker forces from within the missile ring—one offering enhanced resilience and operational effectiveness for air refueling forces. The agile disaggregation of SLB bases and forces would enhance their resilience by denying Chinese commanders the confidence they would want before releasing precious weapons against fleeting targets. Their lack of confidence would reflect reality since the locations of at least some FOLs and hide bases in SLB would shift daily while the aircraft and other key assets on each operating airfield would change position more or less hourly. Further, with the bulk of SLB assets embarked, these base movements would impose minimal disruption on operational efficiency. Additionally, their locations in the missile ring would improve their ability to deliver fuel to supported combat aircraft.

The unpredictable and agile disaggregation of SLB air refueling forces will be the key to their resilience. They will be unpredictable because opening those bases would not depend on the existence of preconflict physical or contractual preparations, or expensive and politically sensitive base-access agreements. In other words, preparations for SLB would not signal intent to use any specific bases.[21] Camouflage discipline, emissions security, and other deception operations could delay the detection of active FOLs, hides, and even the base ship's locations for hours—even days. Enemies who did discover the locations of operating bases would remain uncertain about where to aim their long-range weapons and residual gorilla strike packages. By the time the decision to release precious assets filters through a sluggish and deteriorating political and military command system, the aircraft and support teams on those fields at the time of detection may well have moved on. Even if an airfield were still in operation, tugs would move the few aircraft on it every few hours between dispersal sites. This dynamic dispersal tactic would invalidate enemy targeting information more than a few hours old and ensure that no two aircraft were ever

close enough to be destroyed by a single area weapon or unitary warhead. In most situations, then, enemies sniping at sea-land refueling bases would be shooting in the blind, hoping against reasonable hope that their weapons would do more than just move dirt when they arrived.

Operating air refueling aircraft from inside the missile ring rather than from beyond it will enhance their operational efficiency in two ways. First, at least in the western Pacific, doing so will increase the number of bases and parking spots available for air refueling aircraft. A glance at a map of the western Pacific reveals many civil and military airfields located within the range of DF-21 missiles launched from China and relatively few among the scattered islands further out in the Pacific. With more bases available, SLB units could operate closer to the fight, and they would be less likely to find themselves competing with combat units for scarce parking spaces.[22] Second, moving into the missile ring would greatly increase the amount of fuel that tanker aircraft will be able to off-load to receiver aircraft.

The operational geography of maintaining an air refueling orbit 250 nm west of Manila during a crisis in the South China Sea serves as an instructive example of the efficiencies gained from moving tankers into the missile rings. Basing tankers at Tacloban Airport, in the southeastern Philippines, would put them in the middle of the missile ring but only about 510 miles from the orbit point. Operating those same tankers from Pelieliu or Tinian islands would put them beyond the range of Chinese DF-21s but also about 1,125 or 1,700 nm from the refueling point, respectively. Table 1 indicates the effect of increased distance on the net off-load capacity on KC-46s and C-130Js.[23]

Table 1. Off-load at refueling point (x 1,000 pounds)
(presumes round-trip transit, two hours on station, and one hour reserve fuel)

Aircraft/Departure Base	*Tacloban*	*Pelieliu*	*Tinian*
KC-46	165	138	113
KC-130	50	32	14

Predictably, the tyranny of distance would be greater for the smaller and slower KC-130J, which would lose 75 percent of its productivity from a shift to Tinian from Tacloban, while the bigger and faster KC-46 would lose about 33 percent. For perspective, consider that F-35s will burn about 9,000 pounds of fuel per hour in cruise flight. Thus, a C-130 making the 10-hour round trip from Tinian could off-load enough fuel to extend a single fighter's endurance about 1.5 hours and burn 50,000 pounds of fuel itself making the trip.

Bases

Sea and land bases will be essential to the agility and resilience of SLB. Consequently, though SLB remains too undeveloped conceptually to support a detailed discussion of its base elements—the ship, FOLs, and hides—it remains useful here to list some of the tasks and equipage likely required of them.

The SLB ship would be "missionized" to fulfill the tasks necessary to support ashore units, including

- transporting all of an air refueling unit's personnel, equipment, and supplies over strategic distances at respectable maritime speeds of, say, at least 20 knots;
- debarking, sustaining, and embarking the personnel, equipment, and supplies needed at FOLs and hides at minimally developed ports or over the shore in matters of hours;
- transporting and assembling ship-to-air base fuel systems, such as the Air Force's Expeditionary Fuel System or a variation of the Marine Corps's Amphibious Assault Fuel Systems and Tactical Airfield Fuel Dispensing System, and connecting them to supporting tanker ships;[24]
- conducting close-in self-defense against likely threats, including aircraft, cruise missiles, torpedoes, fast boats, and SOF; and

- providing reinforcements and close air support to ashore security teams under threat from enemy SOF or other small raiding units.

To conduct these missions, the equipage of SLB ships likely should include

- amphibious craft for ship-to-shore moving of FOL, hide, and base-opening/-closing teams and for conducting logistics operations when the ship is near a base or bases;
- optionally armed, multimission utility helicopters to provide ship-to-shore logistics, mobility, and close air support to ashore units;
- at least two ship-to-shore bulk fuel systems, each with enough capacity to support 12–20 air refueling aircraft in high-tempo operations; and
- a sensor and weapons suite capable of providing adequate surveillance and close-in defense against likely threats.

Compared to the two aviation support ships currently in the Maritime Prepositioning Fleet, a ship built or modified for SLB need not be particularly large or expensive. The USS *Curtis* and *Wright* displace around 50,000 tons, but they have a wide portfolio of missions and exercise frequently in support of the full range of Marine Corps aviation support, humanitarian-relief operations, and exercises.[25] An SLB ship, in contrast, would be dedicated to the support of a single, moderately sized aviation unit. In that case, a ship the size of a 16,000–18,000-ton amphibious transport dock (LPD) might suit the mission. In its original configuration, one of the retiring *Austin*-class LPDs, for example, can accommodate over 1,200 personnel, up to 6 helicopters, different types of landing craft, food for 2 months, a 12-bed medical clinic, and large numbers of vehicles and maintenance shop spaces. Of relevance, the USS *Ponce* (LPD-15) was converted for $60 million into an interim afloat forward staging base (AFSB [I]-1) in 2012 to sustain special operations and countermine activities in the Arabian Gulf.[26] Of course, other ships could be converted to the SLB mission. The point is that the

physical requirements for an SLB ship are modest and need not break the bank to acquire.

Given their center-of-gravity importance to the overall SLB concept, it is useful to pause here to consider the survivability of SLB base ships. In reasonable likelihood, an SLB ship would prove as survivable as the other amphibious warfare and surface combatant vessels that the US and allied navies would have to operate in the missile ring. Constant maneuver would be the keystone of a base ship's resilience. It would move constantly, pausing periodically only for an hour or two to disembark or reembark FOL and hide teams or to exploit a hide position of its own. Other evasion tactics available to the ship would include combinations of camouflage, terrain and shallow-water masking, and emissions masking and deception. Its smaller size and freighter-like horizontal and overhead profiles would make it more difficult for long-range radar and overhead infrared and electroptical sensors to parse it out from general maritime traffic. The ship also should be equipped with the close-in electronic and kinetic defensive systems typical of other amphibious warfare ships. When employed as the terminal layer of the overall offensive and defensive operations of a US and/or allied force, such systems would give the base ship a fighting chance to defeat or divert incoming bombs, missiles, torpedoes, small-boat attacks, and the like. Such a ship would not be impervious to every conceivable enemy attack, of course, but it would not be helpless or doomed to an early sinking.

Benefiting from the robust and continual support provided by their base ships, SLB FOLs and hides will be modestly sized and equipped. Hide bases, for example, would field only the personnel needed to park, inspect, and service aircraft; rest and feed air crews; offer a command and communications node; and ensure security. FOLs will perform these functions and operate expeditionary fuel systems. Based on these limited requirements and informal discussions with expeditionary-experienced Air Force and Marine logisticians, one would reasonably presume that the support echelons at a typical FOL would involve

150–200 personnel and about 30 vehicles while a hide would involve 80–100 service members and about a dozen vehicles. These numbers would vary at the margins in reflection of the security environment and the availability of host-nation civil contract and military support. The air command and operational support echelons on ship probably would fall in the realm of 250–350 personnel. Thus, an SLB unit supporting 12–20 tankers at an FOL and two hides would include about 700–900 personnel as well as the ship's company. Of course, most support and operational personnel and most assets would be drawn from the Air Force's existing air refueling force.[27] Only the ship and its crew would be additive to existing Maritime Administration or Navy programs, depending on how they were operated.

FOLs and hides, therefore, would not present the usual picture associated with an Air Force expeditionary air refueling base: rows of aircraft in predictable locations, acres of concrete, a busy traffic pattern, fuel-tank farms, cantonment areas, and so on. Instead, the typical SLB location would look like an ordinary civil airport with the addition of a few scattered military elements. Depending on the daily utilization rate of the aircraft (the percentage of time spent in the air) and the number of dispersal bases utilized, the number of tankers parked around a given airfield might range from a half dozen to only one or two. Fairly often, tugs would be seen towing an aircraft among widely scattered parking spots, many of them perhaps off concrete. Clusters of fuel-bladder tanks would occupy well-separated locations on and off the field. They would be contained by the only substantial engineering project required to open an FOL—soil berms bulldozed up by military civil engineers or civil contractors a day or two before the base ship arrived offshore. In the likely absence of an underground fuel hydrant system, aircraft would taxi or be towed to scattered surface hydrants connected at a safe distance from the bladder system. The cantonment and trailer-mounted support facilities might or might not even be on the field, and the latter would be relocated routinely. The only other indications that a military operation was under way would include a visible presence of local soldiers and vehicles in the environs of the

field, joint patrols of host-nation and US security personnel within the airfield, and the fairly unobtrusive comings and goings of US vehicles. Such minimalist and transitory facilities certainly could and would be detected episodically by enemy air, space, and human ISR components. Looking at the photographs or reading reports, however, enemy intelligence interpreters would be hard pressed to know if the Americans had just arrived or had been there for a couple of days and might have departed already.

Aircraft

Given the criticality of basing agility during operations in the missile ring, the selection of an aircraft best suited for SLB operations will reflect a different *balance* of performance criteria than for other Air Force air refueling missions. Heretofore, Air Force tanker aircraft acquisitions have been predicated on the availability of developed bases and a preeminent emphasis on range and offload capacity. Consequently, all Air Force core tankers, except those purchased to support SOF and helicopter operations, have been modified airliner designs. As long as adequate airfields are available, these aircraft have been the most cost-effective platforms for delivering fuel over long distances. Aircraft designs best suited to exploit SLB, in contrast, would trade some range/payload efficiency for enhanced capacity to operate from less-developed airfields. As the following figure indicates, tanker aircraft capable of operating from austere airfields could disperse more widely than airliner-derived designs and operate further forward—with good effects on their survivability and off-load capacities at their points of need. It may also be useful, as the Marines have done with their KC-130 fleet, to consider the secondary airlift and other uses of aircraft matched to the SLB mission.[28] The austere airfield characteristics of these aircraft would fit them well for logistics operations and for support of maneuvering land forces as well as combat air units operating at forward locations or at main bases with damaged runways or limited parking areas.

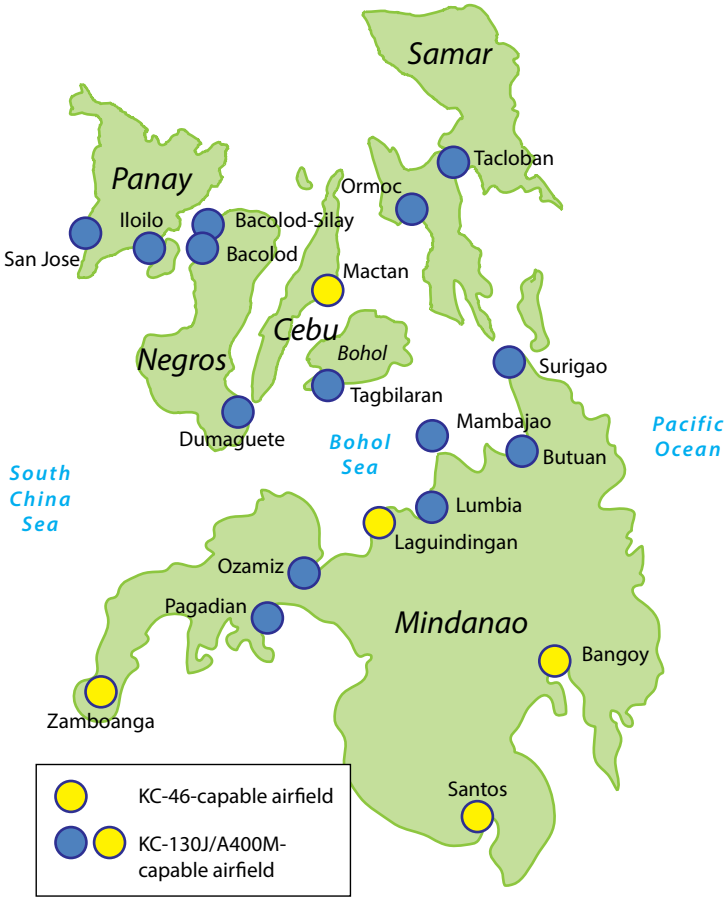

Figure. Airfields in the southern Philippines capable of accommodating KC-46s (yellow) and KC-130s/A400Ms (yellow and blue). Importantly, all are located near—sometimes within yards of—waters navigable by a base support ship and/or its amphibious craft.

At present, the field of aircraft available for comparison as SLB platforms is limited to the Boeing KC-46A, Lockheed KC-130J, and Airbus A400M. Other platforms could be considered, including the US Air Force's current KC-10s, KC-135s, more modern airliner designs, and the Embraer Corporation's developmental KC-390. Nevertheless, this study passes over these aircraft as offering few or no advantages over KC-46s or as being too old (KC-135s) or limited in numbers (KC-10s).

The KC-390 will offer an interesting option for smaller air forces, but it has no performance advantages over the KC-130, apart from speed, to justify its augmentation into the US fleet. For a number of reasons, then, the only aircraft worthy of serious consideration for SLB are the current mainstays of the Defense Department's air refueling modernization programs (the KC-46A and KC-130J) and an in-production international design falling between them in size and general capabilities (the A400M).

The KC-46

An airliner-derived design, the KC-46 is the most productive of the aircraft under consideration in terms of off-load/range performance and the one most *limited* in its access to regional airfields. As indicated in table 2, the KC-46 is designed for long-range, high-capacity operations.[29] Depending on airfield altitude and aircraft weight, however, KC-46s typically will demand hard-surface runways of 7,000–10,000 feet in length as well as hard-surface parking areas.[30] Although airfields of suitable length for KC-46 operations are available in most regions of the world, they are limited in number, and their paved parking areas tend to be sized for just a few large aircraft. Thus, almost anywhere they might be employed, SLB-supported KC-46 units will remain constrained in their ability to employ agile disaggregation among bases and dynamic dispersal upon them. In other words, they will prove more vulnerable to early detection, preplanned attacks, and even blind shots than will aircraft with more agile operational characteristics on the ground.

Table 2. Fuel off-load capacity at varying operational radii (pounds x 1,000)
(presumes round-trip transit, two hours on station, and one hour reserve fuel)

Radius of action (nm)	*0 (capacity)*	*500*	*750*	*1,000*	*1,250*	*1,750*
C-130J	82	51	44	36	28	12
A400M	138	89	77	66	55	32
KC-46A	207	155	144	134	122	110

Able to carry up to 18 standard cargo pallets, the KC-46 does offer significant bulk airlift capabilities. Its airliner cabin, though, has neither the dimensions nor strength to accommodate armored combat vehicles or pallets loaded to exploit the full height of C-5 and C-17 aircraft. These characteristics would undermine or eliminate the usefulness of the aircraft in support of movements by mechanized ground forces and air defense missile units, the resupply of forward airfields damaged by enemy attacks, or interfaces with type-designed military airlifters moving combat relevant cargos further forward.

The KC-130J

From the perspective of SLB, the KC-130J is a mirror image of the KC-46: it offers strong potential for agile basing coupled with modest range/off-load characteristics (see table 2). Perhaps the most obvious attribute of KC-130Js in this role is their ability to operate from weakly paved or even unpaved runways and parking areas. Fully loaded, they can land and take off from runways 3,000–4,000 feet in length, using assault takeoff procedures, or about 5,000–6,000 feet, using normal (and safer) procedures. Moreover, they can taxi or be towed onto unpaved surfaces, greatly increasing the parking areas available to them at many airfields. Consequently able to operate from a wider number of airfields and to frequently relocate assets on them, an SLB force based on the KC-130J would present an unpredictable and generally unremunerative target set for short-supply, high-cost A2/AD weaponry.

Within the limits of the aircraft's capabilities, SLB can mitigate the operational handicaps of the KC-130's modest range/off-load perfor-

mance, equipage for probe-and-drogue refueling operations only, and small size. Indeed, its effectiveness over the vast distances of a theater like the Asia-Pacific would hinge on forward basing, preferably with the agility and resilience provided by SLB. Further, an SLB probe-and-drogue tanker force would offer value to overall theater air refueling efforts by providing more efficient support to Navy and Marine aircraft operating from bases and aircraft carriers outside the missile ring. Doing so would permit theater air commanders to focus boom-equipped tanker aircraft on supporting Air Force planes.

In contrast, SLB would offer only modest and indirect improvements to the KC-130's limited cargo capabilities. Sea-land bases doubling as KC-130 forward refueling points could increase the range and efficiency of their cargo operations. Nevertheless, the aircraft's modest speed and cargo "box" size will restrict its primary roles to transporting passengers, palletized cargo, and the light equipment of tactical air units. Otherwise, it cannot load combat-configured, medium-weight, armored fighting vehicles and, consequently, has only limited ability to support movements by mechanized units or air defense forces. Similarly, even though it could operate on and around damaged runways and ground-movement areas, a C-130 fleet likely would be hard pressed to deliver the cargo tonnages needed to keep major bases operating in the face of persistent A2/AD attacks.[31]

The A400M

Despite—or perhaps because of—its international pedigree, the A400M offers performance compatibilities worthy of serious consideration by US planners (see table 2). Operationally, it can utilize virtually the same runways and parking areas as the KC-130J but with markedly better characteristics of range/off-load, speed, and cargo capacity. Depending on range, the A400M will deliver from two to three times more fuel to receiver aircraft than the KC-130J. It is significantly smaller than the KC-46A, but in the context of SLB, the A400M can offset its relative limitations through forward basing. For example, in the sce-

nario of supporting a refueling orbit 250 nm west of Manila, a KC-46 operating from Tinian would have 113,000 pounds of fuel available for off-load while an A400M operating from Tacloban would offer about 90,000 pounds. Moreover, the KC-46 would burn about 100,000 pounds of fuel performing its mission—a ratio of about .88 burn/off-load. The A400M, meanwhile, would consume 48,000 pounds for a .53 burn/off-load ratio. Depending on operational circumstances, then, an SLB fleet element of A400Ms could greatly reduce the logistical costs and fuel infrastructures required to support combat operations. Once again, the aircraft's probe-and-drogue capabilities would limit it to the support of Navy and Marine Corps aircraft, but it generally would do so more effectively than KC-130Js and with significantly improved flexibility and resilience over KC-46s.

Finally, the aircraft's large cargo box and 41-ton cargo capacity would make it a better airlift partner to the C-5/C-17 fleet than either of the currently programmed tankers. At the moment, Air Force and Army planners contemplating movements into austere airfields confront the reality that C-130s can get into a wide range of airfields but can carry comparatively little while C-17s carry much more but also rut, gouge, and otherwise render unpaved surfaces unusable after only a few passes.[32] A fleet element of flex-role A400s could fill that gap. They could provide substantial lift over strategic and tactical distances in support of main air bases degraded by enemy attacks; furthermore, they could deliver combat-relevant mechanized, engineering, and air defense units closer to their points of need than any aircraft or combination of aircraft in the Air Force program-of-record fleet.

Recommendations

This study set out to encourage the Air Force to take a serious look at a variation of sea basing for air refueling forces in the face of substantial A2/AD threats. The article's discussion of the nature of China's capabilities in this realm suggested that even a robust A2/AD system presents opportunities to operate air refueling forces at forward air

bases as long as their tactics include agile disaggregation *among* airfields and dynamic dispersal *upon* airfields. By assessing historical and existing sea-basing concepts, it also made the point that SLB likely will prove viable both operationally and logistically. Finally, the discussion of aircraft suggested that the air refueling program of record likely would benefit from the addition of a platform better able than those currently in the fleet to fully exploit SLB. As an example, the article noted that a modest fleet of A400Ms would increase the number of bases available for air refueling operations, optimize the operational opportunities presented by SLB, and provide valuable augmentation to the airlift fleet. The costs of such an aircraft could be offset by earlier retirements of geriatric KC-135 and aging C-130H aircraft, and by reduced purchases of other tankers following the current KC-46A program. Taken together these considerations of conceptual viability, capabilities of alternative aircraft, and the availability of cost offsets suggest that the Air Force would do well to carefully examine and test SLB with an eye toward achieving initial operational capability in the four-to-six-year midterm.

Accordingly, the Air Force should initiate an aggressive study-and-test program for SLB in the near term. By the end of 2017, that program should have completed at least the following analytical elements:

1. Assessment of SLB in the context of joint war plans, service operational concepts, and predictions of potential A2/AD threats.
2. Examination of SLB in the context of the full range of tanker aircraft missions. For example, the integration of tankers and fighter aircraft at unpredictable and rapidly changing forward operating locations could greatly improve the ability of air commanders to (a) maintain rotations of aircraft in defensive counterair orbits, (b) support large gorilla strike surges, and (c) maintain forward alert forces to reinforce aircraft in airborne barrier patrols in the event of large-scale enemy attacks.

3. Creation of a whole-of-concept blueprint of the operational, logistical, command and control, and other issues relevant to the effectiveness and resilience of SLB units.
4. An initial field test of the concept using existing C-130 and/or KC-135 aircraft. Initially, these tests could be conducted on land by "FOL," "hide," and "ship" components under rules that simulate the distance, restricted facilities, and logistics of sea-land operations. As soon as possible, however, the Air Force should partner with the Navy to try the concept with an actual ship base.
5. Examination of the applicability of SLB to other Air Force missions, particularly fighter FOLs, ISR, and SOF.

These analytical efforts could be undertaken quickly and cost effectively by a combination of in-house study centers, contract research organizations, well-directed interservice groups of war and staff college students, and service test organizations. Given the threats resident in the Asia-Pacific and elsewhere, it will be important to see if the time-proven concept of blending sea- and land-base elements still has currency in the A2/AD world. ✪

Notes

1. Resilience is the ability to withstand attack, adapt, and perform military operations in the face of continued enemy assaults.

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3. The *Tallahatchie County* veterans maintain an informative web page. See "USS Tallahatchie County LST-1154/AVB-2," accessed 20 June 2014, http://www.usstallahatchiecounty.com.

4. David Kummer, "Aviation Logistics Support: The T-AVB's Role in Aviation Logistics Planning," *Marine Corps Gazette*, September 2012, 52–53.

5. "The Logistical Impact of Seabasing," Second Line of Defense, accessed 20 July 2014, http://www.sldinfo.com/the-logistical-impact-of-seabasing/. This article includes an interview with Marine colonel Bradley Weisz, deputy commander of Expeditionary Strike Group Two, who participated in exercise Bold Alligator 2012. See also Colonel Weisz, "The Bold Alligator 2012 Approach," Vimeo, video, 04:54, accessed 21 July 2014, http://vimeo.com/35058483. For similar US Army tests, see Marcus Weisgerber and Paul McLeary, "US

Army Explores Sea-Basing Helos," *DefenseNews*, 13 April 2014, http://www.defensenews.com/article/20140413/DEFREG02/304130010/US-Army-Explores-Sea-Basing-Helos.

6. Capt Charles Walker, USN, retired, telephone interview by the author, 27 March 2014; and Timothy R. Neuman, telephone interview by the author, 4 March 2014. Captain Walker commanded the *Tallahatchie County* in 1968–69.

7. Capt Charles Walker, USN, retired, to the author, e-mail, 22 June 2014.

8. Department of Defense, *Annual Report to Congress: Military and Security Developments Involving the People's Republic of China 2014* [hereafter *Annual Report 2014*] (Washington, DC: Department of Defense, April 2014), 30, http://www.defense.gov/pubs/2014_DoD_China_Report.pdf.

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10. Ben Blanchard, "China's President Xi Urges Greater Military Use of Space," Reuters, 15 April 2014, http://uk.reuters.com/article/2014/04/15/uk-china-defence-idUKBREA3E03G20140415; and Department of Defense, *Annual Report 2014*, 65.

11. Department of Defense, *Annual Report 2014*, 7, 27, and throughout; Mark A. Stokes and Ian Easton, *Evolving Aerospace Trends in the Asia Pacific Region: Implications for Stability in the Taiwan Strait and Beyond* (Washington, DC: Project 2049 Institute, 2010), 12–13, http://project2049.net/documents/aerospace_trends_asia_pacific_region_stokes_easton.pdf; and Jonathan F. Solomon, "Defending the Fleet from China's Anti-ship Ballistic Missiles: Naval Deception's Roles in Sea-Based Missile Defense" (master's thesis, Georgetown University, 15 April 2011), 25.

12. "Missile Threat: DF-21/-21A/-21B/-21C/-21D (CSS-5)," George C. Marshall and Claremont Institutes, accessed 26 June 2007, http://missilethreat.com/missiles/df-21-21a-21b-21c-21d-css-5/; and "Missile Threat: HN-1/-2/-3," George C. Marshall and Claremont Institutes, accessed 26 June 2007, http://missilethreat.com/missiles/hn-1-2-3/?country=china#china.

13. John Stillion and David T. Orletsky, *Airbase Vulnerability to Conventional Cruise-Missile and Ballistic-Missile Attacks: Technology, Scenarios, and U.S. Air Force Responses* (Santa Monica, CA: RAND, 1999), 99, http://www.rand.org/content/dam/rand/pubs/monograph_reports/1999/MR1028.pdf; and for examples of this widely held position, see Christopher J. Bowie, *The Anti-access Threat and Theater Air Bases* (Washington, DC: Center for Strategic and Budgetary Assessments, 2002), 58–65.

14. Carlo Kopp, "Hardening RAAF Air Base Infrastructure," *Air Power Australia*, 5 February 2008, 25, http://www.ausairpower.net/APA-2008-02.html.

15. Cliff et al., *Entering the Dragon's Lair*, 99.

16. For insights into China's uncertain and contradictory approach to modernized command and control, see Zhao Shengnan, "New Joint Command System on Way," *China Daily*, 3 January 2014, http://usa.chinadaily.com.cn/china/2014-01/03/content_17212780.htm; and the military's quick rebuttal in Bai Tiantian and Liu Yang, "No Joint Command: MOD," *Global Times*, 6 January 2014, http://www.globaltimes.cn/content/835937.shtml. For analysis of the situation, see James Mulvenon, "Rearranging the Deck Chairs on the *Liaoning*? The PLA Once Again Considers Reorganization," *China Leadership Monitor* 43 (Spring 2014),

http://www.hoover.org/research/rearranging-deck-chairs-liaoning-pla-once-again-considers-reorganization.

17. Shai Oster, "President Xi's Anti-corruption Campaign Biggest Since Mao," *Bloomberg*, 4 March 2014, http://www.bloomberg.com/news/2014-03-03/china-s-xi-broadens-graft-crackdown-to-boost-influence.html.

18. Department of Defense, *Annual Report 2014*, 32.

19. Reliable data on the likely performance specifications of China's probable next-generation fighters is not available in unclassified documents. However, this analysis presumes that their range with strike-configuration weapons loads will be roughly equivalent to that of late-model F-16s and F-18s, which fall in the 350–450 nm window.

20. Department of Defense, *Annual Report 2014*, 85.

21. For useful discussion of access issues, see Bowie, *Anti-access Threat*, 33–36.

22. This was exactly the case prevailing during the conflict between NATO and Libya in 2011. Even among southern Europe's many airports, the number of KC-135-capable runways (about 10,000 feet in length) was limited, and they were either unavailable civilian airports or their limited ramp spaces were filled by combat aircraft. Consequently, the productivity of the small air refueling force available was undermined by the necessity of operating from Moron, Spain; Istres, France; and other bases even further away from Libya.

23. Given the public unavailability of nonproprietary information on the KC-46's expected range/off-load characteristics, this data is a product of integration and interpretation of data from several sources, including the following: Boeing, "767 Airplane Characteristics for Airport Planning," September 2005, http://www.boeing.com/assets/pdf/commercial/airports/acaps/767.pdf; Air Force Pamphlet 10-1403, *Air Mobility Planning Factors*, 12 December 2011, http://static.e-publishing.af.mil/production/1/af_a3_5/publication/afpam10-1403/afpam10-1403.pdf; and "Boeing 767-300ER," in *Jane's All the World's Aircraft, 2012–13*, ed. Paul Jackson (London: HIS Global, 2012), 998. This data, therefore, is reasonably accurate but not definitive. Basic presumptions include 207,000 pounds of transferable fuel, 10,000 pounds/hour burn rate, and 460-knot cruise. The KC-130 data is based on C-130J air refueling performance information provided by HQMC Aviation Division, APP-5 (Plans, Concepts and Integration), to the author, e-mail, 13 June 2014. Basic presumptions include 83,000 pounds of transferable fuel (tanker configuration), 5,000/hour burn rate, and 320-knot cruise.

24. In combination the Tactical Airfield Fuel Dispensing System and Amphibious Assault Fuel System consist of about 300 tons of equipment, providing bladder-bag storage for 1.4 million gallons of fuel. Setting up the entire system would require around a dozen individuals working for about four days. However, a more limited capability could be set up in much less time. The long pole in the process is building the earth berms necessary to contain fuel spills or fires. See data sheets provided by the Marine Corps System Command: "Tactical Airfield Fuel Dispensing System (TAFDS)," accessed 5 August 2014, http://www.marcorsyscom.marines.mil/Portals/105/pdmeps/docs/FUEL/B0675.pdf; and "Amphibious Assault Fuel System (AAFS)," accessed 5 August 2014, http://www.marcorsyscom.marines.mil/Portals/105/pdmeps/docs/FUEL/B0685.pdf. See also US Army 10th Transportation Battalion (Terminal), "PHIB SEABEE BATTLEBOOK," 6 February 1998, 16–17, http://www.fas.org/man/dod-101/sys/ship/docs/phibcb-battle.htm; David Willoughby, "Fueling for Today's U.S. Military," Petroleum Equipment and Technology Archive, September 1997, http://www.petrolplaza.com/technology/articles/MiZlbiYxMDIzMSYzJjEmMiYm; and Lance Cpl Keenan Zelazoski, "Bulk Fuel Company Demonstrates Capabilities of Amphibious Assault

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25. John Reardon, US Maritime Administration, Division of Sealift Operations and Emergency Response, datasheet provided to author, 25 May 2014.

26. Notably, the $60 million refurbishment did not include replacement of the ship's engines or upgrades to its defensive systems. "LPD 4 Austin class," Federation of American Scientists, accessed 26 February 2014, http://www.fas.org/man/dod-101/sys/ship/lpd-4.htm; and Robert Johnson, "America Has Never Had a Ship Like the USS Ponce," *Business Insider*, 23 September 2012, http://www.businessinsider.com/photos-uss-ponce-012-9?op=1.

27. These personnel and resources estimates are tentative and approximate, of course. They represent a series of roundtable, telephonic, and e-mail discussions by the author with logistics experts in Air Mobility Command; the 6th Air Mobility Wing at MacDill AFB, FL; Headquarters US Marine Corps; and Headquarters Marine Forces Pacific during June and July 2014.

28. James K. Sanborn, "Corps Pins Its Future on the Multi-mission KC-130J Super Hercules," *Marine Corps Times,* 19 May 2014, http://www.marinecorpstimes.com/article/20140519/NEWS/305190028/Corps-pins-its-future-multi-mission-KC-130J-Super-Hercules.

29. Regarding the C-130J, see note 23 (KC-130 data). Basic presumptions include 83,000 pounds of transferable fuel (tanker configuration), 5,000/hour burn rate, and 320-knot cruise. Information for the A400M is based on extrapolations of data provided in EADS North America briefings: *All* A400Ms Are Tanker and Receiver Capable (2014); and A400M: Combat Delivery to Point of Need (2013). Basic presumptions include 9,000 pounds/hour fuel burn rate, 400-knot cruise. Regarding the KC-46A, see note 23. Basic presumptions include 10,000 pounds/hour fuel burn rate and 460-knot cruise.

30. See note 23.

31. Robert C. Owen, "Theater Airlift Modernization: Options for Closing the Gap," *Joint Force Quarterly* 75 (4th Quarter 2014): 13–18, http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-75/jfq-75.pdf.

32. For discussions of C-17 and C-130 effects on soft fields, see Air Force Civil Engineer Support Agency, "Engineering Technical Letter 97-9: Criteria and Guidance for C-17 Contingency and Training Operations on Semi-Prepared Airfields," 25 November 1997, 10, https://www.wbdg.org/ccb/AF/AFETL/etl_97_9.pdf; and Lockheed Martin Corporation, *C-130J Super Hercules: Whatever the Situation, We'll Be There* ([Bethesda, MD: Lockheed Martin,] n.d.), 18.

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Building a Partnership between the United States and India

Exploring Airpower's Potential

Dr. Adam B. Lowther
Dr. Rajeswari Pillai Rajagopalan

Relations between the United States and India have expanded in the nature, content, and depth of the countries' partnership over the last decade. Highlighting the importance of these relations, President Barack Obama during his visit to India in November

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2010 described relations with India as "one of the defining and indispensable partnerships of the 21st century."[1] Manmohan Singh, the Indian prime minister at that time, echoed similar sentiments when he said that India had "decided to accelerate the deepening of our ties and to work as equal partners in a strategic relationship that will positively and decisively influence world peace, stability and progress."[2]

Bilateral relations are important on their own; however, Prime Minister Singh emphasized "a shared vision of security, stability and prosperity in Asia based on an open and inclusive regional architecture" that both India and the United States share as the apex of the relationship.[3] Therefore, if this partnership is as important as the two leaders seem to suggest, a greater strategic synergy is needed. One way of attaining it is through improved military-to-military relations. That is, as the two countries better understand and appreciate each other, they can work jointly for the greater good of the region and beyond.

This article suggests that a greater focus on the development of "airpower diplomacy" by both the US Air Force (USAF) and the Indian Air Force (IAF) as a strategic and operational capability integrated into the mission set of both services could mitigate conflict, preserve USAF and IAF assets during a time of tight budgets, and further the interests of both nations in the Asia-Pacific. As we define *airpower diplomacy*, it is a proactive approach to preventing and deterring conflict, building partnerships, and defending national interests by employing airpower in nonkinetic operations as an instrument of national power. Such an approach to the use of airpower may be particularly relevant to the United States as it seeks to pivot to a region where alliances in the style of the North Atlantic Treaty Organization (NATO) are unlikely and where the citizenry of many potential partners is sceptical of American intentions in the region. This article explains why a joint US-India airpower diplomacy strategy is a relevant objective and offers some thoughts on such a strategy's ends, ways, and means.

Setting the Strategic Context and Rationale

With Asia in the midst of a major shift in the balance of power as China rises rapidly, the impact of the Chinese on the Asian strategic framework has become a major driver for greater cooperation between India and the United States. If those countries are to be successful, though, they need greater coordination and synergy in terms of both policies and approaches. US-India military engagements have been growing since the 1990s, but they have primarily remained dominated by their navies. On the one hand, the manner in which both of those services were able to coordinate and respond to the 2005 Christmas tsunami and subsequent reconstruction programs is a testimony to their level of cooperation. On the other hand, the two air forces have done their part in annual exercises and training but have not been able to effectively sell the critical importance of their cooperation from a strategic perspective. It is important for both the air force and the political leadership to understand and appreciate their soft-power roles if they are to play a meaningful part in building regional peace and stability.

In broader terms, both India and the United States have to be realistic about the shifting balance of power in Asia and beyond. Also, as India's political and strategic landscape changes, with its influence spreading beyond South Asia, it must remain mindful of the implications of that power dynamic. Few issues are as pertinent as India takes on a more important role in the emerging Asian strategic order. If India is unwilling to play the role of a junior partner in a China-centric Asia, then it has to ensure continued "American primacy," which has guaranteed peace and stability in Asia and beyond for several decades.[4] One of the overriding factors of concern is that India's unwillingness to see an Asia dominated by one power would mean that New Delhi is left with balancing China as a more acceptable option. However, the power differential between India and China today does not present India with many choices for intraregional balancing because significant expenditures would be necessary to match Chinese military capability. Conse-

quently, external balancing is the most feasible option, at least in the near to midterm. India has not been forthcoming in displaying its options despite its inability to balance China on its own. However, this situation is likely to change over the next decade, if not earlier. Very likely, India's interests as well as the lack of full-scale capacity to deal with these issues on its own will move India closer to the United States and other Asian partners, including Japan and Australia.

Even as the two countries speak different languages in reaching the same strategic ends, they face common threats. Thus, it might prove beneficial to share information more frequently about the evolving force ratio and thereafter develop appropriate measures in a more coordinated and coherent manner. As for the common challenges, threats to India's northeastern region are quite similar to the ones that the United States confronts in the Western Pacific, including advanced integrated air defense systems, advanced fighters, and increasingly sophisticated electronic warfare capabilities. These common issues suggest that both countries, particularly their militaries, should talk to each other more often, learn from each other's experience, and develop more coordinated and coherent approaches as a means of ensuring regional stability.

Why should India choose the United States? Looking at the international hierarchy of power, New Delhi must realize that Washington will continue to be a central player in Asia for the foreseeable future. India would do well to see the positive attributes of a closer strategic partnership between New Delhi and Washington—encouraging the military-to-military relationships that lie at the heart of the airpower diplomacy strategy proposed here. In reality, as both India and the United States make efforts at crafting sophisticated strategies to deal with Asian uncertainties, neither can afford to distance itself from the other. The fluidity of the situation in Asia is such that both have to effect a policy of cooperation in order to ensure stability. Doing so calls for greater synergies in their foreign-policy orientations with all the major powers, particularly Japan, Australia, and Russia. The role of

small and middle powers such as Vietnam, Taiwan, and South Korea is equally significant in stabilizing the Asian continent.

Context for Promoting Airpower Diplomacy

Generally associated with the pursuit of peaceful relations between states, diplomacy nevertheless comes in many forms. Although somewhat of an arbitrary distinction, diplomacy can be divided into two broad groups—incentive based and threat based—with more than a dozen specific types of diplomacy falling within these broader groupings. On the one hand, incentive-based diplomacy relies on soft power and the carrot. It succeeds when states engaged in diplomacy reach an agreement that serves the interests of all parties. On the other hand, threat-based diplomacy is coercive in nature, employing means such as the threatened use of force or sanctions. The use of incentive-based diplomacy (traditional, commercial, conference, public, preventive, resource, and humanitarian) is increasing as the Obama administration shifts away from a grand strategy centrally focused on the use of hard power.[5] This movement in policy will give the USAF an opportunity to play a greater role in the conduct of soft power or, more specifically, incentive-based diplomacy.

Although many American Airmen may dismiss the notion of the USAF conducting diplomacy at a time when it seeks to retire the A-10, stand-down flying units, and cut or terminate acquisition programs, there is a pragmatic benefit to convincing Congress of Airmen's ability not only to drop bombs and destroy targets but also to win friends and influence people with those same assets. In many respects, airpower diplomacy highlights the capabilities of airpower at the opposite end of the spectrum where we usually direct our efforts.

Logic of Airpower in the United States–India Context

Viewing the present and future Asia-Pacific security environment as analogous to the post–World War II period would be a mistake. NATO

has been successful at keeping the peace in Europe for more than half a century, but no such organization exists in the Asia-Pacific—nor is a multilateral security organization likely in the near future. The ties that bind NATO members demand a system of formal alliances and cooperation that many national leaders in the Asia-Pacific are unwilling to entertain.[6] They are, however, open to pursuing their shared interests when opportunities arise. One such means available to the United States and India is airpower diplomacy—a capability ideally suited for conditions in the region. Airpower diplomacy as we define it (see above) can be critical in supporting Indian and American foreign policy objectives without resulting in major anxieties and disruptions.

At a time when fiscal pressures are unlikely to dissipate in the next decade and when the number of conventional and nonconventional challenges is increasing, it is incumbent upon both the Indian and American leadership to find cost-effective, nonkinetic means of defending their interests in the Asia-Pacific and in the larger global context. Airpower diplomacy offers India and the United States an opportunity to do just that. It also provides two additional benefits not found elsewhere: it reduces the need for a large military footprint to maintain relationships, and it offers a level of speed and flexibility that cannot be replicated elsewhere within the government. Further explanation is instructive. Simply stated, airpower diplomacy is a means of defending vital national interests, building necessary partnerships, preventing conflict, and expanding Indian and American influence without creating the anti-American or anti-Indian sentiment that often accompanies boots on the ground.

Speed, Flexibility, and Footprint

Airpower diplomacy will grow in importance for another reason. Other forms of military soft power do not have the advantages of speed, flexibility, and a limited footprint. These attributes are attractive for obvious reasons, but they are also appealing to decision makers in the current political environment. With the US military withdrawn

from Iraq and exiting Afghanistan—all while the United States pivots to the Asia-Pacific—the invade, occupy, and rebuild grand strategy of the early 2000s is proving increasingly less appealing to the American public.[7] The hard-power concentration on Afghanistan and Iraq not only was costly in blood and treasure but also required a US presence that cannot be replicated across Asia. As President Obama looks for a better way to build successful partnerships—a core function of the USAF—airpower diplomacy may prove an attractive choice. For India the challenges associated with a rising China and its more muscular and aggressive military posture complicate the regional stability question, making it imperative to work in partnership with the United States.

Practicing US-India airpower diplomacy deliberately and coherently could effectively leverage the two air forces' capabilities in the interests of both nations and Asian stability. Although the IAF and USAF prepare—in peacetime—to fight and win their respective nation's wars, preventing war is equally desirable. Airpower diplomacy is a primary contributor to that mission.

USAF-IAF Partnership in Pursuing Airpower Diplomacy

A rising India, like other countries, has multiple foreign-policy tools available to pursue its national interests. For an India whose power differential with China is significant, it should be careful when it demonstrates its limited capability. By doing so, it would avoid provoking Chinese angst and worsening the situation for New Delhi and the region. That is, India should not demonstrate military power projection in ways that would invoke strong regional responses. Partnering with the USAF to conduct soft-power missions can have the strategic effects desired without the negative consequences that a more aggressive approach would risk. Joining the United States in any number of passive military and nonmilitary operations that include observation flights of the sea lines of commerce and communication, disaster response, and humanitarian missions could prove critical. These options can project

India's military power without necessarily upping the ante. Given the IAF's budgetary constraints, such missions are possible for the IAF and would be well received by the United States, which wishes to expand its partnerships across the region. America is interested in finding regional partners that may shoulder some of the security burden—an important contextualizing factor that strengthens the attractiveness of a US-India airpower diplomacy partnership.

Although China may be a central factor driving American and Indian behavior, such concerns cannot be expressed overtly, as is suggested by Indian rhetoric. This may be so because China is a powerful and immediate neighbor that will have to be dealt with in a more nuanced manner than is necessary for the United States. However, America has had its share of problems with China. Despite intertwined economies, Washington is careful to avoid facing the wrath of China unnecessarily. In the India-China-US context, the United States has not yet had to take a stand on the India-China border and territorial problems. A conflict, even a limited one, would force America to take sides—a choice that may be far more complicated than what is understood, at least on the surface. Therefore, for both India and the United States, the optimal course is to pursue closer military-to-military ties without necessarily provoking adverse reactions from China. Airpower diplomacy provides an ideal opportunity to do that while highlighting the soft-power aspects of airpower.

Given the complexities of an uncertain Asia, India and the United States need to tread carefully as they consider soft power as a viable means of cooperation. Some of the relatively noncontroversial forms of airpower diplomacy could include humanitarian, coercive, traditional, and commercial diplomacy.

Humanitarian diplomacy. America and India can strengthen their cooperation in the area of humanitarian diplomacy without creating much controversy. Given that the Asia-Pacific region is prone to a variety of natural disasters fairly frequently, and in the absence of adequate capacities at a regional level, countries in the region have had to bear

the brunt of disasters. Thus, for humanitarian operations, airpower diplomacy should be pursued with great vigor. In the wake of the 2005 tsunami, India and the United States were able to respond with immediacy because their two militaries had more than a decade of experience with joint exercises and training. However, US-India military cooperation is primarily driven by the two navies, a fact that became evident in the wake of the post-tsunami reconstruction efforts.[8] This collaboration could be expanded to the sphere of airpower, a domain that will be of particular significance in future military operations. Civil-military cooperation (with active participation of civil and military bureaucracies) in disaster response and reconstruction efforts should become a driving force of humanitarian diplomacy.

Several recent examples of the USAF's participation in humanitarian diplomacy include operations Provide Hope (1992–94), Provide Promise (1992–96), and Support Hope (1994).[9] Furthermore, when a 7.9-magnitude earthquake struck a remote area in Sichuan Province, China (12 May 2008), two USAF C-17s deployed from the United States with desperately needed relief supplies, arriving within a week.[10] One final example is instructive. Joint Task Force Port Opening provided relief to victims of the 2010 Haitian earthquake—serving as a temporary communications node in a country whose communications infrastructure was destroyed.[11] Because of its ability to deploy rapidly to locations around the world, the USAF is undoubtedly America's best tool for supplying immediate assistance. These low-cost missions are also an excellent way to build goodwill with governments and citizens around the world—a key capability in the Asia-Pacific, where formal alliances are far less prevalent and personal relationships are far more important.

Similarly, though usually under a United Nations aegis, the IAF has supported many humanitarian operations, including those in assistance of UN missions in Somalia, Sierra Leone, Sudan, and the Congo.[12] The IAF also undertook one humanitarian mission in its neighborhood when it dropped food over the northern Sri Lankan town of Jaffna when it was besieged by Sri Lankan forces fighting a Tamil rebellion.

This operation, however, could also be seen as force projection rather than a pure humanitarian mission.[13]

Coercive diplomacy. The coming years could also see India and the United States cooperate in coercive diplomacy. Potential hot spots in Asia include North Korea, the East China Sea, and the South China Sea, among others. By working to shape and affect the circumstances and situations in these zones of uncertainty without the actual deployment of military forces, India and America could significantly improve regional stability. So far, resource diplomacy has not been explored in the Asia-Pacific context although it has the potential to emerge as an area of cooperation. This is particularly true of the South China Sea, where China is taking an aggressive position in the area, in part because of the large hydrocarbon deposits believed to lie beneath the sea floor.[14] The United States and India have a shared interest in working out safe sea lines of commerce and communications, given the importance of securing energy interests as well as important trade corridors.

Traditional diplomacy. Airpower diplomacy in the form of military interactions also has the appeal of soft power in the air domain. Most of the current efforts fall within the "train, advise, and equip" category. India does not participate in any Inter-American Air Forces Academy type of program, but the number of Indian pilots participating in USAF training programs has grown from 6 in 2006 to 93 in fiscal year 2010. Also in 2010, 170 IAF members participated in non–professional military education (PME) training programs with the USAF. PME is in fact one area in which India and the United States have a growing partnership. The IAF currently sends one officer per year to the USAF's Air Command and Staff College and one to the Air War College. In 2011 that service sent its first officer to the School of Advanced Air and Space Studies. Similarly, the USAF sends a colonel to the Indian Defense College every fourth year and an officer to the Defense Service Staff College every other year. The USAF also sent its first Council on Foreign Relations Fellow to India in 2009.

More traditional high-level visits between senior airmen are also increasing as the United States and India strengthen their partnership. Exercises such as Cope India 2002, Red Flag 2008, the Building Partnership Seminar (2009), and a dozen such others build trust between air forces and countries that were once (and often) at odds with one another.[15] Given the convergence of interests, much more is possible in the years ahead.

Commercial diplomacy. Although the sale of weapons systems to foreign governments—through an embassy's office of defense cooperation—often receives much attention, this example of commercial/military diplomacy is limited in scope.[16] However, this is one area in which the United States and India are expanding their relationship.[17] Over the years, India has made significant shifts in its procurement policy (although unstated) to diversify and thus move away from Russia toward the United States, Israel, and France, among others. Marking this shift, India's major purchases from America include LM2500 marine turbines to power warships, C-130J Super Hercules aircraft, C-17 Globemaster III heavy cargo aircraft, and P-8I Poseidon long-range maritime reconnaissance and antisubmarine warfare aircraft. Additionally, the two sides are in dialogue to finalize deals for AH-64 Apache attack helicopters, CH-47 Chinook heavy-lift helicopters, and M-777 lightweight howitzers.[18] The acquisition of the American C-17 Globemaster III in particular has been significant in the US-India context. The possession of one of the world's largest cargo planes, able to airlift troops and deliver substantial amounts of humanitarian supplies, has a particular relevance in executing several forms of airpower diplomacy, including humanitarian diplomacy and assistance in peacekeeping operations.

Challenges

Despite significant progress over the years in implementing the different facets of airpower diplomacy in the US-India context, drawbacks have occurred as well. India's decision on the procurement of medium multirole combat aircraft (MMRCA) is one such case in point (a deal

not yet concluded, even after selection of the French Rafale). Eliminating the American companies early on and finally narrowing their choices to the French Rafale and the Eurofighter Typhoon options were naive decisions made by Indian political leaders. Basing the decision on technical parameters alone was a strategic blunder.[19] An agreement as high-profile as this could have been used to send a political message to India's friends and foes alike.[20] In addition, an American fighter aircraft in India's inventory could have proved strategically significant. India's major adversaries to the east and west would have thought seriously before venturing into a conflict had New Delhi decided differently.

Despite the adverse MMRCA decision and given that the deal with France has not been concluded, the United States showed interest in selling the F-35—the Joint Strike Fighter—to India. In 2011 Robert Scher, deputy assistant secretary of defense for South Asia at that time, remarked, "The F-35 is something that we would be more than willing to talk to the government of India about should they request to find out more information about purchasing it."[21] The aircraft is one of the most expensive and sophisticated systems ever developed under select international partnership with American allies. India has not shown any interest, citing cost as a major issue. However, the radar-evading nature of the F-35 may be sought after at a later stage, particularly if India does not make much headway in its indigenous stealth aircraft program. Sale of the F-35 came up two years later, again with no decision taken although it reflects strong US interest and desire to deepen ties with India.[22] The new government has not yet made a statement on this matter although murmurs in the last few years suggest that India may drop the Rafale and choose the F-35 option. Such a decision could come in 2015.

Of additional concern is the fact that a few recent agreements have come in the way of strengthened bilateral defense relations. India's hesitancy to sign the Logistics Support Agreement—the India-specific

version of the Acquisition and Cross-Servicing Agreement, currently in negotiation—has also been a hurdle.

Regardless of such issues, India and the United States are already practicing airpower diplomacy. However, the need to institutionalize these efforts cannot be overemphasised. Given the multiple challenges facing Asia and the shifting balance of power, Indian use of soft power is increasingly important. Thus, the opportunity to engage in regional airpower diplomacy with the United States is an option that should be pursued further.

The Ends, Ways, and Means of an Airpower Diplomacy Strategy

Using the previous examples and conceptual discussion to underpin an airpower diplomacy strategy requires concentrated thinking. If predictions of the future fiscal, political, and security environment are correct, then development of an airpower diplomacy strategy is worth the effort for the United States and India. Examining its evolution in terms of ends, ways, and means offers a useful framework.

Ends

The objectives of an American airpower diplomacy strategy focused on India should address three central tenets. First, the strategy should develop cost-effective approaches to building and maintaining partnerships with that country. Although India is unlikely to enter into a formal security arrangement that resembles the North Atlantic Treaty (1949), less formal agreements can build a formidable partnership between the IAF and the USAF. Second, the strategy should develop proactive approaches to engaging with India for the specific purpose of cultivating a partnership that can temper the ambitions of China or a rogue regime in the region—although not limited to this end by any means.[23] India and the United States will not always agree on national strategy, but airpower diplomacy can remain a method of first resort for im-

proving Indo-American relations. Third, the strategy should consolidate the disparate diplomatic capabilities from across the USAF. At present, both the Indian and American air forces conduct numerous airpower diplomacy missions—great and small—but do not leverage them for their own and for India's and America's long-term benefit. Despite considerable efforts by the US Office of the Undersecretary of the Air Force for International Affairs (SAF/IA) to formulate a service strategy for building partnerships, further efforts are necessary. India as well should institute such mechanisms to formulate more coherent policies for cooperation.

Ways

The methods that the organization uses to achieve those ends are perhaps more difficult to develop than are the ends.[24] Although the following list is incomplete, the recommendations may offer a starting point for discussion of those "ways" for an airpower diplomacy strategy that assists in bringing the IAF and USAF together as their respective countries pursue strategies for a stable region.

First, for the United States, the plethora of departmental and service guidance found in the Theater Security Cooperation Strategy, Department of Defense Report on Strategic Communication, Air Force Global Partnership Strategy, Core Function Master Plan, and individual instructions, plans, and approaches could be consolidated and simplified into one document that facilitates creating a strategy that targets a specific country (India) while incorporating the range of airpower diplomacy activities.[25] Admittedly, SAF/IA and its regional affairs specialists do much of this already. The USAF has the benefit of starting from a firm foundation of experience and conceptual understanding. Harmonizing and simplifying competing interests and responsibilities, however, may prove difficult.

Second, clearly elaborating where airpower diplomacy begins and ends will go a long way toward winning support for such a strategy, both at home and in India. Just as other foreign policy tools have

strengths and weaknesses, so does airpower diplomacy. Having a clear way to determine when it is succeeding or failing is important. The ability to measure (e.g., progress, success, and failure) is particularly important in justifying expenditures during tough fiscal times.

Third, an airpower diplomacy strategy should provide a clear component specifying the who, what, when, where, why, and how that the USAF, combatant commands, Office of the Secretary of Defense (OSD), and Indian partners can all understand. When the Goldwater-Nichols Act (1986) reorganized the Department of Defense, it left the services responsible for organizing, training, and equipping forces while moving much of the "strategy" development into the OSD—making the combatant commands the war fighters. This approach makes it difficult for the services to develop and employ a strategy. Such an organizational weakness is difficult to overcome, but the Air Force must do so in order to present the combatant commander—of US Pacific Command in the case of India—with forces prepared to conduct a range of airpower diplomacy missions in conjunction with IAF partners. In light of airpower's (air, space, and cyber) ability to perform hard- and soft-power missions with equal success, the employment of force (systems and personnel) deserves significant consideration since commanders are unlikely to support retasking a shrinking force to perform soft-power missions.

Fourth, the USAF should actively promote airpower diplomacy as an alternative approach within American foreign policy—especially true in the case of India and many other Asia-Pacific nations where, as previously stated, formal alliances are less attractive. Seamlessly transitioning from a hard-power-focused strategy (Afghanistan and Iraq) to a soft-power approach (airpower diplomacy) will have great appeal over the next several years. As the Obama administration looks for a distinct alternative to the present strategy, the time is right to offer an airpower diplomacy strategy.

Means

Thought of by many people as the operational element, the means of an airpower diplomacy strategy are less than straightforward. An examination of the USAF's *Building Partnership Core Function Master Plan* (*BPCFMP*) illustrates why. Ownership of the approximately 60 programs that fall under the *BPCFMP* is widely dispersed across the Air Force. This situation makes coordination of assets difficult not only because of the complex chain of ownership that exists but also because the commands that own these dual-capable systems and personnel often view soft-power missions as lying outside their core mission. For the IAF—which is attempting to understand American motivation and objectives, partly through reading unclassified government publications—the result can be confusion because of the lack of clarity.

Although SAF/IA, Air Education and Training Command, Headquarters Air Force A8 (Strategic Plans and Programs), and the Air Force's major commands all collaborate on the development of the *BPCFMP* and strategic documents (e.g., Air Force Global Partnership Strategy), it is not possible to say that a consensus supports the use of airpower assets for airpower diplomacy missions. Thus, the means to carry out an airpower diplomacy strategy are often employed in other operations. Elevating the significance of airpower diplomacy within the strategic planning process would make it possible not only to develop an airpower diplomacy strategy for India, for example, but also acquire the necessary resources to carry out the mission.

Conclusion

In the end, the wide range of soft-power missions regularly performed by airmen makes airpower an attractive option for building partnerships, assuring allies, and dissuading enemies. Developing an airpower diplomacy strategy that strengthens the relationship between India and the United States is in the interest of both nations and constitutes a positive step toward promoting stability in the Asia-Pacific.

The IAF and the USAF must always remain capable of fighting and winning India's and America's wars, but hard power should not serve as either country's means of first resort. Airpower diplomacy is a soft-power capability having sufficient force behind it such that other nations view it as more than just empty words. As defense spending faces prolonged pressure, innovative approaches to defending the national interest can and will prove attractive. Airpower is such an option. For India, the value of soft balancing against China makes joining the United States an increasingly compelling choice. ✪

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The SAC Mentality

The Origins of Strategic Air Command's Organizational Culture, 1948–51

Dr. Melvin G. Deaile*

> *Air power can attack the vital centers of the opposing country directly, completely destroying and paralyzing them. . . . The basis of air force power is the bombardment airplane or bomber.*
>
> —Gen William "Billy" Mitchell

"KLAXON! KLAXON! KLAXON!" When public address systems echoed these words at Strategic Air Command (SAC) bases across the United States, red lights flashed and "SAC warriors" scrambled to their

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awaiting bombers.[1] As pilots frantically brought their nuclear-armed planes to life, navigators decoded cryptic emergency action messages to determine if the alert response was an actual launch against the Soviet Union or just another exercise. SAC warriors never executed their preplanned missions against America's Cold War enemy, but for over 40 years, the possibility that the United States could and might do so served to deter a possible Soviet attack against the American homeland.

Operating under these strenuous conditions placed a considerable burden on the organization. Every day, SAC aircrews studied their planned routes into Mother Russia and conducted training missions as regimented and scripted as the "real" thing. Additionally, SAC personnel's regular handling of nuclear weapons required a high degree of supervision and strict observance of established procedures. For the command's leaders, controlling this nuclear armada called for a unique operating paradigm built on routine, control, and flawless execution.

The Air Force and the nation came to rely on SAC as the pillar of Cold War deterrence. Therefore, the organization grew in size, strength, and power, reaching its peak in the 1960s. By the early 1960s, SAC's bomber generals held more than 50 percent of the senior command positions within the Air Force.[2] These leaders, largely veterans of the World War II strategic bombing campaigns, collectively believed that the threat of nuclear bombing—as well as, later, the additional risk of a nuclear missile attack—was *the* way to deter potential adversaries. In the mid-1960s, the Cold War shifted its focus when war erupted over the unification of Vietnam.[3] When the Cold War shifted to a periphery strategy, airpower concentrated on tactical aviation, and SAC's primacy in the Air Force began to wane.[4]

In 1989 the Berlin Wall fell, and the Cold War ended. The Air Force decided that the singularity of SAC's mission—nuclear deterrence—no longer met the nation's interests. The command closed its operations in 1992 and transferred its missiles to the newly formed Strategic Command. SAC's bombers became part of Air Combat Command, serving

with fighters instead of remaining separate from them. Unlike the phoenix, SAC would not rise again. Forty years of alert posturing and preparation for an apocalyptic war caused the command and its warriors to develop an organizational paradigm commonly labeled the "SAC mentality," which served the command well in the early, intense years of the Cold War.

This is the story of how this vital organization, a part of American history, developed its own organizational culture. SAC culture did not form overnight; it initially grew out of the Air Force's belief in strategic bombardment. Although SAC's culture was founded on the principle of centralized, independent bombing, the external environment—namely, the Cold War—played an important role in shaping that culture. Like any living organism, SAC evolved over time based on (1) its internal makeup and (2) its response to the external environment. In 1948 Air Force leadership earned a central role for the organization in the nation's defense, but mismanagement by SAC's leaders threatened to unravel these gains. Beginning in late 1948, new SAC leadership put the command on a war footing. By 1951 SAC embodied the belief that a highly specialized strategic bombardment force was paramount to national defense.

Simulating military operations under an "at war" mentality triggered the development of a SAC organizational culture.[5] Facing a conflict measured in hours and days rather than months and years forced the command to implement policies and directives that daily evaluated its preparation for an all-out nuclear war with the Soviet Union. In the minds of SAC's members, scripted and standardized procedures characterized the SAC mentality, setting the command apart from the other military services. Its culture became recognizable in the symbols it embraced. The intercontinental bomber represented the organization's independence from other services; the atomic bomb gave SAC its political power; and SAC's exclusive promotion system set its personnel apart from those in the rest of the Air Force, implying their uniqueness of mission and purpose. At the heart of SAC operations lay the

strategic bomber—all operations supported the main objective to put bombs on target.

Creation of Strategic Air Command: Model of an Independent, Strategic Bombing Organization

SAC embodied what airpower's prophets (e.g., Billy Mitchell and Giulio Douhet) had advocated—an offensive air armada dedicated to strategic bombardment. In Airmen's eyes, successful strategic bombardment required the application of two essential principles of war: unity of effort and mass. The precedent for the creation of SAC came from the strategic bombing campaign conducted in the Pacific. As the war effort shifted from the European theater to the Pacific, Gen Henry "Hap" Arnold recognized the divided effort in that ocean. Adm Chester Nimitz ran the campaign in the Central Pacific, and Gen Douglas MacArthur headed the effort in the South Pacific. Assigning bombers to both commands, Arnold reasoned, would divide the bombing effort. "Hap" asked the Joint Chiefs of Staff (JCS) for a different command system when newly produced B-29s began service in the bombardment of Japan. Although Arnold faced initial opposition from the JCS, he eventually won support for the creation of Twentieth Air Force, which would centrally command and control bomber operations in the Pacific.[6] This command remained the only numbered air force whose operations were directly controlled from Washington, DC. When the Army Air Forces (AAF) created SAC, it pushed for a similar type of relationship.

The JCS submitted its first plan for organizing the US military, known as the Unified Command Plan, in 1946. It specified that the SAC commander report directly to the JCS. Although SAC had not yet been assigned a specific mission, the JCS maintained control of all strategic assets through the SAC commander. Strategic bombing operations were now centrally controlled, bringing to mind Twentieth Air Force's command structure during the strategic bombing of Japan in

World War II. This situation enabled SAC to become the first specified command in the United States.[7] Since SAC now received its directives and targets directly from the JCS, it became a major part of the national war plan.[8] The Air Force, however, wanted more. The leadership desired greater autonomy for SAC operations. To increase the command's power, both symbolically and politically, the Air Force embraced not only the intercontinental bomber but also nuclear weapons.

The service approached atomic weapons from a pragmatic viewpoint. Gen Carl Spaatz issued a report in October 1945 that examined the implications of atomic bombs on strategic air operations. The US Air Force Aircraft and Weapons Board determined that "the atomic bomb . . . has not altered our basic concept of the strategic air offensive but has given us an additional weapon."[9] During World War II, limited bomb-carrying capacity meant that the Americans had to send large numbers of bombers against a single target. Arranged in large formations to defend themselves from German fighters, the bombers became valued targets for Axis air defenses. Nuclear weapons, however, gave the Air Force an opportunity to change operational concepts for strategic bombardment. These powerful bombs dramatically increased the destructive power of each bomber.[10] As one Air Force officer noted, arming bombers with nuclear weapons made "the airplane at present, and its descendants in the future, the greatest offensive weapon of all times."[11]

Nuclear weapons also drastically diminished the number of aircraft necessary to destroy a target. Reducing the number of bombers in formation made it more difficult for fighters to find the penetrating bombers. During the summer of 1947, the Air Force conducted tests to show how new jet fighters had difficulty identifying a sole penetrating bomber. The speed of fighters and bombers increased, thereby giving fighters only one chance for a head-on shot at the penetrating bombers. Finding an elusive single bomber in the sky proved problematic.[12] Combining these factors, the Air Staff submitted a report in 1947 that highlighted how the bomber and the atomic bomb reduced the need

for large conventional forces, concluding that "the atomic bomb and the long-range bomber will permit the delivery of devastating blows to the heart of the enemy without the necessity for the conquest of intermediate bases. . . . Assuming a plentiful supply of atomic bombs, . . . it would be feasible to risk an all-out atomic attack at the beginning of a war in an effort to stun the enemy into submission."[13] Not only did atomic weapons increase the destructive power of each bomber but also, and more importantly, the potential power of nuclear weapons enlarged SAC's power politically. As the command responsible for employing a majority of the US nuclear stockpile, SAC continued to receive presidential and congressional interest. The internal beliefs of the Air Force on strategic bombing *came to fruition with the creation of SAC*. As the Cold War heated up, the organization would respond to the changing strategic environment, and its culture would further evolve.

The Cold War Heats Up

Although the JCS charged the Air Force with the strategic air mission, SAC struggled to muster the resources necessary to carry out that assignment. Attempting to rein in the federal budget, President Truman placed fiscal limitations on defense spending. James Forrestal, the first secretary of defense, attempted to resolve budgetary problems by building "balanced forces." Under his plan, each service would spend funds on forces that contributed to the nation's larger strategic concept. Crucial to Forrestal's strategy was the ability to "strike inland with the atomic bomb."[14] In the interest of balance, he agreed at the 1948 Key West conference to allow the Navy to pursue development of a supercarrier while the Air Force purchased B-36s. Budget matters, however, forced the JCS to reconsider what it believed were duplicative efforts.

The debate over weapon systems and national defense stemmed from the services' competing visions of how the United States should conduct warfare in the nuclear age. The Air Force argued that the B-36 could deliver a powerful counterattack from the United States or

Alaska and return to the United States.[15] An armada of B-36s carrying nuclear weapons could directly strike the vital nodes of the Soviet Union, unhampered by range or access to staging areas. The Navy asserted that the Air Force sought an "atomic-blitz" war with an easy, cheap victory. Not only was there no cheap victory, the Navy contended, but also the idea of depending solely on "big bombers" as the only means of attack was a dangerous policy.[16] The Navy, however, was swimming upstream against JCS desires.

In 1948 Czechoslovakia fell to the Communists, and the Soviet Union blocked all access into West Berlin, causing the United States to respond with the Berlin airlift. America needed a war plan in case Soviet aggression threatened European and US interests. The JCS estimated that it would cost $21–23 billion to maintain adequate conventional forces in Europe and a naval fleet in the Mediterranean to thwart Soviet aggression. Truman, however, on 13 May 1948 placed a $14.4 billion limit on defense spending as he struggled to control a growing federal budget and deficit.[17] Confronting a nation still reeling from a devastating war and struggling to avoid becoming a garrison state similar to the Soviet Union, Truman could not see the point of funding the necessary conventional forces. The Air Force's emphasis on land-based strategic bombing from the United States dovetailed with the fiscal constraints President Truman placed on the defense budget. Therefore, an atomic air offensive offered a fiscally palatable alternative to costly conventional forces.

Most military leaders assumed that a confrontation with the Soviet Union would take place on European soil. Command of the air was essential to victory in this scenario. World War II had proven how air superiority provided troops on the battlefield better movement against the enemy. Although the war plans remained classified, General Spaatz, now in retirement, outlined how he felt the next war would unfold. While American ground forces secured air bases across Europe and fixed attacking Soviet forces in their positions, strategic bombers would strike the industrial base that buttressed the enemy troops,

thereby destroying their means of support.[18] Western forces, enjoying air superiority, would then face a much weaker Soviet force. Gen Omar Bradley, the chairman of the JCS, considered the Navy's primary mission the securing of lines of communication leading to raw materials and to areas of projected military operations. Furthermore, he determined that the United States needed strategic air operations to carry out this plan, and those operations were the purview of the Air Force.[19] When Louis Johnson succeeded Secretary of Defense Forrestal, he canceled the supercarrier, sounding the death knell for the Navy's attempt to carve out a piece of the strategic mission.[20]

In 1948 the battle over power projection, deterrence, and the United States' strategic defense came down to two choices: the B-36 or the Navy's supercarrier. The Air Force won and earned the leading role in national defense. In a speech delivered on 17 June 1949, Secretary of the Air Force Stuart Symington outlined the Air Force's role in national defense: "The Joint Chiefs of Staff's emergency defense plan as you know calls for a powerful air offense at the very outset of hostilities. The core of this air offensive is the strategic bombing effort. . . . The strategic bombing elements of the Air Force are, therefore, primarily designed to destroy—at the very outset—the enemy's means of making and supporting an attack against this Nation and its allies."[21] Developing and equipping SAC became the Air Force's highest priority. By the fall of 1948, Air Force leadership had won two significant battles: independence and a premier role for strategic bombardment. Leadership in DC had worked effectively to elevate the status of strategic bombardment, but SAC's commanders threatened to undo these achievements.

Making a Change at Strategic Air Command

In 1946 Gen George C. Kenney seemed a wise choice to lead the newly formed SAC. As MacArthur's Airman in the Pacific, Kenney had run an efficient air campaign that supported MacArthur's "island hopping" strategy in the South Pacific. Kenney's organizational structure acted as a forerunner to modern ideas of how to organize and control

air assets from multiple services.[22] Although B-17s and B-24s fell under his command, Kenney never took part in the strategic bombing of Japan. Twentieth Air Force ran operations out of Washington, DC. Furthermore, General Arnold sent General Spaatz from the European theater to the Pacific in July 1945 to command strategic air forces, making Spaatz an equal with MacArthur and Nimitz and preventing Kenney from taking part in any strategic bomber operations.[23] After retiring, General Kenney was asked why he was assigned commander of SAC. He quipped, "I don't know. Maybe they didn't know what else to do with me."[24] Critics would eventually use Kenney's lack of "strategic bomber" experience to explain SAC's poor performance under his command.

Despite Kenney's lack of "real" bomber experience, he fulfilled the mission that General Spaatz, now commanding general of the AAF, initially entrusted to him in 1946. General Kenney served as an excellent spokesperson for the Air Force. When he assumed command, the Air Force still was not a separate force, but Spaatz believed that "what we do now, the plans we lay, and the support we gain from the American people, during this period, will firmly establish the pattern for the future of our air power." He encouraged Kenney to be seen and heard, commenting, "While you nor I have any desire for personal aggrandizement, it is part of a commander's job."[25]

General Kenney enjoyed public speaking and accepted the many requests that came his way.[26] These appearances, however, drew him away from his duties as SAC commander. Therefore, he entrusted the daily operations of SAC to a long-time confidant, Gen Clements "Cement" McMullen, who, like Kenney, lacked strategic bombardment experience. In the Pacific, McMullen gave Kenney the logistics, supply, and maintenance needed to carry out his operations. McMullen never commanded a combat squadron but was widely recognized as an expert in organization and efficiency. Cement earned his nickname for his reputation of being stalwart on his command decisions and not eas-

ily swayed from his convictions.[27] This trait would prove both his and Kenney's undoing.

Kenney and McMullen inherited an impossible situation. The demobilization following World War II left SAC in a dire predicament as it faced shortages in several critical areas. In May 1946, the AAF authorized the command 43,729 personnel, but SAC had only 37,426 in its ranks.[28] Furthermore, those who left the service during the drawdown were usually the highly skilled personnel—especially aircraft maintenance and repair specialists—capable of landing lucrative jobs as civilians. A large portion of those who remained were unskilled and served in a command that heavily relied on new technology. Kenney and McMullen had three problems to overcome: obtaining new personnel and training them, reorganizing for efficiency, and rotating combat groups to forward bases and the Arctic.[29] McMullen's solution to the manning problem worsened SAC's condition to the point that it could not perform even its basic functions.

McMullen operated with a pre–World War II mind-set whereby pilots made up most of the Air Force. During those days, the AAF expected pilots to serve in multiple capacities. For example, the future SAC commander, Curtis LeMay, became famous for his skills as a navigator when his inexperience as a pilot prevented him flying the early models of the B-17. Gen John Montgomery, then a young pilot, recalled training in all three positions prior to the war: navigator, bombardier, and pilot.[30] This versatility was no longer practical in the highly technical Air Force of the Cold War. Nevertheless, Cement stood firm in his convictions. McMullen believed in cross-training crew members and assigning them to multiple billets to compensate for manpower shortages. The constant deployments overseas, though, meant that absent crew members often left staff work unfinished. More importantly, the combat readiness of the command suffered. Brig Gen Everett Holstrom, a SAC planner under LeMay and a pilot under Kenney, recalled that "everybody would do everything, and the pilots would do a navigator's job or a bombardier's job. It was cross training completely when

no one was fully trained in what we were doing."[31] The lack of specialization manifested itself in disappointing bomb scores and lower readiness rates.[32] While McMullen directed daily operations, Kenney continued his speeches.

Kenney never seemed to grasp what Air Force leaders were trying to accomplish. When the Aircraft and Weapons Board met in November 1947 to consider procuring more B-36s, the SAC commander cast the lone dissenting vote.[33] As Air Force leadership fought for SAC to become the primary instrument of the nation's defense, Kenney and McMullen allowed proficiency to decrease. Bombs scores rose as crews dropped their bombs farther and farther from the intended target.[34] Additionally, crews failed to drop the number of allotted bombs; they practiced in unrealistic conditions; and visual bombing received emphasis during training. Visual bombing (the sighting of targets through the Norden bombsight) harkened back to World War II and left an impression that the Air Force had not advanced since the end of the war. Radar bombing provided SAC the means to deliver atomic weapons through adverse weather and under the cover of darkness; however, Kenney and McMullen failed to offer sufficient guidance on training.

In April 1948, General Spaatz grew concerned over the number of SAC aircraft out of commission and the increasing bombing scores.[35] As General Montgomery later recalled, before Spaatz retired in the summer of 1948, he had decided Kenney's future. Montgomery had worked as Secretary Symington's executive officer prior to Montgomery's assignment to SAC. Gen Lauris Norstad, vice-chief of staff of the Air Force, told Montgomery that General Spaatz had called him into his office and said, "Larry [Norstad], I am going to have to change the SAC commander. George Kenney is a great commander, but he is making too many speeches and talking about the great blast in the horizon, and he is not running SAC. Who would you put there?" Norstad replied, "LeMay. Put him in there now so we can get ready for war."[36]

Spaatz retired in mid-1948, and Gen Hoyt S. Vandenberg took over as chief of staff of the Air Force with Kenney still in command. Secretary

Forrestal insisted that Vandenberg look deeper into SAC operations to determine if it was ready for war. Vandenberg asked Charles Lindbergh, the famed aviator, to fly with SAC crews and report his findings. During the weeks of his investigation, Lindbergh flew over 100 hours with SAC crews from six different bases.[37] On 14 September 1948, he delivered a blistering report to Vandenberg.

Lindbergh's report ended Kenney's tenure as SAC commander. Lindbergh stated frankly that Kenney and McMullen were training crews to the standards of the past: "It is obvious that the standards of performance, experience, and skill satisfactory for the 'mass' air forces of World War II are inadequate for the specialized atomic forces we have today. . . . Since a single atomic bomber has destructive power comparable to a battle fleet, a ground army, or an air force . . . its crews should represent the best in experience, character, and skill."[38] Lindbergh found that improvements in personnel were not keeping pace with those in equipment. Additionally, frequent moves between SAC bases caused morale to suffer. He recommended that SAC stabilize personnel in the atomic forces, maintain crew integrity (keeping integral crews together longer), concentrate on the primary mission of atomic forces (i.e., bombing, not ancillary jobs), give priority in selection and assignment of personnel to atomic squadrons, and create conditions that would draw the highest-quality personnel into the command.[39]

One week after receiving the report, Vandenberg notified Kenney of his transfer to Maxwell AFB, Alabama. Vandenberg also terminated the cross-training program. More importantly, he alerted Lt Gen Curtis LeMay, currently in Europe, that he was the new SAC commander.[40] Within three years, LeMay would transform SAC from a "hollow threat" into a "cocked weapon." Through this process of transformation, an organizational culture began to take shape as SAC members learned and understood LeMay's new vision for the command.

"We Are at War!"

After assuming command in October 1948, LeMay's first order of business was to change SAC's perspective. SAC no longer prepared for war, said LeMay. SAC was at war—now![41] LeMay knew the time it took to train his first squadron for operations in World War II. After Pearl Harbor, the AAF lacked the preparedness to mount an immediate response. LeMay recalled that during World War II, "every group I saw go into action during the war tied up its first mission something awful, complete failure, without exception."[42] The atomic age did not afford the United States the luxury of learning by failure. LeMay's leadership philosophy reflected this new paradigm: "We had to operate every day as if we were at war, so if the whistle actually blew we would be doing the same things that we were doing yesterday with the same people and the same methods."[43]

LeMay believed in the importance of strategic bombing and knew how to attain success. World War II proved formative for many of the cultural norms, values, and routines that he would bring to SAC. Standardization characterized his operations in Europe and the Pacific. Successfully employing a bomber meant that different personnel who performed special tasks had to act in unison. This operating mentality stood in contrast to the fighter that performed based on the skills of one person. To make sure that crews ran effectively, LeMay published manuals in both theaters that defined what each bomber position would do during every phase of flight.[44] Bombers relied on synchronized operations, every person knowing what the other did at a particular moment—especially during critical phases of flight. As LeMay emphasized in his manuals, "The importance of teamwork cannot be overemphasized. The individuals who are proficient in their respective duties do not necessarily make a good crew, but these ten individuals will definitely make a good crew if they know how to work together as a team."[45] Various aspects of LeMay's command philosophy would work their way into SAC as he embarked on his third bombing command assignment.[46]

To implement his vision, LeMay surrounded himself with staff officers experienced in conducting bomber operations. Thomas Power, whom LeMay pulled out of an air attaché job in England, became his deputy. In the Pacific, LeMay considered Power his best wing commander and charged him with leading the first B-29 bombing raid on Tokyo.[47] Andrew Kissner, who enjoyed a reputation for organization and efficiency, became SAC's new chief of staff, a position he had previously held under LeMay in Europe and the Pacific. Assuming responsibility for operations was John Montgomery, who had trained under LeMay when he first joined the Air Corps and had held a similar assignment under LeMay in the Pacific.

Almost immediately, LeMay began to change SAC from the top down. He made the same demands of his staff officers that he did of his aircrews. To make the point, LeMay assigned each staff officer his own crew. LeMay put it bluntly: "We can't show up at some operating base in a plush job flown by a sharp young pilot and then chew the combat people out for the way they are handling their combat planes."[48] Gen Paul Carlton remembered when LeMay selected him as his aide-de-camp. LeMay wanted a highly experienced pilot to run his crew. Carlton recalled, "Aiding was just strictly secondary. My number one job was to run a combat-type crew."[49] The SAC commander expected the same from his crew as he did from SAC members writ large: standardization. In other words, all personnel followed the written procedures perfectly, executed their jobs flawlessly, and worked as a team to accomplish the mission.

General Vandenberg gave LeMay considerable latitude as the new commander began transforming SAC. Since the JCS agreed with the Air Force's concept of power projection, Vandenberg needed LeMay to build an organization capable of providing a credible deterrent. According to LeMay, Vandenberg told him to "get SAC in shape to fight as fast as possible."[50] Furthermore, Vandenberg wanted LeMay to make sure that if a war started, SAC could win it almost immediately.[51] Although LeMay knew how to employ bombers, his personal goal was to

build an organization "that was so strong and so efficient that no one would dare attack us."[52]

A New Mentality

In order to change SAC's mentality, LeMay had to show the members of the organization that their way was not working. Upon assuming command, he received a briefing that detailed SAC's bomb scores. The scores were so good, LeMay recalled, that they were unbelievable.[53] And they were. SAC bombers had been conducting their bomb runs at 12,000–15,000 feet, an altitude way below that required for combat. At these altitudes, crews did not have to use the supplemental oxygen system necessary for flying at combat altitudes. Since radar sets had functioned imperfectly at those altitudes, the crews had been practicing their runs at lower altitudes where the equipment would work. Finally, they had been conducting the radar bomb runs against targets with large radar reflectors out in the middle of the ocean to make them easily identifiable. The combination of these factors led LeMay to the conclusion that SAC crews were not conducting realistic training.[54]

To make his point, LeMay planned a commandwide exercise commencing in mid-January 1949.[55] Each bomber crew would fly at 30,000 feet and conduct a simulated radar bomb run against Wright Field in Dayton, Ohio. The Dayton exercise confirmed exactly what LeMay suspected: that SAC was not ready for war. Not one airplane finished the mission as briefed. Either crews were not accustomed to the higher altitudes or the planes experienced mechanical failure before getting there. LeMay called the Dayton exercise "just about the darkest night in American aviation history."[56]

From January 1949 forward, SAC would never be the same. Its leaders took a systematic approach to getting the organization combat ready. They would start with one group, get it up to speed, and move on to the next one. Carlton, LeMay's aide and personal pilot, remem-

bered that LeMay had a concentrated focus, refusing to scatter resources as Kenney had done.[57] SAC began with the 509th Bomb Group, the original atomic outfit from the Pacific theater. According to LeMay, they cleaned the supply warehouses, stocked the parts and supplies the unit needed, and outfitted planes with the necessary equipment.[58] General Montgomery, SAC's director of operations, claimed that this efficient approach to getting organizations combat ready brought 3,000 crews up to combat strength and effectiveness as SAC executed three sequential developmental plans throughout 1948 and 1949.[59]

Just as LeMay had emphasized and believed in his bomber organizations during World War II, so did standardization become the new SAC commander's key to realizing success in organizational strategic bombings. Applied to SAC, standardization ensured that once a unit achieved combat-ready status, it never regressed. Each crew position would receive technical manuals and checklists that outlined in detail the procedures to perform its task. LeMay freed radar observers and bombardiers from their additional duties so they could concentrate on studying targets and procedures.[60] Furthermore, the aircraft commander and the flight engineer would complete a 600-item checklist before each flight to ensure they understood and finished critical tasks.[61] Several problems initially plagued SAC: increased bomb scores, high accident rates, and low maintenance rates for aircraft. LeMay saw standardization as the answer to all three.

In November 1948, he instructed his numbered air force commanders to make standardization programs a priority across the command. Furthermore, he asked each wing and headquarters to appoint a standardization (lead) crew.[62] Such crews had become a feature of LeMay's bombing commands dating back to the European theater in World War II. In Europe, LeMay had assigned each of his lead crews a different city. The 305th developed target folders for each city, and when a crew's city became the target, the crew led that particular mission.[63] LeMay continued this practice in the Pacific. Crews would spend their spare time studying target folders to familiarize themselves with the

features of their assigned city. His lead crews knew every aspect of their target and could find it through either bad weather or darkness.[64]

Beginning in 1949, SAC established a Lead Crew School (later termed the Combat Crew Standardization School) to train and observe an aircrew's standardized procedures. SAC expected commanders to send their best crews to the school, where instructors evaluated these integral personnel on their bombing procedures and discipline. Bombing accounted for 40 percent of the crew's overall score; bombing technique (following the checklist) and the aircraft commander's ability to command his crew made up the remainder. The school put more emphasis on radar bombing as a means of selection since this procedure required greater concentration and perfection of technique. Graduates of the school returned to their units and trained the rest of the unit's bomber crews in the best techniques and procedures.[65]

SAC's emphasis on standardization and procedures significantly lowered bomb scores. At the beginning of 1949, crews were averaging a miss distance of 3,679 feet; by the end of the year, that figure had dropped to 2,928 feet for medium bombers (B-29s/-50s) and 2,268 for heavy bombers (B-36s).[66] Throughout LeMay's tenure and beyond, bomb scores continued to receive emphasis. Low nuclear stockpiles meant that every bomb had to hit its target—there was no room for error. Furthermore, the command's push for lone penetrating bombers elevated SAC's emphasis on precise bomb delivery.

Once LeMay's commanders had assembled a crew that worked efficiently, SAC wanted to keep them together. Since the command depended on combat readiness, LeMay directed that successful crew combinations fly together year after year. If these crews mastered their planes and procedures, they could avoid the threat of a desk job.[67] LeMay, however, demanded a maximum effort from these crews. They flew longer training missions at higher altitudes against American cities that resembled their assigned targets in the Soviet Union. The general combined his ritualistic flying in the air with security measures on the ground as a daily reminder to SAC members that they were at war.

The Soviet Union made deliberate attempts to penetrate America's open society and gain intelligence. In response to these covert actions, SAC made security a top priority. The command's inspector general issued a letter stating, "The possibility exists that prior to or immediately subsequent to a national emergency an attempt may be made to destroy or damage aircraft . . . through fifth column type activity thus weakening or delaying employment of the force."[68] To address the perceived threat, SAC began to build fences around its installations and increase security controls. SAC leadership also had indications that the Communist Party USA placed the command's offensive airpower high on party plans to wreak havoc should a war break out with Russia.[69] Consequently, LeMay created special penetration teams to simulate sabotage on SAC installations. These teams acted like enemy agents trying to infiltrate various bases disguised as flight crews, civilian contractors, or even soft-drink vendors.[70]

Exacting 70 to 90 hours of rigorous training a week from SAC's aircrews would soon take a toll and decrease retention unless LeMay could devise a way to reward his warriors for outstanding performance. Therefore, he implemented a "spot promotion" system to do just that. Under this system, LeMay rewarded exceptional performers an increased rank "on the spot." In late 1949, the SAC commander petitioned the Air Force Personnel Center and requested his first allotment of spot promotions. LeMay justified his request by arguing, "I believe that by virtue of the mission of Strategic Air Command, a higher degree of dependability, flying proficiency, and individual stability under pressure is required of the combat crew member than would be required of officers of equal rank and experience in the Air Force."[71] Within two months, he received approval. Eventually, LeMay expanded the program to include enlisted personnel. According to Gen William Martin, the 509th Bomb Wing deputy commander in 1950, the system also worked to enhance crew integrity and professionalism.[72] On the one hand, entire crews could gain spot promotions for significant achievements such as winning the annual SAC Bombing Competition. On the other hand, they could lose their temporary promotions if

either the crews or an individual member failed to maintain high standards of performance.[73]

Standardized procedures lowered accident rates among SAC's airplanes as well. When LeMay assumed command, SAC averaged more than 60 accidents per 100,000 flying hours. In the second month of his command, LeMay temporarily grounded the B-29 fleet due to repeated crashes.[74] The SAC commander believed that crews were not strictly adhering to the aircraft's checklist, commonly referred to as "checklist discipline," and that this practice was causing a significant number of accidents. He demanded that crews follow standard operating procedures; otherwise, he would hold them and their commanders accountable. If a wing commander had an accident at his base, LeMay required him to fly to Offutt and personally brief the SAC commander on the accident.[75] According to SAC's director of operations, LeMay demanded that flight members and maintenance teams follow checklists or get penalized, even when the violation did not lead to an accident.[76] After two years, the effort paid off, and SAC had the lowest accident rate in the Air Force.[77]

Insisting on constant vigilance, LeMay took steps to ensure it. Every night, SAC bases sent their combat readiness reports to command headquarters. Each morning by eight o'clock, LeMay reviewed the number of aircraft and aircrews available should war come. The staff at headquarters loved to crunch numbers. Combat readiness meant more than just bombing scores, which by 1950 had improved by 500 percent; it also meant lower venereal disease rates, higher maintenance readiness, and better retention.[78] Retaining trained personnel led to less turnover and enhanced combat readiness. Within LeMay's first year, SAC's reenlistment rose to 70 percent, significantly better than the Army's 40 percent.[79]

LeMay ensured that his commanders kept their units combat ready through constant, often unannounced, inspections. Every year, SAC required its commands to execute their war plans in an operational readiness inspection. Suddenly, an inspection team would arrive on base

and insist that the commander execute his war plan while they evaluated his organization's proficiency. Either the unit did it, or it did not. The commander's career rose or fell with his organization's performance. Those commanders who succeeded gained status; those who failed found new jobs.[80] By 1951 General LeMay's prescription of no-notice inspections, standardized procedures, and intense scrutiny had turned SAC around.

Conclusion

At its core, SAC's organizational culture reflected the values and assumptions of Air Force leaders who believed in the promise of strategic bombardment. Since the days of Billy Mitchell and Giulio Douhet, American Airmen were convinced that strategic airpower alone could win wars. SAC was the organizational manifestation of that doctrine. Newly developed nuclear weapons further increased the destructive power of each bomber. Early mismanagement of the organization, though, had threatened to undermine all of these victories.

LeMay and his team of "bomber generals" put SAC on alert; war was only hours away—not weeks or months. The command conducted operations each day as though war could come at any time. Since the Cold War could become "hot" at any moment, bomber crews had to memorize their routes and targets. In a regimented training program that simulated the real event, crews studied target folders, flew preplanned missions following standardized procedures, and delivered simulated bombs on American cities that represented Soviet targets. Crews either developed cohesion or they received no rewards. This mentality spread from flying operations to maintenance functions and eventually permeated every aspect of SAC's daily life. Wing commanders ensured that they knew the location of each crew member, reported daily "numbers" to LeMay, and nervously anticipated the yearly test of their leadership. Like the crews under their command, the careers of these commanders depended upon the outcome. Such was the life of SAC's warriors—the nation's first line of defense. SAC leaders not

only built a highly specialized and standardized organization but also constructed an air force within the Air Force. Because the organization's mission set it apart from the rest of the service, LeMay believed that his members should receive special consideration. The Air Force had one promotion system; spot promotions gave SAC its own. From 1951 to 1962, the command would expand greatly to fight the Cold War. This expansion brought many new warriors into the organization and indoctrinated them in the SAC mentality.

General LeMay remained at SAC until 1957, making him the longest tenured four-star general to serve in any military command. He built the nation's first nuclear deterrent and left behind an organizational culture that survived long after his tenure. According to Russell Dougherty, who rose through the ranks in LeMay's SAC and assumed command of SAC in 1974, LeMay attended the ceremony and warned him that "my [Dougherty's] nuclear command responsibilities to this nation were such that I could not afford to fail, that I could never do anything wrong myself, nor ever condone mistakes on the part of others, that affected the mission of my command." LeMay ended his advice with this comment: "Don't you be remembered in history for a single mistake." SAC's culture emphasized standardized procedures, perfection in detail, and—most of all—physical presence because this was the type of war the nation was fighting. "Every single procedure and requirement for employing those weapons . . . ," Dougherty recalled, "had to be seen to be believable, robust, and reliable."[81]

The procedures and routines to build a credible deterrent have outlived General LeMay. Although the strategic environment has changed, SAC is gone, and the intensity of the Cold War has dissipated, the operating mentality and culture associated with the nuclear mission cannot follow suit. Today's Airmen need to understand how and why these routines came into being, why the nuclear mission is important, and why those who perform it are held to the highest standards. The military has been given a special trust and responsibility for handling the most powerful weapons on the earth. Airmen need to

understand that their actions have implications extending far beyond the fence line. ✪

Notes

1. SAC leaders commonly referred to aircrews and missile crews as "SAC warriors." In 1989 Gen John T. Chain Jr., SAC commander in chief, declared 1989 the "Year of the SAC Warrior" and published a "Warrior Code of Ethics" to guide all SAC crew members. Furthermore, he issued a patch for all of those personnel to wear, labeling them SAC warriors. For additional information and a view of the patch, see "Warrior Code of Ethics," 19 April 2005, http://www.fb-iiia.net/warrior.html.

2. Col Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945–1982* (Maxwell AFB, AL: Air University Press, 1998), 103–4.

3. The United States and the Soviet Union never directly confronted each other. Instead, these two superpowers conducted their opposition through "periphery" nations in Asia (Vietnam, Korea, etc.) and South America (El Salvador, Nicaragua, Guatemala, etc.).

4. For an explanation of how tactical fighter leadership replaced bomber leadership in the Air Force, see Worden, *Rise of the Fighter Generals*.

5. Joanne Martin, *Organizational Culture: Mapping the Terrain* (Thousand Oaks, CA: Sage Publications, 2002), 57–59. According to Martin, there are at least two schools of thought concerning organizational culture. The ideational school defines organizational culture as "a set of important understandings (often stated) that members of a community share in common" (p. 57). Ideationalists see organizational culture as cognitive and conceptualized in terms of meanings or understandings. Another school of thought, the materialist approach, stresses the subjective nature of organizational culture and looks at the material condition under which the employees work. Materialists define organizational culture as "the system of values, symbols, and shared meanings of a group including the embodiment of these values, symbols, and meanings into material objects and ritualized practices" (p. 57). Martin recommends an approach that incorporates both schools of thought. Therefore, this article examines both aspects of organizational culture with respect to SAC: how its leadership instilled an organizational culture using formal channels—policy, orders, and so forth (idealist)—and how symbols and rituals within SAC came to reflect the organizational culture (materialist).

6. For a history of Twentieth Air Force's operations in Japan and Arnold's justification, see Kenneth P. Werrell, *Blankets of Fire: U.S. Bombers over Japan during World War II*, Smithsonian History of Aviation Series (Washington, DC: Smithsonian Institution Press, 1996), 90–91.

7. Ronald H. Cole et al., *The History of Unified Command, 1946–1993* (Washington, DC: Joint History Office of the Office of the Chairman of the Joint Chiefs of Staff, 1995), 11–21, http://www.shsu.edu/~his_ncp/UCS.html.

8. Department of the Air Force, "Topical Digest of Testimony before the House Armed Services Committee during Hearings on the B-36 and Related Matters: Section II," October

1949, roll 33780, frame 891, text-fiche, Air Force Historical Research Agency (AFHRA), Maxwell AFB, AL.

9. General Spaatz's report as quoted in Steven L. Rearden, "U.S. Strategic Bombardment Doctrine since 1945," in *Case Studies in Strategic Bombardment*, ed. R. Cargill Hall ([Washington, DC]: Air Force History and Museums Program, 1998), 387.

10. "Why the Air Force Wants the B-36," *U.S. News and World Report*, 17 June 1949, 18.

11. Maj Kenneth Gantz, "The Atomic Present," *Air Force Magazine*, March–April 1946, 4.

12. Robert Frank Futrell, *Ideas, Concepts, Doctrine: Basic Thinking in the United States Air Force*, vol. 1, *1907–1960* (Maxwell AFB, AL: Air University Press, 1989), 231.

13. Lawrence Freedman, *The Evolution of Nuclear Strategy* (New York: St. Martin's Press, 1981), 54.

14. Walton S. Moody, *Building a Strategic Air Force* ([Washington, DC]: Air Force History and Museums Program, 1995), 159.

15. "Why the Air Force Wants the B-36," 18.

16. "Why Navy Officers Risk Careers," *U.S. News and World Report*, 14 October 1949, 22.

17. David Alan Rosenberg, "American Atomic Strategy and the Hydrogen Bomb Decision," *Journal of American History* 66, no. 1 (June 1979): 68.

18. Carl A. Spaatz, "The Air-Power Odds against Us," *Reader's Digest*, June 1951, 11–12.

19. Phillip S. Meilinger, *Hoyt S. Vandenberg: The Life of a General* (1989; repr., Washington, DC: Air Force History and Museums Program, 2000), 131.

20. The Navy would not give up its fight for a part of the strategic mission. With the development of missile technology, it pursued the submarine-launched Polaris missile and became part of the United States' strategic triad.

21. W. Stuart Symington, "Our Air Force Policy," *Vital Speeches of the Day* 15, no. 18 (July 1949): 569.

22. For further discussion of Kenney's achievements in the Pacific, see Thomas E. Griffith Jr., *Macarthur's Airman: General George C. Kenney and the War in the Southwest Pacific* (Lawrence: University Press of Kansas, 1998).

23. Ibid., 227–28.

24. Gen George C. Kenney, interview by Dr. James C. Hasdorff, 10–21 August 1974, transcript, United States Air Force Oral History Program, K239.0512-806, AFHRA.

25. Gen Carl Spaatz, commanding general, AAF, to Gen George Kenney, commanding general, SAC, memorandum, 1 May 1946, Borowski Papers, B-26, United States Air Force Academy.

26. Harry R. Borowski, *A Hollow Threat: Strategic Air Power and Containment before Korea*, Contributions in Military History, no. 25 (Westport, CT: Greenwood Press, 1982), 141.

27. Richard H. Kohn and Joseph P. Harahan, eds., *Strategic Air Warfare: An Interview with Generals Curtis E. LeMay, Leon W. Johnson, David A. Burchinal, and Jack J. Catton*, USAF Warrior Studies (Washington, DC: Office of Air Force History, US Air Force, 1988), 74.

28. Borowski, *Hollow Threat*, 45.

29. Ibid., 135.

30. Maj Gen John B. Montgomery, interview by Capt Mark C. Cleary, 30 April–1 May 1984, transcript, United States Air Force Oral History Program, K239.0512-1586, AFHRA.

31. Brig Gen Everett W. Holstrom, interview by James C. Hasdorff, 14–15 April 1988, transcript, United States Air Force Oral History Program, K239.0512-1793, AFHRA.

32. Bomb scores were measured in circular error probable, the distance in which one-half of a plane's bombs fall within the circle and the remainder outside. In the grading of crews and bomb squadrons, lower bomb scores mean a greater chance of hitting the target; therefore, lower scores were better. Combat readiness was measured by the percentage of assigned personnel considered prepared for combat duty; hence, higher rates were considered better.

33. Moody, *Building a Strategic Air Force*, 180.

34. Borowski, *Hollow Threat*, 148–49.

35. Moody, *Building a Strategic Air Force*, 221.

36. Montgomery, interview.

37. Meilinger, *Hoyt S. Vandenberg*, 105.

38. Charles Lindberg, "Report to General Vandenberg," 14 September 1948, Emmett "Rosie" O'Donnell Papers, United States Air Force Academy.

39. Ibid.

40. Meilinger, *Hoyt S. Vandenberg*, 106–7.

41. Curtis E. LeMay with MacKinlay Kantor, *Mission with LeMay: My Story* (Garden City, NY: Doubleday, 1965), 436.

42. Gen Curtis E. LeMay, interview by John Bohn, 9 March 1971, transcript, United States Air Force Oral History Program, K239.0512-736, AFHRA.

43. Ibid.

44. "Lead Crew Manual, 3rd Bombardment Division"; "Combat Crew Handbook, 3rd Bomb Division"; and "Combat Crew Manual, XX Bomber Command," all by Maj Gen Curtis E. LeMay, were published during World War II and outlined standardized procedures for each crew position. Curtis E. LeMay Personnel Papers, Box B4, Library of Congress, Washington, DC.

45. Maj Gen Curtis E. LeMay, "Combat Crew Handbook, 3rd Bomb Division," Curtis E. LeMay Personnel Papers, Box B4, Library of Congress, Washington, DC.

46. Harrison M. Trice and Janice M. Beyer contend that a characteristic of organizational culture is that it is historically based. As LeMay and his staff prepared SAC for strategic bombing in the atomic age, they consistently drew on their experiences in World War II. See Trice and Beyer, *The Cultures of Work Organizations* (Englewood Cliffs, NJ: Prentice Hall, [1992]), 6.

47. Werrell, *Blankets of Fire*, 161–62.

48. Harold Martin, "Are Our Big Bombers Ready to Go?," *Saturday Evening Post*, 30 December 1950, 65.

49. Gen Paul Carlton, interview by Maj Scott Thompson, 13–15 August 1979, transcript, United States Air Force Oral History Program, K239.0512-1138, AFHRA.

50. LeMay, Bohn interview.

51. "Bombers at the Ready," *Newsweek*, 18 April 1949, 25.

52. LeMay, Bohn interview.

53. Kohn and Harahan, *Strategic Air Warfare*, 79.

54. LeMay with Kantor, *Mission with LeMay*, 432.

55. Kohn and Harahan, *Strategic Air Warfare*, 79.

56. LeMay with Kantor, *Mission with LeMay*, 432–33.

57. Carlton, interview.

58. Kohn and Harahan, *Strategic Air Warfare*, 80.

59. Montgomery, interview; and Borowski, *Hollow Threat*, 166–70.

60. Charles W. Bosanko, "The Architecture of Armageddon: A History of Curtis LeMay's Influence on the Strategic Air Command and Nuclear Warfare" (PhD diss., California State University–Fullerton, 2000), 64.

61. "Man in the First Plane," *Time*, 4 September 1950, 17.

62. Excerpts of the letter in Capt Robert K. Weinkle, USAF, "The Progression of the Standardization/Evaluation Program in Strategic Air Command" (Maxwell AFB, AL: Air University, 1965), 7.

63. LeMay with Kantor, *Mission with LeMay*, 256–57.

64. Gen Curtis E. LeMay, interview by Col Bill Peck, March 1965, transcript, United States Air Force Oral History Program, K239.0512-785, AFHRA.

65. Office of SAC History, "Lead Crew School and Combat Crew Standardization School," SAC History Study no. 8 (Offutt AFB, NE: Office of SAC History, 1951), 1–10, K416.01-8, AFHRA.

66. Office of SAC History, "History of Strategic Air Command, 1949" (Offutt AFB, NE: Office of SAC History, 1950), 141, K416.01, AFHRA.

67. Martin, "Are Our Big Bombers Ready to Go?," 65.

68. Office of SAC History, "Development of Strategic Air Command Security Program," History Study no. 17 (Offutt AFB, NE: Office of SAC History, 1951), 2, K416.01-17, AFHRA.

69. Ibid., 4.

70. LeMay with Kantor, *Mission with LeMay*, 479.

71. Office of SAC History, "The Strategic Air Command Spot Promotion Program: Its Rise and Fall," History Study no. 167 (Offutt AFB, NE: Office of SAC History, 1978), 3.

72. Lt Gen William K. Martin, interview by Lt Col David L. Olson, February 1988, transcript, United States Air Force Oral History Program, K239.0512-1791, AFHRA.

73. Office of SAC History, "The Development of Strategic Air Command" (Offutt AFB, NE: Office of SAC History, 1972), 16.

74. "U.S. Grounds B-29s As Another Crash Kills 5 in Florida," *New York Times*, 19 November 1949, 1.

75. LeMay with Kantor, *Mission with LeMay*, 439.

76. Montgomery, interview.

77. Office of SAC History, "Development of Strategic Air Command," 26.

78. "Man in the First Plane," 16.

79. "Bombers at the Ready," 24.

80. LeMay with Kantor, *Mission with LeMay*, 446.

81. Russell E. Dougherty, "Leadership during the Cold War," in *Warriors and Scholars: A Modern War Reader*, ed. Peter B. Lane and Ronald E. Marcello (Denton, TX: University of North Texas Press, 2005), 119.

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Common Sense

Improving the Efficacy of Wide Area Surveillance

Hugh McFadden Jr.

Before us stands a great challenge and a great opportunity. Our nation has invested billions of dollars to develop, field, and maintain an array of optical and radar-based wide area surveillance (WAS) systems. The demand for such systems lies in their potential to persistently monitor significant portions of a threat's operating environment. This ability greatly contributes to learning and understanding a threat's key actions, associations, and locations, thus providing decisive knowledge to our nation's leaders. The capability is powerful,

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unique, and indispensable. However, WAS systems on the whole are plagued by inefficient and suboptimal methods of operation. More specifically, this particular type of intelligence, surveillance, and reconnaissance (ISR) asset is often applied improperly and employed without using the full extent of its inherent flexibilities. In addition, no defined or even de facto process exists for extracting progressive, cooperative, or multisource integrated intelligence from WAS systems. The combination of these factors means that the potential synergy and power from multiple intelligence (multi-INT) source collections and analyses using WAS systems are seldom realized. Although this has undoubtedly come at a cost of lost opportunity in Afghanistan, the "embarrassment of riches" there, "with hundreds of [ISR assets] and thousands of analysts," has mitigated the impact.[1] Our nation is unlikely to be so fortunate in the future.

Defense spending has already taken severe cuts, and the prospect of additional reductions looms ominously over the defense community.[2] The final state remains unknown, but our nation's WAS resources probably will be reduced and therefore serve as a catalyst for determining how to "do more with fewer" WAS assets. Some WAS capabilities will atrophy, others will disappear, and still others will not transition to programs of record—all occurring within the context of a changing and unstable world. The United States is expected to continue facing the ever-present danger of terrorist organizations, along with instability in Africa, the Middle East, and parts of Asia. However, it will also confront new issues such as multiple gravitational centers of global power; growing tensions over vital resources; greater conflation of irregular and regular forms of warfare in conflict; and increasingly powerful, organized nonstate actors.[3] This future strips us of the luxury of inefficiency and suboptimal applications of our WAS capabilities. The goal, then, is to attain the greater efficacy that our future demands and to do so with better efficiency.

Setting the Framework

We have an opportunity to refine elements of our surveillance enterprise to maximize the effect of our systems through a more unified and robust operating framework—one with principles and methods common across our WAS sensing resources, one that will guide them toward consistently producing the most powerful information possible for enabling field operations and policy decisions. This article seeks to aid in advancing surveillance tradecraft by defining these principles. Though they apply broadly, it focuses specifically on motion intelligence systems such as wide area motion imagery and ground-scanning moving target indicator radars; consequently, subsequent references to WAS are to these systems. The following principles are founded in accepted military doctrine, expanded to provide WAS-specific guidance, seasoned with adaptations of proven practices from other professions, and blended with practical operational experiences:

- Strong Partnerships
- WAS Economy of Force
- Information Cycle Synchronization
- Harmonious ISR
- Maximum Value Extraction
- Information Orchestration

Concurrent implementation of these principles, systematically detailed below, forms a basic conceptual structure that instigates refinements capable of enhancing the effectiveness and efficiency of our surveillance enterprise. Furthermore, the framework can also impart synergistic value to investments of the current service and intelligence community in standardized formats, searchable data, improved data accuracy, advanced analytic methods, automated exploitation, and large data-management systems by supplying the requisite conditions that each one needs to realize its full potential. Better data management does not mean that concurrent layers of ISR are meaningfully

arranged or integrated; enabling data discovery doesn't ensure that something of value is present; and there is no guarantee that advanced analytic methods and algorithms will have data of sufficient quality to generate actionable intelligence. A precondition to these benefits, though, is to overcome inhibitors like the existing cultures that run counter to the concepts described and the complacency that so easily besets their traditional practices.

Making Collaboration Possible: Strong Partnerships

Understanding a complex enemy extends far beyond the domain of a single discipline. It requires intentional, solicited consultation and collaboration from other perspectives, fields of expertise, and external organizations.[4] Collaboration is by nature a very interpersonal activity insofar as it demands established, positive, and trustworthy partnerships to function well.

The need for cultivating and maintaining strong partnerships is emphasized at the department and international levels as a necessary part of shaping and determining the overall success of military outcomes.[5] That is, strong partnerships are not only a prerequisite for collaboration but also the single most significant, proven factor for attaining desired outcomes.[6] Such partnerships facilitate the type of dialogue necessary for learning the true intent and capabilities of others. They also set conditions for joint planning, effective coordination, and corrective action in a way that faceless spreadsheets, e-mails, or even superficial calls do not allow for. The effort invested in these relationships that pays out in the length of their effectiveness and the ability of in-person interactions and liaisons to facilitate them cannot be overstated.[7]

Selecting, developing, and maintaining stakeholder relationships can genuinely shape every aspect of WAS operations and activities. Therefore, WAS organizations must become intentional and strategic in establishing and nurturing relationships within each key stakeholder

group. Partnerships should span trained disciplines, discrete units, different ISR domains, and governmental departments. They must be established with the focused intent to facilitate more responsive, relevant, timely, efficient, and effective WAS. Partners can be viewed as two distinct groups—customer or collaborator organizations (fig. 1). Together they enable tailored surveillance, a robust multi-INT environment, and the thorough extraction of value from collected data.

Figure 1. Building broad and strong stakeholder partnerships. (Images from http://www.defence.gov; http://www.aqc.osd.mil; http://www.army.mil; and http://www.nsa.gov.)

Customers

Customer organizations are the combat divisions, task forces, brigade combat teams, battalions, and their service or agency equivalents that request ISR. They make decisions or respond in some manner to the information provided by WAS systems. Building strong partnerships with these organizations is how true "command intent" is understood—

not just assumed. It involves learning about their upcoming operations, the existing intelligence that underpins them, current knowledge gaps, concurrently planned ISR collection, and their specific surveillance needs. Obtaining those needs in this manner allows an understanding of them in their truest sense and context, with nothing lost in reduction or from poorly trained attempts of the requesting units to use surveillance parlance. This rich information will enhance the comprehension of WAS operators and analysts, allowing them to respond in the most effective manner. Strong customer partnerships should also include intentional probing of a unit's more distant or emerging needs. Engaging at this stage has the potential to shape future requests for enhancing multi-INT synergy, optimizing the impact of individual WAS collections and evolving collects in synchronization with the operations process.[8] These powerful effects come only through strong working relationships built upon open, frequent, and meaningful dialogue. They cannot emerge from the present common practice of merely calling a unit to verify the task and gather a few minor details.

Collaborators

The benefit of strong collaborator partnerships is that they essentially create de facto multidiscipline teams—the very thing necessary for addressing the complex, diverse threats that our nation faces.[9] They form much of the gears and glue associated with developing and executing plans for synergistic effects. Collaborators are any organization willing or tasked to labor collectively with the shared purpose of delivering an effective final product to a customer organization from WAS collections. They include other ISR platforms, theater intelligence centers, enterprise-level analytic units, strategic reachback sites, domain experts, and even technical advisers. WAS organizations should build strong partnerships across a diverse set of these to enable their personnel to tap into the wealth of contextual information, relevant intelligence, domain knowledge, and technical expertise that exists within them. Doing so empowers WAS operators and analysts to optimize their sensor and platform, develop joint plans for synergistic multisensor sur-

veillance, and define and execute multisource exchanges and integration at levels that would otherwise be unachievable. The potential effects are astounding. Such partnerships can even transform insular cultures, common among WAS units, into open and collaborative ones. They literally can transform units that operate as if they are "the center of the fight" into contributing members of a highly lethal multi-INT collaborative.

Economy of Force for Wide Area Surveillance

The premise of economy of force involves limiting the use of available resources applied to general shaping and sustaining activities so that the preponderance of those resources remain dedicated to key operations.[10] This core military principle has long been embedded in Western defense training and doctrine, and applying it en masse is fairly straightforward. The ambiguity lies in trying to apply the concept to lower-level, individual actions such as specifying what constitutes proper economy of force for WAS.

Economy of force for WAS can be defined as the minimal use of surveillance assets and sensor resources against activities of minor value so that they may be judiciously applied in a manner that produces the most significant impact across the widest area for the largest number of priority objectives and decisive operations. Two components are involved—platform allocation and sensor employment. They translate into having to make difficult choices regarding the servicing of requests and sensor trade-offs, respectively. In large part, this is an issue of properly exercising the tenet of prioritization toward preeminent effects to prevent excess division of platform persistence and sensor resource for the sake of lower-priority surveillance activities.[11] Practically, WAS economy of force becomes a matter of task advocacy—adjusting collection timing and duration, sensor configuration, coverage area, and platform to target geometries. Given that field units and intelligence community analysts are prone to requesting ISR without tem-

perance, higher-level collection managers and surveillance units will likely serve as the concept's vanguards.[12]

Platform Allocation

Primarily, economy of force for platform allocation means conducting surveillance in support of significant operational effects against the key command objectives. Embedded in this statement is the need to concentrate collection on the priority objectives themselves and on the types of ISR support likely to produce the most considerable effects for those objectives. To do so requires minimizing collection on secondary objectives and those with limited effects. It also demands that assets are dedicated to those tasks for durations sufficient for producing the desired effects, though no more. On the one hand, for example, discovering and understanding hard-to-detect mobile threats can consume several weeks or months of persistent collection. On the other hand, learning general patterns of activity for an area often requires only a few consecutive days of collect, with periodic collects thereafter for updates. This procedure seems apparent, but a review of historical resource applications indicates otherwise.[13]

Each type of conflict will have its own set of primary and secondary effects, but the goal is always to minimize the expenditure of limited and unique WAS capabilities on those secondary effects. Consider the United States' recent history with counterinsurgency campaigns. Some of the primary surveillance tasks for this type of mission are finding the key elements of insurgent networks, determining their influences, and assessing their impact on the local populace—all to a degree that allows countering of the networks.[14] Therefore, tasks that offer situational awareness for minor military activities or those to which no response is planned are secondary and should consume only limited surveillance capacity. This principle is especially true when WAS resources are applied to these very tasks while suboptimally functioning as a surrogate instead of a complement for other types of ISR such as narrow-field-of-view full motion video.[15] Examples of this sort of

misallocation include high-resource dedication for persistent traffic volumetric sampling or overwatch of a squad's routine patrol. Both constitute excessive allocation to secondary efforts at a cost to the primary campaign effects. Ideally, robust tools would assist in recognizing these situations and improving allocation decisions.[16] Ultimately, though, decisions are made by collection managers, making it incumbent upon the WAS providers, as knowledgeable and self-interested parties, to engage with them to this end. The privilege of injecting these types of guiding inputs into the planning process is explicitly granted to WAS units through their liaisons.[17] Thus, staffing of the role with effectual individuals is crucial for maximizing an asset's effects.

Sensor Employment

Ultimately, applying economy of force to sensor employment concerns obtaining the greatest impact from the smallest resource pool against a variety of needs by exercising the versatility inherent to many WAS platforms. It entails focusing sensors to satisfy priority surveillance requirements in their entirety and across the broadest extent possible. However, data quality and area coverage are opposing forces competing in a zero-sum game, so trade-offs must be made between them. In addition, the data quality and coverage area necessary for success vary wildly by surveillance activity and environment. Therefore, WAS providers must approach each problem uniquely, determining the requisite data quality and persistence necessary to satisfy the most stringent aspect of each priority surveillance request. In other words, if the essential elements of information include both a need to supply volumetric measures for a specific location and a need to understand the connections and interactions of individuals associated with that location, then the collection must hold to the higher quality and longer duration surveillance requirements of the latter essential element of information. This requirement, in effect, sets the boundary for coverage area, which should not be violated. Nor should the overall collection scheme fail to extend up to the aggregate coverage limits since doing so would constitute waste. If the demands for coverage

and quality are incompatible, then the surveillance provider must ask the supported unit to decide which aspect to favor.

The process takes thought, but its importance cannot be overstated because it determines whether the information derived can be made actionable or is merely interesting. This concept works in conjunction with the activities outlined in information cycle synchronization to form the basis of tailored surveillance. The significance of the whole idea is best understood through examples. For instance, assume that a need for surveillance requires only the observation of motorized traffic for a specific threat. Yet, if the collection platform chooses to configure its sensor to "get better data" and capture dismounts through different optical lenses or radar settings, depending on the sensing domain, then it runs counter to WAS economy of force. The choice comes at the expense of significant loss of coverage area over the threat's known territory. It is counter to economy of force because the allocated sorties could have produced the full scope of necessary intelligence but didn't, either leaving unknowns or requiring additional sorties. Sensor employment aligned with economy of force, though, would guide the collector to optimize the system for monitoring point-to-point movement of discrete vehicles and then maximizing area coverage within the hard constraint created by that need for data quality. Another example: assume that a top-priority task calls for monitoring a threat's detailed activity, but in an effort to simultaneously collect as many tasks as possible, the data quality becomes compromised—often called the "peanut butter spread." The resulting data is too poor to accurately or confidently observe the targets or their key locations.[18] This excessive division of sensor resources comes at the expense of satisfying primary objectives, directly contradicting the principle.

In contrast, WAS economy of force always ensures that the appropriate resources are provided to satisfy such tasks, with the implied understanding that scarcity dictates that doing so comes at a cost to lower-priority needs. Therefore, the timing, persistence, coverage area, sensor settings, and geometries necessary for monitoring the detailed

activity of that specific threat would be determined as part of a systematic effort to assess the resource demands of each task or its elements. Given the resource costs of this particular task and others whose accumulative costs do not exceed the WAS resource's capacity, selected in priority order and accounting for constraints, many tasks in a large deck may have to be rejected with an "alibi" of being unfeasible. Consequently, the requirements of highest-priority tasks are genuinely met. It is worth stating that both examples hold true across the spectrum of applications, from counterterrorism activities, through support of policy decisions regarding state-sponsored proxies, to full-scale military operations in contested environments.

Information Cycle Synchronization

If ISR is to provide decisive knowledge, its activities must be synchronized with those of operations. Therefore, the sequencing and timing of ISR collections and production must be informed by and must hinge upon the operations process.[19] This sort of intimate coupling between ISR and operations, along with adaptation, flexibility, and tailoring, makes ISR more effective and relevant for operations.[20] For WAS, the practical application takes shape in several ways.

Surveillance activities need to be fully aligned in purpose and timing with the cycle of learning and responding for the supported field operations or strategic actions.[21] Therefore, WAS providers must develop and execute evolving surveillance strategies directly linked to the cycle of detecting, understanding, and responding to threats. The cycle can include four phases for WAS: planning, initial discovery, focused development, and response (labeled herein as the WAS information cycle) (fig. 2).

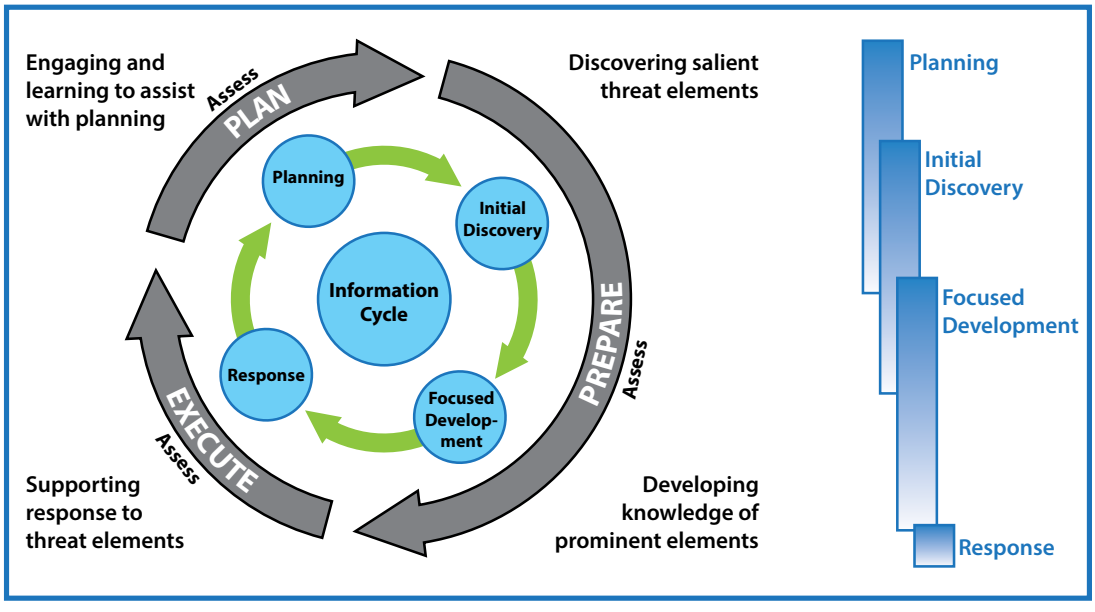

Figure 2. Information cycle synchronization and the operations process

The principle is meant to allow WAS assets to shape US actions onto the most important targets, leading to and thoroughly preparing the WAS unit for direct support of kinetic and nonkinetic operations against those targets and thus embodying the "integration of operations and intelligence."[22] It occurs by progressively building knowledge of and characterizing specific threat activities to enable the selection and development of the most significant targets. For WAS systems, this process begins with a larger surveillance area to map the threat, and then collections are refined into smaller areas to concentrate on the more significant elements as they become apparent, facilitating WAS's assistance in identifying, defining, and nominating objectives at the level of named operations.[23] Quite unfortunately, it is most common for WAS systems to be anchored to one end or the other rather than evolving the surveillance scheme to refine and focus as the needs change.

Good planning sets the stage. Sadly, this part of the cycle is often undervalued and initiated too late. The planning phase can expedite mutual learning among contributing and customer organizations to allow robust,

accurate, and evolving ISR plans to be generated together. Strong partnerships are critical for making this a reality. The next phase, initial discovery, initiates the collection, using surveillance and analysis to contribute to a greater understanding of a threat and thus discover its salient elements. This "find" function precedes every "finish." It is difficult and takes time, but it is an important strength of WAS systems that narrow-field-of-view ISR assets struggle to fill on their own. The initial findings of this phase lead to focused development, which involves further developing information and knowledge pertaining to the prominent threat elements that have been discovered. Once those elements have been understood sufficiently, a response phase naturally follows whereby WAS can directly support the military or policy response to the threat. Execution of this process as part of a multi-INT plan dramatically increases the effectiveness and timeliness of the process, a fact that should not be overlooked.[24] Bringing the power of this principle to life requires (1) aligning and tailoring WAS with the operations cycle for priority-supported units and (2) preparing components and processes for rapidly assembling custom WAS plans.

Matching WAS activities to a supported unit entails aligning a WAS information cycle to the unit's own cycle for a specific operation or suboperation. The phase and cycle durations shrink or expand depending on the complexity of the threat, level of detail required, and priority of the objectives set by the appropriate commands. Meeting the exact surveillance needs present in each phase of the operations cycle can involve adjusting almost every aspect of the collection at each stage—namely, shifting the collection times, amount of persistence, coverage area, orbit, platform-to-target geometries, and sensor configuration. These aspects must be driven by the types of observables, nature, and complexity of activities under scrutiny; the physical features and motion density of the sensing environment; and the precision of detail required. As stated earlier, facilitating effective and progressive plans that truly align at each phase in the cycle will come only by way of a strong partnership that includes engaging units before articulation of their ISR requests.

Without preparation, developing tailored surveillance schemes for evolving requirements can be burdensome. Fortunately, the commercial sector has already created a transferrable approach called "build-to-order" production for meeting shifting and timely needs. This well-established method of building all components in advance and performing custom assembly at the moment of need allows for the highest level of variability in the least amount of time, providing flexibility and responsiveness to shifting requirements with minimal burden.[25] Using this method to create build-to-order surveillance involves predefining the full array of collection components that best suit each of the surveillance activities and conditions that a system may be asked to perform against. For example, a unit should define and label orbits optimized for a primary need of persistent observation, maximizing coverage area or nonpersistent observation mapping. Similarly, common standoff distances should be specified for ideal detection of certain types of targets, achieving discrete coverage-area sizes and meeting geolocation accuracy requirements. Furthermore, sensor configuration presets should be defined based on the type of target, activity density of the target environment, and type of surveillance activity sought. Because details of these components will vary substantially, depending on sensing domain and sensor model, they must be defined at the individual system level. After creation of the components, a set of processes for tailored assembly with adjustments for area-specific flight constraints must be established. WAS providers will then have a broad repertoire of surveillance employment schemes at their fingertips, each prepared in a manner that enables thoughtful, customized, collaborative, and dynamically evolving surveillance solutions constructed for unique, phased problems within a high-tempo environment. This situation will offer a far more potent capability for meeting the idiosyncratic needs of a given operation than the standard model of using "off the shelf" collection schemes based upon a very limited set of solutions that inevitably become stagnant.

A Culture of Fusion: Harmonious Intelligence, Surveillance, and Reconnaissance

Fusion is the process of generating a more complete intelligence assessment from the evaluation of all accessible sources. It is a core principle of joint intelligence, and achieving desirable results from it relies on thoughtful ISR collection and the skillful output of several specialized disciplines.[26] However, when one is inundated with data and information amidst a high operations tempo, the thorough execution of this principle becomes challenging. For WAS, whose front-end operations are very often trained to be fixed upon their single source, this makes timely fusion stunted or outright elusive. It is a state that will persist until the emergence of a deep ideological soak among WAS organizations that is designed to create a culture of fusion. A well-defined concept, the beginnings of which are addressed below, can guide and facilitate its absorption and eventual execution.Fusion is complicated. Creating a reasonably complete assessment of any detectable activity involves countless variables and interdependencies. Consequently, WAS providers and exploiters must labor to cultivate a deep fusion culture within their units. The ethos of this culture must drive and empower unit representatives to directly engage all contributing elements of the ISR process. It is necessary to underpin the ethos with a robust and well-trained multi-INT collaboration framework—a far cry from the limited interaction and data ingestion that currently passes as fusion within the greater WAS community. Sadly, much of WAS's potential power is squandered under these conditions.

Timely and accurate fusion demands a comprehensive, unifying framework of coherently arranged, individually guided, and concurrently executed ISR activities designed to weave an inseparable body of knowledge—here labeled harmonious ISR. The latter seeks to produce optimal effects from the available and applied resources through a holistic and collaborative approach to fusion that inspires unity of effort.[27] It becomes possible through the cooperative, intentional, and thoughtful collection and analysis of multiple synergistic sources.[28]

Harmonious ISR envelops the entire process, from planning to collection and data analysis, for each organization involved in producing information about a specific threat, actually producing an integrated intelligence picture that empowers decision making. The concept implies (1) that every aspect of the ISR operation is considered and then planned with the intent of attaining unity of effort across all contributors, (2) that the elements are ordered and set into a logical arrangement in advance, (3) that ISR activities like multisource collection, cross-pollinating analyses, knowledge synthesis, and information distribution are conducted concurrently, and (4) that the component processes and automated systems are very explicitly and intentionally guided toward producing a truly fused product.[29] For WAS units, this has several practical implications:

- Planning must extend beyond the immediate collection tasks and outside the individual unit.
- Broad collaboration is required across the tasking, collection, and analytic stakeholders.
- Genuinely tailored surveillance is necessary for making the most significant contribution.
- Predefined systematic cueing is indispensable for efficient and highly effective layered ISR.
- Iterative analyses with cross pollination from multiple data sources and analytic disciplines are necessary for developing the deepest threat understanding.

The statements above acknowledge that fusion is both end-to-end and collaborative in nature. Although it appears overwhelming, practice has proven it possible. Unit culture and training must embrace that truth, driving their members to intentionally plan their contribution at each point, from ISR request to the production of actionable intelligence. This shift should also combat the stifling "center of the universe" view and move coordination, planning, and collaboration expressly toward the purpose of realizing complete and multi-INT

knowledge of a specific threat—the essence of fusion. Until this happens, fusion will remain a principle that many people talk about but few truly put into action.

Achieving Unity of Effort: Maximum Value Extraction and Information Orchestration

Attaining a unified effort calls for close, continuous coordination and cooperation with clearly defined objectives and a common interest.[30] This is especially true when participants are not subject to the same immediate command structure because attempts to create unity of effort can easily become smothered by differing perspectives, dissension, lack of formal procedures, and bureaucratic limitations.[31] The WAS community is loosely connected and disparate with little overarching management or obligation among members, making unity of effort difficult. It is, nevertheless, critical to ensuring that the greatest value is obtained from each asset and every single collect. As with other loosely connected cooperatives, though, realizing that objective will be "more art than science."[32]

Maximum Value Extraction

WAS is powerful because it allows for monitoring and learning the physical activities, interactions, and influences associated with an entity, human network, or population. However, if WAS data is rarely subjected to something more than a simple analytic triage, then this potential becomes nothing more than lofty ideals that are seldom realized. Unfortunately, that is near the state of reality for most WAS collections, which are conducted and supported in a generally fragmented manner. The collection assets are commonly connected only to a short-term analytic process, which in some cases may merely cover near-real-time analysis. This fact alone challenges the possibility for extracting all potential information from WAS collects. However, the most significant obstacle is the absence of a mechanism, formal or

informal, that threads the initial analytic efforts into more thorough multi-INT analyses.[33] In reality, this deficiency renders the vast majority of value from WAS systems locked up, leaving the ISR equivalent of "cash on table" and potential gains unexploited.[34] In the business of intelligence, though, the result is missing key information or unnecessarily duplicating collections.[35] Unity of effort can and must be achieved to press the greatest potential value from our nation's substantial WAS investments. Maximum value extraction is a concept designed to address this situation by creating a unified effort to exhaust every possible means for extracting value from priority surveillance collections. The benefit is increased operational significance and greater efficiency from WAS collections.[36]

Maximum value extraction involves enhancing and threading the existing discrete processes and disparate organizations using a value-added model (fig. 3). The concept is held together by mutually agreed upon and systematic processes initiated and constrained by a priority task, effectively creating an analytic cooperative that focuses on and guides the various platform and analytic units. Pulling such a construct together relies upon strong partnerships, frequent coordination, and cooperation as well as defined expectations and objectives.[37] Even then, however, it is still a bit of an "art." By contrast, common practice is to haphazardly engage other ISR organizations and combat units to exchange what amounts to minimal direction. The rest is left to a string of disconnected requests for information.

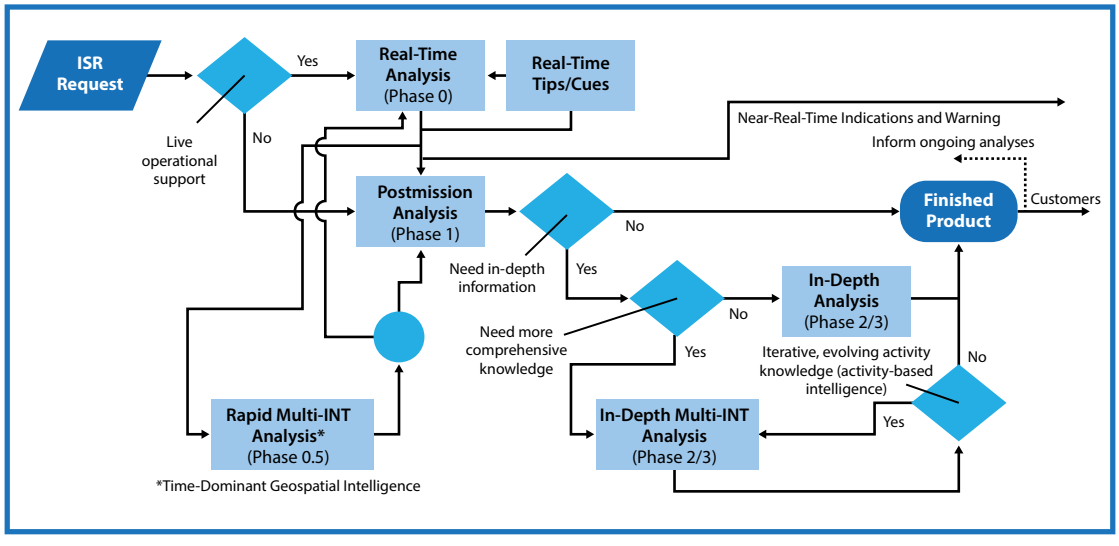

Figure 3. Threading and enhancing discrete processes for full-value extraction

Maximum value extraction involves moving content through the analytic phases and different organizations according to explicit expectations to create a progressive and concentrated accumulation of knowledge related to the original task. It requires individual units to establish procedures that ensure the right content is captured and made easily accessible to the other organizations. The foundation of this value-added model is quality real-time analysis. For WAS, this can be as simple as observing and reporting motion or as complex as collaborative multisource tipping to build knowledge of a deceptive threat. The yield for each is quite different, but the need to accurately capture the mission-relevant information as time-referenced (as applicable) geospatial content is the same. Each detail of the phase zero activities must be captured—the analysis, cues, associated reporting, and original intelligence that drove the task—thus forming the baseline intelligence, which should inform subsequent analyses. At present, very little of this information is captured or distributed. Similarly, organizations that conduct rapid multi-INT historical analysis for near-real-time emerging points of interest—time-dominant geospatial intelligence—need to capture and distribute all content.[38] These value layers must

then be passed after each collect to an analytic group charged with discovering and building new information in the context of current value layers and tied to the original task. Doing so focuses phase one analysis on filling information gaps left by the necessary haste of the phase zero work. The threading continues in this manner, connecting the content and intent from the earlier phases to phase two/three, building successive degrees of value using the increasing resources of time and intelligence accesses to more fully satisfy the initial unit's priority task. Finally, the threaded chain of actions must feed information back into itself to increase the effectiveness of WAS planning, operations, and future analyses. It should go on until the full measure of the need defined by the task has been met, each phase providing an off-ramp for value to be cycled out to the action units. These actions are laid out in a series of phases, but that is for the sake of the conventional analytic construct. The greatest effects actually come from running these functions concurrently, allowing the constant building of knowledge while feeding it back into the other processes—both shortening the timelines and improving the final intelligence.

Both automation and multi-INT analyses should be incorporated as much as possible. Automation will alleviate some of the workload, expediting the processes, and rich multi-INT data environments enable a greater understanding of the threat and its context.[39] Further, full satisfaction of many of the more demanding operational needs will require use of the activity-based intelligence methodology. This type of approach involves the integration of iterative, evolving, transactional, and focused multi-INT collections and analyses.[40] The value resulting from the method is often substantial, especially for revealing the most deceptive and complex mobile threats although it requires well-trained or clearly guided individuals.

Information Orchestration

The entire purpose for investing in and deploying ISR assets is to deliver capabilities that support operational and strategic requirements.[41]

Therefore, the most fundamental question for all WAS activities asks how to make certain that the surveillance outcomes match the operational need. On the surface, the answer seems simple enough, but deeper consideration reveals the enormity of the challenge. A few major points of consideration include (1) the complications in understanding the actual WAS need that underpins a task description, (2) the way it is translated into a plan that offers significant information at each stage in the operations process, and (3) the means of producing the desired information from a collection using a disjointed and unaffiliated exploitation and analysis process. This is simply too complicated, so organizations do what they can and move on. Better outcomes are achievable, but they call for a unified effort.

Realizing a unified effort that produces the most desirable outcomes from WAS demands an orchestrated process for creating information. Such efforts become increasingly necessary as the need for details or the complexity of a threat increases. Information orchestration involves linking and integrating WAS activities throughout the entire process by guiding colocated and disparate people, processes, and machines to labor with a unified purpose to create specific, defined knowledge. The explicit intent of the collaboration is to produce threat knowledge of sufficient accuracy, precision, breadth, and timeliness to enable the operational or policy decisions sought by each request, ensuring that the final information delivered to a supported unit accurately matches its core surveillance need. The principle is inherently end-to-end or cradle-to-grave, requiring very intentional engagement and cooperation with key stakeholders. There are two aspects to information orchestration: the actions themselves and the requisite capacity for collaboration necessary to execute those actions.

Process. The actions of information orchestration are designed to vertically integrate the fragmented, nonaligned, and disparate efforts and organizations tied to WAS collections to ensure that the outcomes match the needs (fig. 4). The process begins by investigating the true root of the surveillance requirements, followed by developing optimal

employment plans, defining platform interactions, setting data-exchange expectations, and specifying how the data must be exploited to fully satisfy the requirements. No single organization takes on the entire process although one must purposefully guide it.

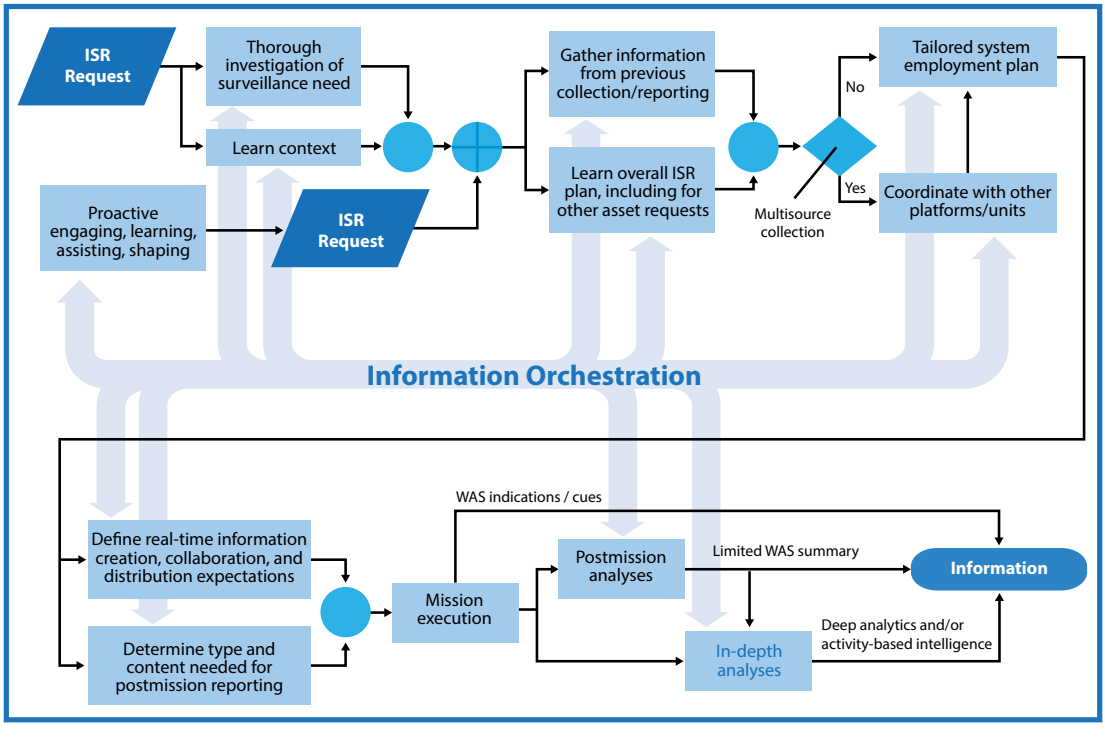

Figure 4. Activity diagram for ensuring that WAS results match the needs

Data providers perform the front end of the process, actively engaging the supported unit to understand the underlying surveillance requirements driving their task. Through close partnerships and a good understanding of theater priorities, this step can and should occur before tasking to allow for planning assistance. This type of engagement is necessary since task descriptions are often recycled to save time and are written by people with a limited understanding of the systems they request, making them generally insufficient on their own. Adapting a set of accepted steps from other professions permits mission planners and the liaisons who assist them to acquire a thorough under-

standing of the fundamental requirements and of the best way to satisfy each. The necessary steps are as follows: (1) define the primary mission and the core needs associated with it, (2) translate the needs into surveillance criteria, (3) enlighten customer units on potential surveillance solutions to satisfy the needs, (4) maintain flexibility for direct input for customization of key aspects, (5) link the surveillance requirements directly to sensor strategy and data utility, (6) account for sensing-environment factors, (7) define the necessary duration for the surveillance activities, and (8) provide clear feedback mechanisms to measure effectiveness.[42] Digging deeply into customer requirements will reveal that many of them will benefit from the formation of a multi-INT collection scheme and that they will rely upon collaborator partnerships for successful creation and execution.

After establishment of the collection plan, the data exchanges and analyses must be defined. The first step entails guiding the reporting expectations for planned information exchanges between platforms and analytic groups. Providing sufficient detail is important, especially for the more complex, collaborative multi-INT collections. Continual interaction between these organizations must then be instigated with the express intent of enabling the degree of informed, iterative, multidisciplinary analyses necessary to satisfy the request. This process produces a robust plan that is well coordinated in execution and that thoroughly exhausts the data's potential through analyses.

Capacity. Actions alone do not ensure effective collaboration. There are indispensable qualities and conditions that facilitate creation of a unified effort from a cooperative group, especially for the voluntary cooperatives that information orchestration would create. Personnel must have the proper skills, knowledge, and attitudes to foster effective collaboration—specifically, robust interpersonal skills, the ability to effectively manage projects, and the expertise to set up cooperative infrastructures. Members also must be strongly committed to the purpose of the collaboration, perceive it as more valuable than the cost of cooperation, and view contributing stakeholder inputs as enhancing

final solutions.[43] The inputs themselves come from effective partnerships, which are built through interpersonal investments of time and attention.[44] When unit culture and training incorporate these elements and when unit representatives that embody them are rewarded, then inspiring voluntary partners to unify in effort will come naturally.

From Talk to Transformation

For most of the past decade, our nation has enjoyed the twin luxuries of ease of surveillance over enemy territory and a seemingly limitless funding source to support legions of ISR collection assets.[45] However, this paradigm is in decline and will continue to degrade until a new one replaces it. Inevitably, the new paradigm will require greater efficiency and efficacy from the ISR programs that survive the ongoing budget reductions. This article has sought to provide a set of guiding principles that address this shift for our nation's WAS investments, especially regarding resources such as moving target indicators and wide area motion imagery. These principles are primarily a decomposition of fundamental doctrinal elements like collaboration, economy of force, synchronization, unity of effort, and fusion that are synthesized into specific and directly applicable statements for WAS. They are based on a thorough application of flexibility, cooperation, and efficiency. This type of approach should make the concepts look and feel comfortably familiar yet offer a level of clarity and detail that has been absent thus far.

With greater clarity comes the opportunity for WAS organizations to reduce the inefficiencies and suboptimal employment that have long plagued them. It also should increase cooperation, enhance our nation's threat knowledge, and reduce the "find, fix, finish" loop. The specific benefits of shifting to a more efficient, multi-INT, and highly customized framework for conducting surveillance will vary. Certainly, they will be clear and pronounced when WAS resources are applied to finding, monitoring, and responding to difficult-to-detect and complex mobile threats. The need to understand both tactical and strategic

threats of this nature in lawless regions and denied areas alike will only expand in volume and significance for the United States, making a framework that better suits them all the more necessary.

The most significant challenge moving forward will be transforming the principles into practice within WAS units. Practitioners will have to work through making nuanced adjustments to fit their organization's unique structure and roles. Without a doubt, these efforts will be met by critics who will too quickly dismiss the ideas as "something we already know and do" due to some vague resemblance to a current practice or its derivation from familiar high-level doctrine. We can expect such resistance because change is seldom well received. However, we are facing an inevitably more complex threat and policy environment, coupled with reduced defense budgets. Such reality must drive us to both negotiate the inhibitors and embrace the opportunity to unleash the maximum operational potential from the WAS resources that remain available. ✪

Notes

1. Air Chief Marshal Sir Peach Stuart (keynote address, GEOINT [Geospatial Intelligence] 2012, Gaylord Palms Hotel, Orlando, FL, 10 October 2012).

2. Brad Plumer, "America's Staggering Defense Budget, in Charts," *Washington Post*, 7 January 2013, http://www.washingtonpost.com/blogs/wonkblog/wp/2013/01/07/everything-chuck-hagel-needs-to-know-about-the-defense-budget-in-charts/.

3. National Intelligence Council, *Global Trends 2030: Alternative Worlds* (Washington, DC: US Government Printing Office, 2012); National Intelligence Council, *Global Trends 2025: A Transformed World* (Washington, DC: US Government Printing Office, 2008); and National Intelligence Council, *Global Governance 2025: At a Critical Juncture* (Washington, DC: US Government Printing Office, 2010).

4. Joint Publication (JP) 2-0, *Joint Intelligence*, 22 October 2013, II-12; and Dr. Lee Fuell Jr., "Understanding the Enemy as a Complex System: A Multidisciplinary Analytic Problem Requiring a Multidisciplinary Team Approach," *Air and Space Power Journal* 23, no. 2 (Summer 2009): 19–24.

5. JP 1, *Doctrine for the Armed Forces of the United States*, 25 March 2013, II-20, II-21; JP 2-0, *Joint Intelligence*, 22 October 2013, V-4, V-5; Curtis E. LeMay Center for Doctrine Development and Education, *Volume I, Basic Doctrine*, 14 October 2011, 29, https://doctrine.af.mil/download.jsp?filename=Volume-1-Basic-Doctrine.pdf; and House of Representatives, *"National*

Security, Interagency Collaboration, and Lessons from SOUTHCOM and AFRICOM," Hearing before the Subcommittee on National Security and Foreign Affairs of the Committee on Oversight and Government Reform (Testimony of James Schear), 111th Cong., 2nd sess., 28 July 2010, http://www.gpo.gov/fdsys/pkg/CHRG-111hhrg64927/html/CHRG-111hhrg64927.htm.

6. Branda Nowell, "Profiling Capacity for Coordination and Systems Change: The Relative Contribution of Stakeholder Relationships in Interorganizational Collaboratives," *American Journal of Community Psychology* 44, nos. 3–4 (December 2009): 196–212.

7. Ibid.

8. Army Doctrine Reference Publication (ADRP) 5-0, *The Operations Process*, 17 May 2012, 1-2–1-4. When surveillance organizations understand a maneuver unit's operations process and learn the nuances of its implementation, then they are able to best tailor and evolve collections to align with it.

9. Fuell, "Understanding the Enemy," 19–24.

10. ADRP 3-0, *Unified Land Operations*, 16 May 2012, 4-2; and Curtis E. LeMay Center for Doctrine Development and Education, *Volume I, Basic Doctrine*, 53–54. The most descriptive definition for economy of force occurs in Field Manual (FM) 3-0, *Operations*, 27 February 2008, A-2. This document precedes ADRP 3-0, *Unified Land Operations*.

11. JP 2-0, *Joint Intelligence*, xi, II-6.

12. It is common for individuals requesting ISR collection to ask for all potentially applicable systems for as long as may be possibly relevant without constraint; therefore, collection managers and the system liaisons that aid them will be left imposing most aspects of WAS economy of force.

13. Based on a review of ISR requests for ground moving target indicators (GMTI) and wide area motion imagery (WAMI) in Afghanistan during 2011, 2013, and 2014 compared to actual collection durations and data-quality levels.

14. FM 3-24 / Marine Corps Warfighting Publication (MCWP) 3-33.5, *Counterinsurgency*, 16 December 2006, 3-27–3-32.

15. Some assets like VADER, Gorgon Stare, and Blue Devil have at times been almost notorious for their use as surrogates for full motion video (FMV). The evidence is apparent in how the systems are requested to operate and can sometimes be seen in the ISR requests. The most obvious instance occurs when a unit requests FMV, is not allocated a line, and therefore resubmits the requests replacing WAMI or GMTI for FMV.

16. Sherrill Lingel et al., *Methodology for Improving the Planning, Execution, and Assessment of Intelligence, Surveillance, and Reconnaissance Operations* (Santa Monica, CA: RAND Corporation, 2008), 41–61, http://www.rand.org/content/dam/rand/pubs/technical_reports/2008/RAND_TR459.pdf.

17. JP 3-08, *Interorganizational Coordination during Joint Operations*, 24 June 2011, IV-20.

18. This example is most often seen in the WAS radars although certain future imaging systems will run the same risk. When collection resources are spread too thin, sampling of the target is too poor to monitor target activity with actionable confidence. In addition, optimum target-to-platform geometries are almost always compromised, providing degraded-quality data for the priority surveillance areas.

19. ADRP 5-0, *Operations Process*, 1-2–1-4, 1-13; and JP 2-0, *Joint Intelligence*, II-2.

20. Curtis E. LeMay Center for Doctrine Development and Education, *Volume I, Basic Doctrine*, 11, 61; and Curtis E. LeMay Center for Doctrine Development and Education, "Annex

2-0, Global Integrated Intelligence, Surveillance & Reconnaissance Operations," 6 January 2012, 5–7.

21. JP 2-0, *Joint Intelligence*, x, II-2.

22. Curtis E. LeMay Center for Doctrine Development and Education, "Annex 2-0," 5.

23. JP 2-0, *Joint Intelligence*, I-4.

24. A rich multi-INT environment provides identifying, characterizing, and contextual information about an entity. Its actions and locations reveal the most important elements with more thoroughness, confidence, and speed than are possible through single or limited sources. It includes various forms of still and motion imagery, signals collection, measurements and signatures, human collection, cyber activity, document exploitation, cultural information, location history, publicly available content, and so forth.

25. Angappa Gunasekaran and E. W. T. Ngai, "Build-to-Order Supply Chain Management: A Literature Review and Framework for Development," *Journal of Operations Management* 23 (2005): 423–51; Matthias Holweg and Frits K. Pil, "Successful Build-to-Order Strategies: Start with the Customer," *MIT Sloan Management Review* 43, no. 1 (Fall 2001): 74–83; and Andreas Reichhart and Matthias Holweg, "Creating the Customer-Responsive Supply Chain: A Reconciliation of Concepts," *International Journal of Operations & Production Management* 27, no. 11 (2007): 1144–72. The concept of build-to-order (BTO) surveillance is based on BTO production, so it is beneficial to investigate the original concepts first before proceeding with creating the elements described for BTO surveillance.

26. JP 2-0, *Joint Intelligence*, II-12.

27. Ibid., II-4–II-6. The purpose and effects described are perfectly applicable although for WAS they must be achieved through a cooperative because adjacent organizations may not be subject to the same command.

28. Desired information sources will change, based on the target and theater availability, but a mixture of collection sources must exist to provide insight into the full scope of activity and to eliminate ambiguity. An effective collection must be conceived with great thought to actually gain synergy and obtain integrated, actionable intelligence—a process that differs from simply "stacking" resources and accepting their standard output.

29. Smart automation can expedite the analytic process; however, more complex tools may have requisite conditions. For example, WAS-centric multi-INT fusion systems will deliver limited value only if applied outside the type of framework described because their success hinges upon the related and quality data provided by it.

30. JP 1, *Doctrine for the Armed Forces*, xv, II-13–II-14; and JP 2-0, *Joint Intelligence*, V-4–V-5.

31. JP 1, *Doctrine for the Armed Forces*, xv, II-13–II-14.

32. The interagency process often is described as "more art than science" in the now-superseded JP 1, *Doctrine for the Armed Forces of the United States*, 20 March 2009, xxi, VII-1.

33. In some instances, ad hoc agreements have been made to temporarily create an effective chain of analyses, but they are generally neither pervasive nor long-standing.

34. Robert H. Frank and Ben Bernanke, *Principles of Macroeconomics*, 3rd ed. (New York: McGraw-Hill/Irwin, 2007), 83–84.

35. By not fully exploiting collected WAS data and by doing so within a multi-INT construct, one will fail to discover valuable and relevant intelligence within the volumes of content. When information is not perceived as available-—perhaps a result of inadequate exploitation of existing data—then more collection is tasked.

36. Increased significance occurs by producing more actionable intelligence and improved efficiency due to a reduction in collections based on resolving the need through more thorough exploitation.

37. Given that units will not be subject to a unified command or even prescribed agreements, achieving success toward this end must take place through cooperatives. Doing so, among other things, requires the attributes listed.

38. This form of support has generally been provided only by selected analytic groups that support special operations.

39. House of Representatives, *Testimony of Alan Shaffer to the Committee on Armed Services, Subcommittee on Terrorism, Unconventional Threats and Capabilities*, 111th Cong., 1st sess., 20 May 2009; Col Jon Kimminau, "ISR Focus: A Culminating Point for Air Force Intelligence, Surveillance, and Reconnaissance," *Air and Space Power Journal* 26, no. 6 (November–December 2012): 113–29; and Hugh McFadden, "Building Batman's Belt: Considerations for Automated Processing in Support of Manual Analysis" (paper presented at National Air and Space Intelligence Center conference, Wright-Patterson AFB, OH, August 2009). The congressional hearing states that "without improving our ability to process data and extract actionable intelligence, we run the risk of becoming data bound and information starved." Kimminau's article cites a US Air Force report that says we need "automation to reduce the time that analysts spend on mundane . . . and routine [tasks]" (p. 123), and McFadden advocates for WAS automation that provides small pieces of useful information to analysts instead of trying to produce a complex final solution.

40. A series of sensitive documents regarding activity-based intelligence (ABI) was released in 2010, providing significant detail on the subject. See also Mark Phillips, "A Brief Overview of ABI and Human Domain Analytics," *Trajectory Magazine*, September 2012, http://www.trajectorymagazine.com/web-exclusives/item/1369-human-domain-analytics.html. ABI tradecraft was originally developed to support counterterrorism but has expanded to cover a broad spectrum of defense applications.

41. Curtis E. LeMay Center for Doctrine Development and Education, "Annex 2-0," 6; and ADRP 3-0, *Unified Land Operations*, 2–6.

42. Benjamin S. Blanchard and Wolter J. Fabrycky, *Systems Engineering and Analysis*, 4th ed. (Lebanon, IN: Prentice Hall, 2006), 59–69; and Holweg and Pil, "Successful Build-to-Order Strategies," 74–83. The process listed is mostly a direct adaptation from systems engineering principles but includes elements from BTO production.

43. Pennie G. Foster-Fishman et al., "Building Collaborative Capacity in Community Coalitions: A Review and Integrative Framework," *American Journal of Community Psychology* 29, no. 2 (2001): 241–61.

44. JP 1, *Doctrine for the Armed Forces*, II-22; and Curtis E. LeMay Center for Doctrine Development and Education, *Volume I, Basic Doctrine*, 134.

45. Combat commanders may argue that they did not have the luxury of ISR, but the facts show that our nation now possesses more such systems than at any other time in history—and in numbers that would baffle any other nation.

Hugh McFadden

Mr. McFadden (BS, MS, Florida Institute of Technology) works for Northrop Grumman Corporation, where he has spent most of his career developing and evolving intelligence, surveillance, and reconnaissance (ISR) technologies and applications. In this capacity, he has contributed to space, unmanned systems, manned aircraft, and data-exploitation programs. Aside from his primary role of managing emerging ISR programs, Mr. McFadden has participated in numerous direct-support roles for the government within the United States and has deployed to forward operating locations, supporting both the military and the intelligence community. Doing so has allowed him to experience several different perspectives within the wider ISR community, from advanced research to fielded technology and from in-depth analyses to real-time operations.

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Benefits and Costs of Transforming Military Cyberspace

Dr. Panayotis A. Yannakogeorgos

> *Maintaining awareness of advancing technology and harvesting the opportunities it creates is in our blood as innovative Airmen. . . . Pursuit of the next "game changing" technology is central to maintaining the asymmetric advantage our Air Force has always provided the nation.*
>
> —Secretary of the Air Force Deborah Lee James

As the US Air Force prepares for an age of strategic agility, we become excited with headline-grabbing emerging technologies such as hypersonic aircraft, nanotechnology, and remotely pi-

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loted and autonomous systems that will in time become core mission enablers.[1] Too often overlooked are the invisible transmission control protocol (TCP) / Internet protocol (IP) networking protocols that revolutionized the military and the world by changing how humans exchange and use information. This networking protocol enhances and enables the Air Force's five core missions: air and space superiority; intelligence, surveillance, and reconnaissance (ISR); rapid global mobility; global strike; and command and control.

Secretary of the Air Force Deborah Lee James notes in the recent strategy document *America's Air Force: A Call to the Future* that "this strategy challenges our Air Force to forge ahead with a path of strategic agility—breaking paradigms and leveraging technology just as we did at our inception."[2] Today, the Department of Defense (DOD), Air Force, and nation are focused on technologies important to future development. However, unbeknownst to many people, the structure of the Internet is changing for the first time in its history with the exhaustion of the IP version four (IPv4) protocol and the adoption of IPv6. The DOD—as well as the Air Force in particular—has a tremendous opportunity and responsibility to lead the nation in the transition to IPv6 to enhance and enable core functions and missions, assuring that our cyber operators are educated and trained to keep pace with technological change.

A recent report by the DOD inspector general found several missteps on the part of the department's chief information officer (CIO), US Cyber Command, and the Defense Information Systems Agency in terms of making IPv6 a priority. A lack of coordination and failure of the CIO to maintain a plan of action, together with milestones for transition to IPv6, have cost the DOD time and will increase expenses.[3] Over the course of an 18-month-long cyber workforce-development study, the Air Force Research Institute discovered several worrisome trends and perceptions that contributed to an environment in which IPv6 was not a top national security priority that it should be. This article outlines why it should have higher priority and why operators

and senior leaders alike should be worried about the slow pace of IPv6 migration within the DOD.

The department researched and developed the Advanced Research Projects Agency Network (ARPANET), which eventually became the Internet, when it transitioned the ARPANET from network control protocol (NCP) to TCP/IP in 1981. The DOD led the world in developing and deploying the core protocols and standards by which applications and services were delivered to users. Today the core of the Internet, cyberspace's most potent manifestation, is about to change for the first time in history, and we are not in the lead. The TCP/IP communications protocol, a scarce, critical Internet resource, is transitioning from IPv4 to IPv6. The latter will introduce features into the networking environment, such as quality of service and multicasting that will enhance how information is used and exchanged. Voice over IP and television over IP are but two applications that stand to benefit from IPv6 and will revolutionize how the world communicates in the same way that satellites have.[4] The need to transition from IPv4 to IPv6 is not hypothetical since the global supply of IP addresses in IPv4 is quickly being exhausted (fig. 1).[5]

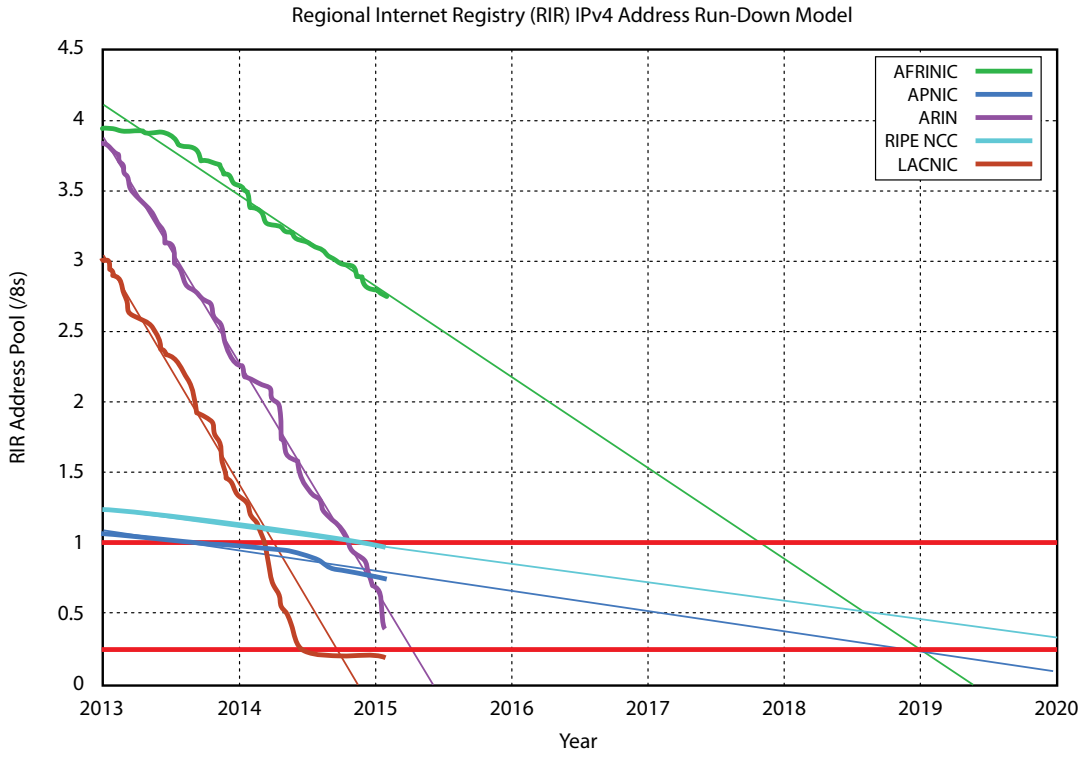

Figure 1. Projection of consumption of remaining regional Internet registry address pools. (From "IPv4 Address Report," accessed 29 January 2015, http://www.potaroo.net/tools/ipv4/. This report generated 29 January 2015, 08:07 UTC. Reprinted with permission.)

AFRINIC - African Network Information Center

APNIC - Asia Pacific Network Information Center

ARIN - American Registry for Internet Numbers

RIPE NCC - Réseaux IP Européens Network Coordination Centre

LACNIC - Latin American and Caribbean Network Information Center

Internationally, calls for transitioning to IPv6 have been ongoing since 1996 and have intensified with the 2013 "Montevideo Statement" of the Internet Corporation for Assigned Names and Numbers (ICANN) calling the "transition to IPv6 to remain a top priority globally. In particular Internet content providers must serve content with

both IPv4 and IPv6 services, in order to be fully reachable on the global Internet."[6] It will require more than just a flip of a switch for the DOD and the Air Force to transition. It will demand significant resources and commitment to the educating and training of our cyber workforce to preserve the missions in this evolving domain upon which the DOD relies so heavily.

What Is an IP Address, and Why Do We Need It?

Machines identify each other on the Internet and most networks by means of IP and media access control (MAC) addresses. Although invisible, IP addresses are finite in number, making them a scarce and critical Internet resource. All networked hardware and software must have a valid IP and address to function on a network, whether the open Internet or a closed sensor-control network. In particular they identify machines, guiding data packets and information across computer networks—including the Internet. The use of data packets, the basic units of network traffic, is the standard method of dividing information into smaller units when it is sent over a network. A vital component of networks, the IP header, contains information pertaining to the source and destination addresses. Machines require these strings of numbers to connect with other computers on the Internet or other networks.[7] Data packets are re-created by the receiving machine based on information within a header of each packet that tells the receiving computer how to re-create the information from the packet data. Without standardized communications protocols, such as TCP/IP, there would be no assurance that packets could be read by a receiving machine.[8]

As more people, organizations, and machines cross the digital divide, IP addresses become depleted as they are allocated by service providers. The processes for assigning scarce IP addresses and allowing the Internet to serve as a global platform are complex. ICANN allocates IPv4 address space to various registries via the Internet Assigned Numbers Authority (IANA) in agreement with the US National Tele-

communications and Information Administration of the US Department of Commerce, which currently retains stewardship over the procedural role of administrating changes to the Domain Name System (DNS) root-zone file.[9] The IANA allocates address space in the size of /8 prefix blocks (16,777,216 IP addresses) for IPv4 to requesting regional registries as needed.[10] The regional Internet registry (RIR) then resells smaller /16 blocks (64,000 IP addresses) to Internet service providers (ISP) and other organizations. ISPs then resell smaller blocks of IP address space to end users to access the Internet (fig. 2). The allocation of IPv6 addresses is similar; however, it is structured so that all IPv6 networks have space for 18,446,744,073,709,551,616 IPv6 addresses. In layman's terms, each network will have more space than the entire IPv4 pool.[11]

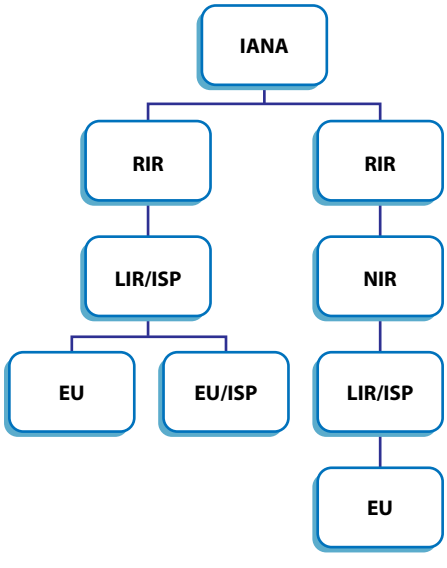

Figure 2. Current address allocation hierarchy

IANA: Internet Assigned Numbers Authority

RIR: regional Internet registry

LIR: local Internet registry

ISP: Internet service provider

NIR: national Internet registry

EU: end user

Unlike the popular conception of a limitless Internet, the underlying address space is finite. Indeed, IPv4 address space has already run out for allocation by IANA and RIRs in Europe, Asia, and Latin America. Foreseeing this eventuality, engineers developed IPv6 in the 1990s. Among other improvements, it increased the total number of potential IP addresses from 4,294,967,296 in IPv4 to 2^{128} in IPv6.[12] Although the IPv6 protocol has been deployable since 1996, today the world faces a shortage of IPv4 address spaces on which the Internet currently relies. This deficit will only become worse as the establishment of an "Internet of things" intensifies. As machines begin communicating with other machines, each will require its own IP address. ICANN noted in 2011 that "future expansion of the Internet is now dependent on the successful global deployment of the next generation of Internet protocol, called IPv6."[13] Although CIOs within the DOD and US government acknowledge that the world is transitioning from IPv4 to IPv6 as the dominant communications protocol for the global Internet, it is not evident that rapid transition is a priority.

The Air Force's Road to Migration

Within the service, the Air Force Network Integration Center (AFNIC) has been working on the Air Force's transition from the current IPv4 addressing format to IPv6 since 2002. The latest transition deadline received a soft mandate of 2014.[14] In reality, however, Air Force migration will take much longer, based on the fact that the service has not begun migrating the core network service capabilities except at selected bases. Even those that have started have since rolled back their efforts.[15] Other than a few labs and the Defense Research and Engineering Network, no more than a half dozen machines on the live Air Force Nonsecure Internet Protocol Router (NIPR) Network are legitimately using IPv6.[16] Even so, it has been noted that the plan involves using both IPv4 and IPv6 in parallel for the next 10–15 years. This approach further complicates operational success because the dual framework creates an additional energy load on processors to run both

protocols, potentially negating some of the benefits of a complete transition. Further, it introduces vulnerabilities into the system.

What Are the Military Benefits of Transition?

In his foreword to *America's Air Force: A Call to the Future*, Gen Mark A. Welsh III, the Air Force chief of staff, emphasizes that "the Air Force's ability to continue to adapt and respond faster than our potential adversaries is the greatest challenge we face over the next 30 years."[17] Certainly, an entire article can be written about the fact that China is leading the world in operational deployment of IPv6-only networks through its China Next Generation Internet program.[18] The effects on US national security could be substantial.[19] The ability of foreign actors to begin dominating the field of Internet governance poses a tremendous problem to our current security environment. However, addressing such threats lies beyond the scope of this article. This section concerns itself less with the threat than with the utility of deploying IPv6 native networks and the potential vulnerability of not doing so without a strategy to educate our cyber workforce in this new operating environment.

For both the DOD and the Air Force, IPv6 is a critical technology for enabling network-centric warfare theories in support of all five of the service's core missions. In addition to the basic number of IP addresses available, IPv6 allows for more advanced networking capabilities than does IPv4. Networked machines/sensors, devices, applications, and services will benefit from improved functionality with IPv6. Indeed, the outcome of the Air Force chief scientist's *Cyber Vision 2025* study suggests several technologies that would greatly benefit from the expansive address space that IPv6 offers. Adopting widespread use of the protocol would prove especially beneficial in the areas of assuring and empowering the mission, as well as enhancing agility and resilience of the systems dependent on cyber capabilities. IPv6 benefits could be leveraged to reduce cyber risk to Air Force missions by enabling IP hopping; morphable architectures; agile, tactical communica-

tions; heterogeneous, operationally responsive networks; and other crosscutting mission areas. *Cyber Vision 2025* acknowledges these benefits of IPv6.[20] However, current CIO strategies call for the transition to full IPv6 to occur with IPv4/IPv6 dual stacking in phases.[21] Dual stacking or the running of IPv4/IPv6 in parallel is a bad idea. First, it introduces well-documented security vulnerabilities.[22] Do we expect that our potential adversaries will not understand this fact and fail to leverage the advantages of IPv6, thus challenging our efforts in the cyber domain? Second, it increases manpower costs since the workforce must understand both.

IP address space is important for delivering the elements of all of the Air Force's core missions. Allocations are occurring all the time, and large programs demand substantial allocations. One example that illustrates this point within the global-mobility mission set involves the new KC-46 tanker aircraft currently on an assembly line that is expected to produce 179 aircraft over the next 20 years. All of them need IP address space. Every Air Force mission must have large IP address spaces per platform to support a robust and redundant communications platform that requires multiple network switches to ensure resilient command and control as well as mission objectives.

Another example highlighting the advantages regards flexible, global integrated ISR capability as called for in the Air Force's strategy document: "Expanding requirements and a growing threat to high cost air-breathing assets will also necessitate a shift from an architecture focused on dedicated ISR platforms to one based on a diverse network of sensors arrayed across the air, space, and cyber domains, placing a premium on the ability to draw data from any and all US systems."[23] The expanded address space would allow for a massive number of sensors networked together in a vast IP address space that would give sensors their own static IP addresses. Further, communications devices with their own static IP address running solely IPv6 would consume less energy, thus providing longer-lasting battery life in mobile

devices on which the command and control of many military operations depend.[24]

Why Have We Not Converted Yet?

Persistent myths continue to hamper discussions about transitioning to IPv6.[25] Primarily they fall into four categories: (1) immature architecture, (2) security vulnerabilities, (3) the myth that the DOD has a sufficient allocation of IPv4 addresses, and (4) the fiscal burden of conversion during a time of austerity.

Immature Architecture

Some people assert that the v6 arena has not matured enough to force a change that includes technology, architecture, and the skills of operations personnel. One view within the Air Force holds that there are no compelling drivers to IPv6 at this time and that the cyber operations community has more than enough on its plate for now. However, this argument falls flat on its face on two points. First, the US government CIO and Government Accountability Office, as noted above, encourage dual stacking. Second, the Air Force strategy declares that "one of the most important responsibilities of a military service is to prepare the force for the challenges of tomorrow, not just the realities of today."[26] It is also clear that although most information technology (IT) equipment is IPv6 capable, the Air Force does not have any substantial plans to make use of this capability in the foreseeable future (two to five years).[27] At present, the greatest operational challenge is making sure that new capabilities to tunnel v6 over v4 and vice versa are turned off so that our adversaries cannot exploit them.[28]

Security Vulnerabilities

A key future challenge is that even if v4 and v6 are enabled during a transition period, the National Institute of Standards and Technology (NIST) notes that "prevention of unauthorized access to IPv6 networks

will likely be more difficult in the early years of IPv6 deployments."[29] Indeed, contrary to conventional wisdom, serious security vulnerabilities exist that go beyond turning on IPv6 on the networking equipment that the Air Force has already purchased. NIST warns,

> As the IPv6 protocol becomes increasingly ubiquitous, all enterprise and Internet-connected networks need to be prepared for specific threats and vulnerabilities that the new protocol will bring. For example, an IPv4-only network segment may contain several newly installed hosts that are both IPv4 and IPv6-capable, as well as hosts that have IPv6 enabled by default. This circumstance can come about simply as a result of the normal systems life cycles. Additionally, IPv6 could be enabled on a host by an attacker to circumvent security controls that may not be IPv6-aware; these hosts can then be leveraged to create covert or backdoor channels. Taken further, IPv6 traffic could be encapsulated within IPv4 packets using readily available tools and services and exchanged with malicious hosts via the Internet.[30]

Implications include that many host-based defense and forensics tools can't handle the large address space of IPv6 networks. The smallest IPv6 subnet will be 4 billion times larger than the entire IPv4 range; consequently, defenders will have difficulty finding victims. An IPv6 scanner could take days or weeks to locate all the hosts on the Air Force network, let alone actually scan them for vulnerabilities. Existing IPv4 intrusion detection systems cannot inspect the contents of an IPv6 tunneled packet and vice versa. Thus, a financial cost will be associated with acquiring the systems to defend v4 and v6 networks. This is in addition to the cost to educate and train our cyber operators, who will need additional education and training as well as the establishment of network defense tools to detect the potential threat of exactly the opposite of tunneling IPv4 over IPv6. Hence, although going dual stack everywhere is an admirable goal, realistically, doing so will have an effect on each of the tunneling protocols on the throughput, data rates, and latency that result.

Myth That the Department of Defense Has a Sufficient Allocation of IPv4 Addresses

Another erroneous perception pervading the discussion touts that IPv4 depletion is not a problem for the DOD since a large allocation of IPv4 addresses worldwide has already been reserved for national security purposes.[31] Historically, the DOD has been a repository of technical expertise regarding the Internet, given the latter's roots within the Defense Advanced Research Projects Agency; its operation of the ".MIL," a top-level domain for exclusive use by the DOD; and its running DNS name servers to support it. In the early 1990s, the DOD acquired a significant amount of the IPv4 space—12 blocks of /8 block space. With each /8 block containing 16,777,214 IP addresses, the DOD has over 200 million addresses available in v4 space. The current situation with IPv6 is analogous to that of IPv4 in the early 1990s. The DOD has purchased a /13 block of v6 space, the equivalent of 42,000,000,000,000,000,000,000,000,000,000,000,000 IP address spaces.[32]

Conventional wisdom across much of the Air Force is that the DOD and the Air Force have no reason to worry about IP address depletion. Indeed, only a very small percentage of the Air Force network uses any IPs from those 12 allocations. Huge chunks of that network predate the assignment of those /8 networks, and it skews the DOD projections if one assumes that those 12 /8 networks are all that are available to work with. Thus, an accurate analysis will consider the true IPv4 addresses that the Air Force is using, most of which were directly acquired before the DOD received its big allocations.[33] Calculations on the publicly available DOD Network Integration Center "WHOIS" database reveal that the department has slightly more than 317 /16 networks currently listed as reserve networks that have been recovered for future assignment.[34] A mixture of smaller allocations also exists. Of the 317 /16 networks, currently one unused /8 network (29.0.0.0/8) is being held in reserve. If the purpose of doing so is to support the entire DOD, then that is not adequate address space for future applications.

Within the Air Force, annual averages of the IPv4 rate of depletion do not clearly show a trend for increasing or decreasing burn rates (fig. 3). Anomalous numbers in 2010 were caused by network cleanup that fixed long-standing problems and really should be considered an outlier. Using these numbers on a linear exhaustion path, one finds that the projected exhaustion date of all currently Air Force–owned IP address space is Monday, 31 December 2029, although this is more likely to occur prior to that date because of increasing demands of IP address space as new systems go online that demand more of this limited resource. Thus, the notion that the DOD and the Air Force do not need to worry about IPv4 depletion is a myth. Planning for the inevitable conversion must start sooner rather than later since allies will likely run out of IPv4 address space well before 2029.

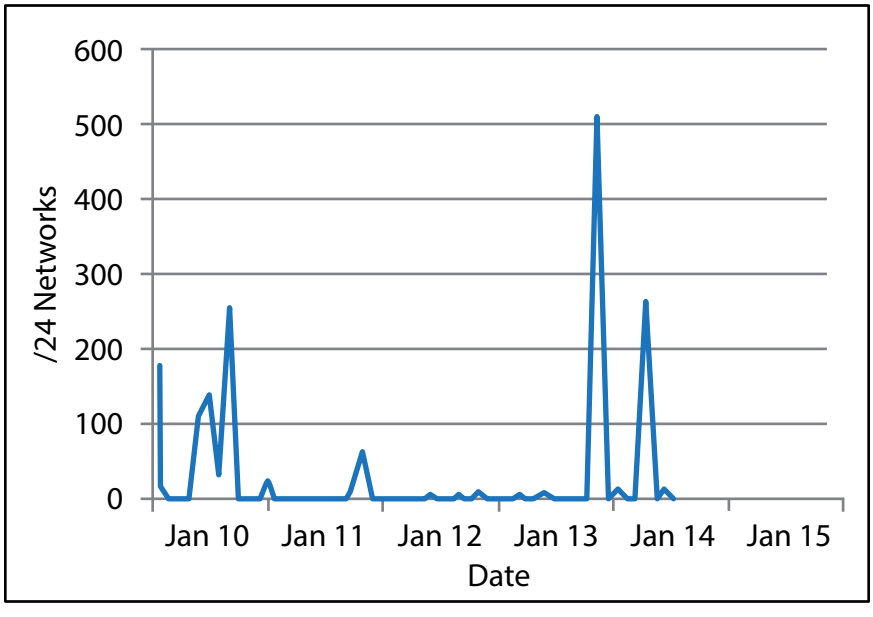

Figure 3. Number of /24 networks assigned per month, Nonsecure Internet Protocol Router

The Air Force's *Call to the Future* document is unambiguous in its belief that coalition warfare will continue to be critical to the success of the service over the next 30 years: "Indeed, the most likely and most demanding scenarios involve the Air Force working in concert with, or leading, coalition Airmen."[35] Assuredly, this prospect is already a challenge.[36] If and when partner and allied nations shift their domestic and military networks to IPv6, then interoperability between our networks and allied/coalition networks will not be possible without transition or translation techniques between the two protocols. This situation will increase vulnerability to operational missions. To mitigate this vulnerability, NIST recommends in its *Guidelines for the Secure Deployment of IPv6* that the best practice is to block all IPv6 traffic on IPv4-only networks.[37]

IPv6 penetration is increasing worldwide, including in the United States.[38] However, the DOD is not keeping pace because of the perception that having many IPv4 addresses allocated to the .MIL domain does not necessitate the transition. To remain interoperable, the DOD will need to be on IPv6 and able to work with full IPv6 systems in the future. It takes a long time to plan deployment and train operators to successfully employ and defend a new system. Thus, we need to start sooner rather than later.

Fiscal Burden of Conversion during a Time of Austerity

Finally, individuals who oppose a rapid conversion to IPv6 also raise the issue of a financial burden associated with transition. Admittedly, additional funds will be required to cover the cost of new infrastructure and network services. Therefore, according to critics, in a budget-constrained environment with competing priorities, it is not the right time to conduct the transition. This argument is partly true. Because the DOD pioneered the Internet, the United States owns a very large legacy infrastructure that is IPv4. Thus, the cost of transitioning will be higher than that of most other organizations that do not have a legacy infrastructure. Nations and organizations with little infrastructure

will be able to start directly on IPv6-compatible infrastructure utilizing methods such as dual stacking during the transition period and then shutting off IPv4. However, the AFNIC has been an advocate for IPv6 since 2002. Using the tools at hand and emphasizing strategies focused on buying IPv6-capable equipment were refreshed during the normal tech refresh cycle since 2003 when the DOD required all hardware and software "developed, procured or acquired shall be IPv6 capable (in addition to maintaining interoperability with IPv4 systems/capabilities)."[39] The National Defense Authorization Act also includes an IPv6 inspection element for the Air Force's CIO to use as a metric for each program's score cards: "The PM [program manager] shall initiate efforts to transition IPv4 systems and applications to support IPv6 and determine the IPv6 impact. The PM shall conduct an analysis to determine cost and schedule impacts necessary to modify the system. The PM shall include IPv6 requirements in program acquisition and technology refresh budget and POM [program objective memorandum] submissions."[40] A bad mark on this report card could hold up funding for a program.[41] Federal acquisition regulations also direct that IPv6 equipment be obtained for any purchase after December 2009 when the IPv6 requirement came about.[42] Figures 4–6 show the status of IPv6 enablement across both the Air Force and the DOD.

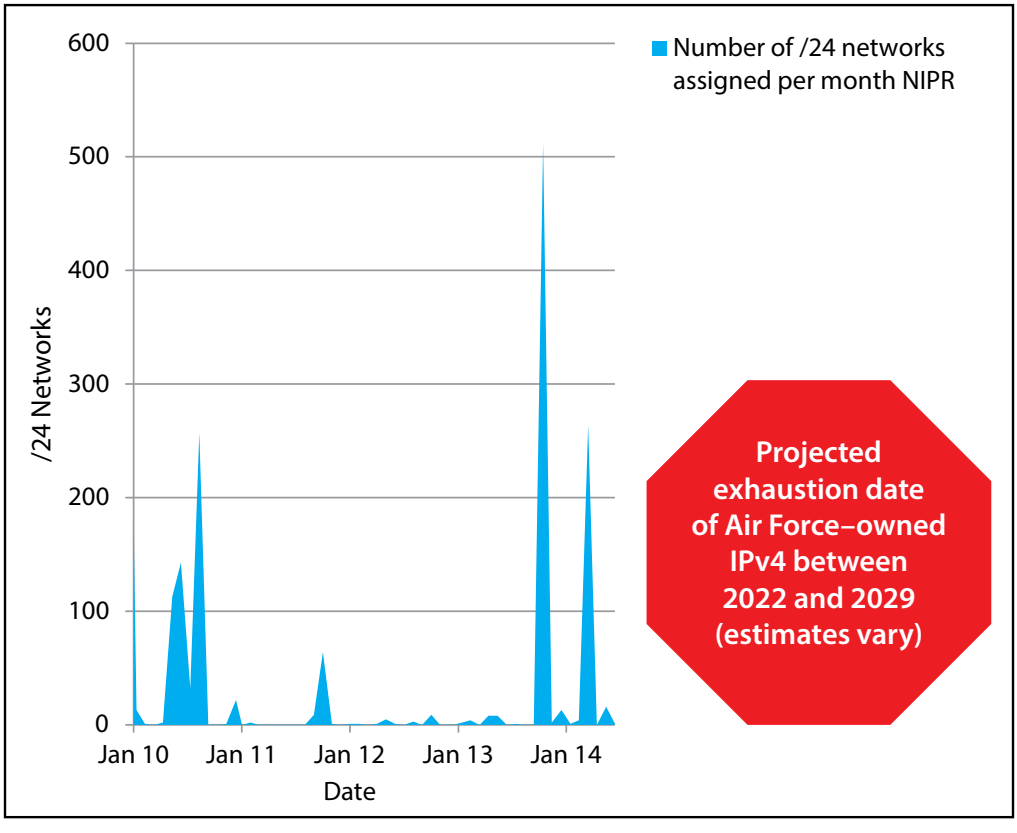

Figure 4. Number of IPv4 networks assigned per month. (Reprinted from data provided by the Air Force Systems Networking office.)

NIPR - Nonsecure Internet Protocol Router Network

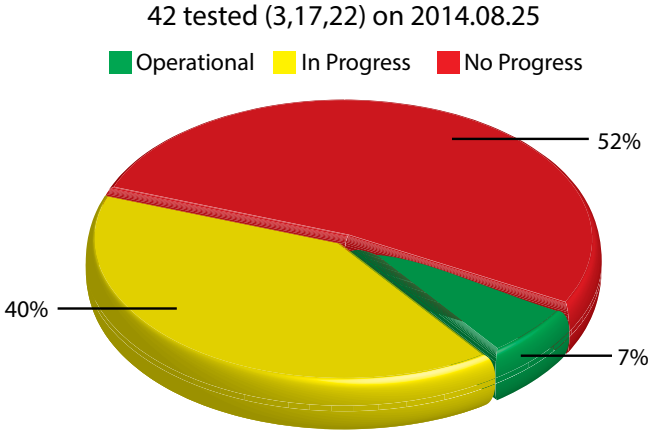

Figure 5. Completed IPv6 enabled domains, Department of Defense. (Reprinted from "Estimating IPv6 & DNSSEC External Service Deployment Status, Department of Defense," Information Technology Laboratory, Advanced Network Technologies Division, National Institute of Standards and Technology, accessed 2 February 2015, http://fedv6-deployment.antd.nist.gov/cgi-bin/cfo?agency=defense.)

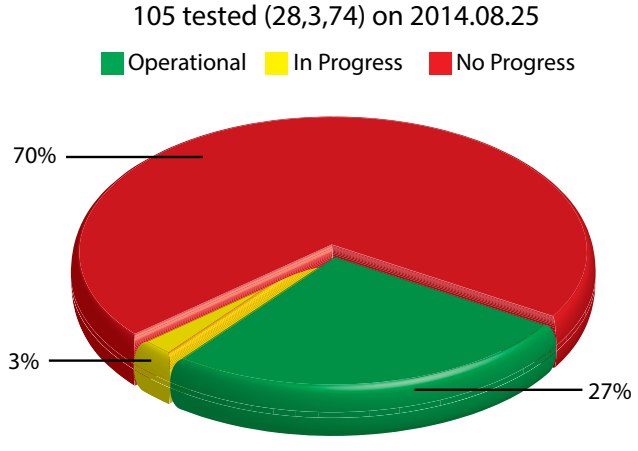

Figure 6. IPv6 enabled services, Department of Defense. (From "Estimating IPv6 & DNSSEC External Service Deployment Status, Department of Defense," Information Technology Laboratory, Advanced Network Technologies Division, National Institute of Standards and Technology, accessed 2 February 2015, http://fedv6-deployment.antd.nist.gov/cgi-bin/cfo?agency=defense.)

Thus, in accordance with the acquisition regulations, the equipment has been purchased during tech refresh cycles. As new devices, appliances, and additional infrastructure are purchased and old equipment is replaced, all new equipment must be IPv6 capable—and that has not been an issue. The DOD, however, has fallen behind in applications and systems that are not IPv6 capable. The AFNIC must work with the Air Force Business Enterprise System to develop a path forward for implementing IPv6 compliance for all digital services and applications that will harness the benefits of IPv6 in military operations.

Despite the few (if any) equipment costs, one cannot argue that IPv6 transition involves no expenses. If the Air Force and DOD continue down the current path, it is almost certain that more financial hardships will occur due to manpower requirements; specifically, the Air Force and DOD will need two staffs of network administrators and so forth—one IPv4 trained and the other IPv6 trained. Indeed, in an *IPv6 Economic Impact Assessment*, NIST estimated the cost of training one person on the high end as $2,906, with total costs much higher (see the table below).[43] Indeed, the same report indicates that the more accelerated the transition to IPv6, the more expensive it becomes.

Table. Summary of transition costs from IPv4 to IPv6

	Costs (Present Value Millions $2003)[a]
Infrastructure vendors	$1,384
Application vendors	$593
ISPs	$136
Users	$23,321
Total	$25,434

[a] Calculated using a 7 percent real social discount rate

Source: Reprinted from Michael P. Gallaher and Brent Rowe, *Planning Report 05-2, IPv6 Economic Impact Assessment* (Washington, DC: NIST, US Department of Commerce, Technology Administration, October 2005), ES-4, http://www.nist.gov/director/planning/upload/report05-2.pdf.

Recommendations

Mandate a Firm Transition Date to IPv6 Utilizing DOD Acquisition Policies and the Joint Information Environment

Currently the level of commitment and willingness to take risk and begin a migration of services into the Air Force environment does not exist. The DOD has a forgotten history of protocol conversions. When the ARPANET was first deployed, it was not TCP/IP based but relied on an implementation of NCP. On the basis of additional research from 1973 to 1981, TCP/IP was developed to allow for improvements to the existing packet-switched networks, allowing "internetworking" to emerge as a network architecture—hence, the Internet was "born." Indeed, the *NCP/TCP Transition Plan* proclaimed in November 1981 that "the Department of Defense has recently adopted the internet concept and the IP and TCP protocols in particular as DoD wide standards for all DoD packet networks, and will be transitioning to this architecture over the next several years. All new DoD packet networks will be using these protocols exclusively."[44] The transition to TCP/IP was successful only because of the firm mandate. Specifically, the *NCP/TCP Transition Plan* mandated "a complete switch over from the NCP to IP/TCP by 1 January 1983. It is the task of each host organization to implement IP/TCP for its own hosts. This implementation task must begin by 1 January 1982."[45]

Air Force leadership must enforce a similar mandate today. Firm transition dates have been attempted with IPv6 in the past—for example, in an order by the Office of Management and Budget (OMB) in August 2005, and again on 28 September 2010 another OMB memorandum mandated the federal transition to IPv6.[46] The Air Force acknowledged that the transition should take place but did not solidly establish an actual command emphasis on the effort. The most forceful requirement was the August 2005 OMB memo that actually included dates that everybody attempts to ignore. Thus, without emphasis from the Air Force A6/CIO mandating a firm date for migration

with penalties for noncompliance, the migration has little chance of full implementation.

The time is ripe today to implement this migration throughout the DOD. Corresponding with the development and deployment of the joint information environment (JIE), "in order to facilitate implementation of JIE through acquisition across the Department, new IT programs will be required to comply with the JIE. Existing IT programs will be mandated to address JIE requirements as they progress through their lifecycle, and decisions will be made on how they can best comply with the JIE."[47] Indeed, the DOD has directed the completion of this migration no later than the end of fiscal year 2018.[48] Critics might argue that the reliance on IPv4 is stronger today and more integrated into day-to-day military operations. Though that statement is true, development of the JIE offers the DOD-CIO office an opportunity to pause this effort and include language aligning JIE net readiness with a mandatory IPv6 implementation plan to transition the JIE to IPv6 by the end of fiscal year 2018. Doing so will go a long way to ensure that the DOD has IPv6 hosts enabled and services deployed, enabling the paradigm shift to the IPv6 environment. Thus, assuming that JIE is fielded sometime before 2030, the DOD and the Air Force should not have any issues running out of IPv4 address space before migrating to JIE and IPv6.

Educate and Train Our Cyber Operators in IPv6

Today the Air Force cyber schoolhouses offer some general background on IPv6 in the curriculum—in the best case, two hours of instruction. This amount is not sufficient. Detailed, specific training on IPv6 should be required, but some people believe it is not needed since it does not represent current operational reality.[49] Instead, the preference is to reserve that type of training for future cyber field training units that will catch up operators on the latest advances in our actual capabilities as they move between assignments. This reasoning is perilous since in cyber operations, experience matters. As noted

briefly above, our Chinese competitors, among others, are gaining experience in operating IPv6 networks while the Air Force ignores the problem. To resolve this dilemma, the service should begin by educating and training future cyber warriors in IPv6 as soon as the Air Education and Training Command (AETC) and Air Force Space Command (AFSPC) curriculum design processes allow.

Important elements that should be included in a training tasking letter from career field managers and Twenty-Fourth Air Force to AETC and AFSPC education and training units include, but are not limited to, curriculum updates covering the following specific elements of IPv6 that are prone to vulnerabilities when employed:

- multicast listener discovery/enumeration;
- router discovery/enumeration;
- node querying;
- user datagram protocol (UDP)/TCP checksum calculation;
- transition mechanisms 6to4, 6in4, 6over46rd, 4rd, Teredo, intrasite automatic tunnel addressing protocol (ISATAP);
- stateless address autoconfiguration (SLAAC);
- secure neighbor discovery protocol (SeND);
- neighbor discovery protocol;
- duplicate address detection;
- router, dynamic host control protocol (DHCP), and DNS discovery;
- redirection;
- new features in DHCPv6; and
- host and network mobility for the tactical, satellite, and aircraft systems.

Because cyber operations demand hands-on experience, this may involve considering additional funding and creating an IPv6 range both

at Keesler and Hurlburt Air Force bases where Undergraduate Cyber Training and the 39th Information Operations Squadron conduct training. Critics might counter that the curriculum does not include enough hours for both IPv4 and IPv6. However, given the interrelationship between IPv4 and IPv6, by teaching v6 we also would effectively be teaching v4. Furthermore, the Air Force must ensure that Airmen already in the career field get more exposure to v6. One short-term solution would entail encouraging enrollment in the Federal Virtual Training Environment as more long-term retraining solutions are developed by AETC and AFSPC.

Conclusions

Transitioning to IPv6 is not a hurdle too difficult to clear. It is neither an undeveloped nor untested technology. Rather, the transition remains a problem of policy disconnected from the technological realities. IPv6 migration should be a primary concern for our senior leadership, and it appears that only clear commitment and direction will spur the necessary transition. When this does occur, a strategy must be put in place to assure that this transition is not a hastily executed solution but one that has clear goals and road maps for the secure implementation of IPv6 throughout the Air Force. In terms of the DOD, the JIE is an excellent place to begin full deployment of IPv6 and avoid additional costs of delayed transition, including possible mission failure. Our cyber operators must begin training now in the operating environment in which they will certainly be immersed during the next decade. Protecting the network and developing the next generation of tactics, techniques, and procedures for cyber operations will allow for assured and rapid execution of core Air Force missions. Harnessing IPv6 is critical if the service is to remain the best equipped, trained, and most lethal force on the planet. ✪

Notes

1. The research was partially supported by Office of Naval Research Grant N000141310878 and the Department of Defense Minerva Research Initiative.

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3. Michael Peck, "DoD Fumbled IPv6 Transition, IG Says," C4ISR&Networks, 5 December 2014, http://www.c4isrnet.com/article/20141205/C4ISRNET/312050009/.

4. Voice over Internet protocol (VOIP) applications, for example, running on IPv4 sometimes drop packets, causing communications to sound garbled. With the quality-of-service feature in IPv6, this problem would go away because each VOIP data packet is marked and delivered in a manner that prevents garbling of the data.

5. For daily reports on the current IPv4 exhaustion-rate status, visit "IPv4 Address Report," accessed 3 February 2015, http://www.potaroo.net/tools/ipv4/.

6. "Montevideo Statement on the Future of Internet Cooperation," Internet Corporation for Assigned Names and Numbers, 7 October 2013, https://www.icann.org/news/announcement-2013-10-07-en.

7. Elihu Zimet and Edward Skoudis, "A Graphical Introduction to the Structural Elements of Cyberspace," in *Cyberpower and National Security*, ed. Franklin D. Kramer, Stuart H. Starr, and Larry K. Wentz (Washington, DC: National Defense University Press, 2009), 91–112. See also Robert E. Molyneux, *The Internet under the Hood: An Introduction to Network Technologies for Information Professionals* (Westport, CT: Libraries Unlimited, 2003), 85–86.

8. Molyneux, *Internet under the Hood*, 27. For the layperson, a good way to think about the importance of standardization in international telecommunications is how we connect to electrical distribution networks while we travel. Because electrical adapters are not standardized, travelers must get an adapter to plug their device into foreign sockets if that region is not compatible with the traveler's home region. With electricity comes the added danger of nonstandardized voltage and cycles. Therefore, travelers must also be aware of whether or not their device will burn out if connected to a 220-volt electrical network if the device is capable of receiving only 110 volts of energy.

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10. "Making Internet Number Resource Allocations to Regional Internet Registries," IANA, accessed 3 February 2015, http://www.iana.org/help/inr-request-procedure. IANA distributes the IPv4 space in /8 blocks.

11. "Understanding IP Addressing," RIPE Network Coordination Centre, 22 April 2014, http://www.ripe.net/internet-coordination/press-centre/understanding-ip-addressing.

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15. E-mail exchange between the author and AFNIC personnel, 21 April 2015.

16. I am grateful to Air Force Systems Networking (AFSN) for this observation.

17. Headquarters US Air Force, *America's Air Force*, 5.

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25. The highlights in this section are a compilation of observations made over the course of 15 months during interviews in support of a study on cyber workforce development directed by the chief of staff of the Air Force (publication forthcoming from Air University Press) as well as research conducted during an Office of the Secretary of Defense Minerva project METANORM, a multidisciplinary approach to the analysis and evaluation of norms and models of governance for cyberspace.

26. Headquarters US Air Force, *America's Air Force*, 20.

27. Airman in Headquarters Air Force, Air Staff A6 and A3/6, unattributed interview by the author, 24 April 2014.

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31. Air Force senior leaders, officers, enlisted and civilian cyber operators, unattributed interviews by the author, 2013–14.

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34. To do the calculations, one may visit the DOD Network Integration Center (DODNIC) website and do a search for "DNIC-RNET [reserve networks]," which will bring up all networks that the DODNIC considers "returned networks" (the NIC uses "RNET" to annotate networks returned to the IP managers). This information changes daily, depending on what is issued on any day but nearly always decreases. See "Search NIC Whois For," accessed 3 February 2015, https://www.nic.mil/cgi-bin/whoisweb.

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Twenty-First-Century Aerial Mining

Col Michael W. Pietrucha, USAFR

On 23 September 2014, a B-52H bomber at high altitude north of Guam accomplished an aviation first—the release of a winged, precision aerial mine (fig. 1). The inert, orange and white GBU-62B(v-1)/B Quickstrike-ER (extended range) separated cleanly from the B-52, rolled, and three seconds after release, the BSU-104 wings deployed, transforming a free-fall munition into a medium-range weapon. Under command from the attached Joint Direct Attack Munition (JDAM) tail kit, the weapon flew around 40 nautical miles (nm) and impacted the water. Had the weapon been a live system dropped in shallow water, it would have settled to the bottom to lie in wait for a target. This effort marked the first advance in aerial mine-delivery techniques since 1943 and demonstrated a capability that substantially changes the potential of aerial mining in a threat environment. Using off-the-shelf components and operational aircraft, aerial mining quietly entered the twenty-first century.

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US Air Force photo

Figure 1. The first-ever release of a Quickstrike-ER, 23 September 2014

Historical Background

The use of mines in naval warfare is extensive, dating from the American Civil War.[1] The Luftwaffe mined the Thames Estuary in November 1939, marking the first use of aerial mines. By 1940 the Royal Air Force (RAF) was laying an average of 1,000 each month for the entire duration of the war. For some areas, such as inland waterways and the Danube, mine laying by aircraft was the only option.[2] Aerial mines, placed in the harbor approaches and training areas used by U-boats, sank 16 of the 26 German submarines destroyed by mines during the entire war.[3]

The US Navy's offensive mine laying began in late 1942, when the USS *Thresher* mined the Gulf of Siam. In December *Trigger* laid mines near Tokyo and witnessed the first sinking before leaving visual range. Nevertheless, the number of submarine-laid mines was small, and risk to the boats was high. Avenger torpedo bombers laid mines effectively

against Japanese island bases in conjunction with antishipping strikes, but no such attempt took place against the home islands. In total, naval aviation was responsible for only 3 percent of the aerial mines laid in the Pacific.[4]

Fifth Air Force relied on the RAF and Royal Australian Air Force (RAAF) for its mine-laying capabilities.[5] Tenth Air Force, though, embraced aerial mining more enthusiastically and closed the Rangoon River for the duration by using British mines from early 1943. Fourteenth Air Force laid airlifted mines in China's rivers, including the Yangtze. Twentieth Air Force conducted its first aerial mine-laying mission off Sumatra in August 1944, later mining Singapore, Saigon, and Cam Ranh Bay.[6]

In March 1945, the 313th Bombardment Wing (B-29) began mine-laying operations in Japanese home waters.[7] Referred to as "Starvation" missions, the mining effort was directed at the Shimonoseki Strait, the key remaining choke point in the Japanese maritime supply network, along with Tokyo, Nagoya, and smaller Japanese and Korean ports.[8] Despite the short duration, aerial mining effectively stopped maritime traffic, racked up almost as many ships damaged as all US Army Air Forces (USAAF) land-based air during the entire war, and accounted for half of all of the ships sunk or damaged during the aerial mining period. According to Wesley Frank Craven and James Lee Cate,

> The 313th Wing got into the game late, operating with mines for only four and one-half months and at a period when the enemy's merchant fleet had contracted in size and in scope of its activities. During that short period, mines planted by the wing were more destructive than any other weapon, accounting for about half of the total tonnage disposed of. To accomplish this task, the 313th sent out 1,528 sorties and planted 12,053 mines, a much heavier effort than had been suggested by the Navy in the negotiations of 1944 and, indeed, the heaviest aerial mining campaign ever waged.[9]

The United States again conducted large-scale aerial-mining efforts in Vietnam. President Johnson authorized mining of the Song Ca, Giang Song Ma, Kien, and Cua Sot Rivers in 1967.[10] Throughout the

later days of Operation Rolling Thunder, carrier aircraft were mining inland roads and waterways.[11]

Aircraft from the *Coral Sea* mined Haiphong Harbor on 8 May 1972, dropping 36 Mk-52 mines and giving the harbor the dubious distinction of being the only foreign port mined by the United States in two wars.[12] The mining of Hon Gai and Cam Pha followed, along with the approaches to Haiphong. All were periodically reseeded. The mines shut down Haiphong until Operation End Sweep in 1973, which cleared Vietnamese harbors (but not rivers).

Aerial mining remained a Cold War mission conducted by US Air Force bombers and carrier air, primarily with the intention of constraining the Soviet fleet—especially submarines. Two days into Operation Desert Storm, A-6 aircraft from the USS *Ranger* dropped 42 mines in the Khawr Az Zubayr River to no known effect, marking the most recent combat drop of aerial mines.[13] With the exception of this sortie, which resulted in the loss of Jackal 404 and its crew, aerial mining has proven highly effective in enforcing a maritime blockade against both warships and submarines.

The Mines

In Operation Starvation, the B-29s employed Mk-25 (2,000-pound) and Mk-26/36 (1,000-pound) aerial mines. Blunt-nosed and parachute-retarded, these weapons had magnetic fuzes with either pressure or acoustic sensors, variable sensitivity settings, randomly set arming delays, and ship counters between one and nine, allowing some mines to ignore a certain number of ships before they triggered. None had any kind of deactivation device, and all were bottom mines.[14]

Mines used in Vietnam were mostly variations of general-purpose (GP) bombs with high drag tails. Called Destructors, the Mk-36 (500 pounds), Mk-40 (1,000 pounds), and Mk-41 (2,000 pounds) incorporated arming delay and self-destruct features. Fuzes were magnetic, seismic, contact, or a combination, and the system could be used on

land or in shallow water. Destructor mines and GP bombs differ only in fuzing and (sometimes) in the tail kit attached to the bomb body. This design feature continued in the Quickstrike, the successor to the Destructor series.

The Quickstrikes (Mk-62/-63/-64/-65) are the current US air-delivered bottom mines, intended for shallow water at depths from 40 to 200 feet.[15] The weapon consists of a GP bomb body, safe/arming device, tail kit, battery, adapters, and a target detection device (TDD). The Mk-65 is the only weapon in the series not derived from a GP bomb. The legacy Mk-57 TDD is magnetic-seismic, and the Mk-58 is magnetic-seismic-acoustic. The newest TDD, intended to replace both of the older TDDs, is the microprocessor-driven, programmable Mk-71.

Mine Delivery

Typically, mine delivery has been a low-altitude operation, largely because of the drift of a parachute-retarded weapon. Aircraft typically laid Starvation minefields at night, under radar navigation and at altitudes ranging from 200 to 30,000 feet. Bombers would drop mines in a straight line in a planned location, sometimes with individual mines landing ashore.[16] About 50 percent of the emplaced mines were dropped within a half mile of their intended location.[17]

The same techniques are used today, often requiring multiple passes with inaccurate, parachute-retarded mines. A B-52 mine-laying pass occurs at 500 feet and 320 knots—too slow to be safe in fighters or the B-1B. The F-18 and P-3 employ similar profiles, leaving the laying aircraft low, slow, and predictable—a contributor to the loss of one aircraft and crew in Desert Storm's only mine-laying attempt.

The Twenty-First-Century Aerial Mine

Aerial mining techniques have not advanced since the Second World War, but the demonstration of Quickstrike-ER changed the picture en-

tirely, mixing a modern mine with both precision and standoff. The Mk-82/-83/-84-series bomb bodies can be fitted with JDAM kits, which convert the weapon into a GBU-38/-32/-31, respectively.

The short range of the JDAM provides little standoff, but the addition of a wing kit corrects that deficiency. The GBU-62B(V-1)/B Quickstrike-ER is Pacific Air Forces' nomenclature for an Mk-62 Quickstrike configured with a BSU-104 JDAM-ER wing and the GBU-38's guidance kit. The range of the system is in excess of 40 nm when launched from 35,000 feet.

These kits, applied to the Mk-62 Quickstrike, allow both precision delivery and "one-pass" standoff mine laying from either medium or high altitude.[18] A bomber aircraft with a full load of guided Quickstrike-ERs can lay an effective minefield with a single release sequence. Mines with guidance kits can be laid in an unpredictable pattern, making mine clearance that much more difficult; furthermore, they can be tailored to the characteristics of specific waterways.

The Twenty-First-Century Aerial Minelayer

The implications for the Quickstrike-ER (fig. 2) go beyond precision, allowing aircraft to emplace mines from range. Today, only F-18, P-3, B-1, and B-52 crews train for mining. JDAM training, on the other hand, is ubiquitous. There is no practical difference between JDAM employment against a fixed ground target or a fixed location under shallow water; no additional training for basic mine laying is required.

US Air Force photo

Figure 2. Airmen from the 36th Munitions Squadron load a recently assembled Quickstrike-ER onto a munitions trailer.

The addition of low observable aircraft to the stable of potential standoff minelayers introduces two new capabilities to the mix. The first is the possibility of laying minefields within the outer limits of a target country's air defenses. The second is the potential to air-deliver a minefield covertly.

Mine Warfare

Typically, aerial delivery of mines is offensive mine warfare because mines are emplaced in a country's home waters. This technique is effective for maritime interdiction (Starvation, 1945), port closure (Hanoi, 1972), or even antisurface warfare (Palau, 1944). Offensive mining of inland waterways interdicts local traffic, a technique used extensively in Germany, Burma, China, and Vietnam. Unlike the RAF, the US Air Force has never used aerial mining for defensive purposes.

The collateral effect of mining extends beyond simple target destruction. Fear of mines is likely to interdict more shipping than actual mine detonation, and the requirement under the Hague Convention of 1907 to declare minefield danger zones actually increases the effect. All Eastern Bloc vessels in Hanoi remained for the duration—even though the United States gave 72 hours' notice of minefield activation. During mining of the Hanoi harbor, no ship challenged the minefield or made an attempt to clear it. For commercial vessels, the increase in insurance rates in a declared danger zone can be prohibitive, causing ships to avoid mined or potentially mined areas entirely. Ambiguity is key; a mined zone must be declared, but not all declared zones must be mined.

Introduction of the TDD has improved the specificity of mines. The new Mk-71 Mod 1 TDD is software programmable and has different algorithms for various classes, including submarines, minisubs, air-cushion vehicles (hovercraft), and fast patrol boats, allowing the mine to classify and select the desired target. The Mk-71 can distinguish between actual targets and decoys or countermeasure devices. This capability might allow for tailored mining, intended to interdict one kind of vessel but not another.

Never before has aerial mining been conducted with either precision or standoff. The emergence of this kind of capability not only will enable more effective and easier offensive mining but also will allow for short-notice defensive mining and a new category—reactive mining.

Offensive Mining

Offensive mining can affect harbors and shipping channels, river mouths, canals and interior waterways, choke points, and straits or coastal waters. It might even be possible to introduce reactive offensive mining—quick-reaction minefields designed to interdict surface combatants in littoral waters.

Harbor Mining

Harbor mining interdicts vessels at the source, preventing effective use of the harbor. For navies that lack an underway replenishment capability, preventing naval combatants from returning to refuel and rearm may effectively neuter them without a direct attack. With no port available, most adversaries have little ability to project naval power. This mission is nonlethal—at least until attempts are made to clear or pass the minefield. The effect extends to merchant ships, warships, and auxiliaries—if the harbor exit is closed, it can be closed to everybody.

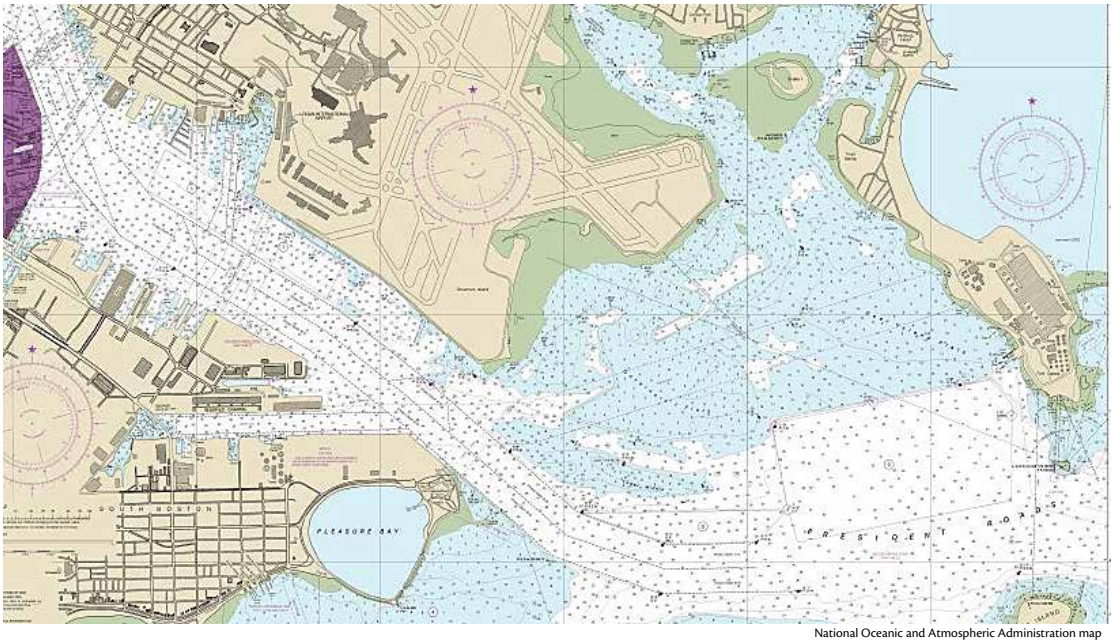
Harbor mining can trap vessels inside, prevent them from entering, or sink vessels to deny access to channels, piers, or off-load facilities. Naval bases, more concentrated than commercial ports, are even easier to close. Headquarters People's Liberation Army Navy fleet at Zhanjiang, Ningbo (Zhoushan), and Qingdao are all susceptible to interdiction, with Zhoushan the easiest to isolate and Ningbo the most difficult. The fleet's submarine pens on Hainan Island have limited approaches and might be bottled up from standoff range. A sunken ship in a shipping channel can prove brutally effective.

Mine laying in the Hanoi harbor occurred in the face of significant opposition. Aircraft placed strings of mines released at a specified interval, some of them actually landing in locations where they were not useful. A minefield laid using precision guidance would create a precisely defined pattern optimized for the particular body of water. Quickstrike-ER standoff capabilities would have enabled the mining of Vietnamese harbors from outside the range of surface-to-air missiles (SAM).

Westward, the dual-use port at Bandar Abbas would be a prime candidate for mining. We have long-standing concerns about Iranian navy submarines—Russian-built *Kilo*-class diesel-electrics. Bandar Abbas hosts the Iranian Revolutionary Guard Corps navy as well, including minisubmarines and the ubiquitous small speedboats. The anchorage is 30–35 feet deep with an entrance only 800 feet wide fronted by a

breakwater with a gap of 1,300 feet, making it an ideal candidate for closure.

Not all port facilities offer as lucrative a target. Commercial ports are likely to be more spread out but will still rely on dredged shipping channels for large traffic. Boston Harbor, though no longer a naval facility, has been a busy port since the 1680s and has a long history of blockade (fig. 3).[19] It has two parallel inbound and outbound shipping channels, each 1,200 feet wide with a dredged depth averaging 40 feet. East of Deer Island, the approaches open up into three deepwater channels and then into unrestricted waters. Using traditional aerial mine-laying techniques outside the harbor's antiaircraft artillery defenses is feasible but munition-intensive; employing Quickstrike-ERs to close the twin channels between Logan Airport and Fort Independence would require roughly only 10 percent of the mines necessary to mine the harbor approaches.



National Oceanic and Atmospheric Administration map

Figure 3. Boston's inner harbor, showing two lucrative choke points—the channels south of Logan International or the Deer Island channel in the lower right. Areas in blue are too shallow for larger vessels, including naval ships.

As a final note, the RAF and US Air Force attacked and destroyed most of the Libyan navy, sinking ships in port to prevent their use. Had precision mines been available, those ships might have been successfully bottled up in the harbor, retaining them for a successor government.

River Mining

The Second World War saw extensive river operations, including effective mining of the German canal system as well as the Yangtze and Rangoon rivers. By late 1944, mines routinely sank shipping at the mouth of the Yangtze.[20] In the Vietnam War, inland waterways were extensively mined in both North and South Vietnam to interfere with the North Vietnamese army's supply and infiltration routes, often forcing men and materiel back onto jungle roadways. In Vietnam, as in China during the Second World War, aerial mining of rivers was effectively unopposed.

The Yangtze is a lucrative target. Navigable for at least 1,000 miles from the river mouth, it carries a full 40 percent of China's inland waterborne freight and more inland freight than any other river.[21] Shanghai is the world's busiest port, making the Yangtze a viable candidate for standoff mining both at the river mouth and along its length. Shanghai's air defenses make standoff mining—even with Quickstrike-ER—a dicey proposition, achievable only with low observable aircraft. Similarly, mining the interior reaches of the waterway would involve some penetration into the country, if only to avoid Shanghai. Mining, of course, is by no means the only way to block a waterway.

North Atlantic Treaty Organization operations in Allied Force included the destruction of a number of Danube River bridges, including all of those in Novi Sad, Serbia. Several took five years to clear and rebuild, and one, the Žeželj Bridge, took more than a decade to replace. Almost 1,000 ships were trapped in the river network, unable to pass Novi Sad, and four years went by before clearing of the debris.[22] A need for rapid clearing and the seeding of the approaches to the bridge with aerial mines at the same time it was attacked would have made

the task immeasurably worse.[23] As for cases in which engineers might rapidly construct a pontoon bridge or in which underwater bridges are feasible, mining efforts might very well prevent completion of those structures.

Mining of Choke Points

Aerial mines might successfully interdict narrow choke points in numerous places worldwide. Straits often have no reliable alternative route, and closure may have a major economic and military impact. Candidates must be narrow but shallow with significant traffic. The Dardanelles strait, 35 nm long with an average depth of 180 feet, is only 4,500 feet wide at the narrowest point and was closed to surface ships in the First World War by 370 moored mines, laid in 10 strings.[24]

The Gulf of Finland, approaching Helsinki and Saint Petersburg (Leningrad), was mined extensively by the Russians in the First World War and the Germans in the Second World War. In Asia, the Strait of Malacca, Sunda Strait, and Lombok Strait are critical choke points, especially for oil tankers. Malacca, which narrows to only 1.6 nm with a minimum depth of 82 feet in the Phillips Channel, sees 60,000 ship transits per year.[25] The Singapore Strait, which abuts the Strait of Malacca, was mined by the Royal Navy during the Second World War. The Strait of Hormuz is shallow, and the vast majority of the Persian Gulf (average depth of 150 feet) can be affected by Quickstrike. The selective capability of the Mk-71 TDD might allow closure of the straits or portions of the Persian Gulf to diesel-electric submarines yet leave commercial shipping unaffected. Some straits, such as Gibraltar, Lombok, or the Bab el Mandeb (Red Sea) are too deep for bottom mines.

Coastal Mining

Coastal mining, which attempts to interdict shipping in between the origin and destination, depends heavily on maritime topography. Intracoastal waterways increase the feasibility immensely. In the Second World War, B-29s conducted mining along the Korean coast, pushing

ships out further from shore where they were more easily detected and attacked. The key disadvantage of mining in coastal waters is the requirement for area mining rather than point application used in the vicinity of a harbor, river mouth, or choke point—making avoidance much easier. Notably, mines in coastal waters are impossible to sweep if the adversary cannot determine where mines were laid.

In 1940 the RAF began extensive coastal mining ("gardening") in areas of high shipping density, with aerial mines considered more effective than those laid by ships. Coastal mining included defensive minefields laid off Britain as well as mines placed off the coasts of Germany, Denmark, France, Holland, and Belgium. A series of operations targeted iron-carrying vessels off the coast of Norway between 1942 and 1944; mine-laying operations off France were constant even past D-day.[26] Northern European waters were lucrative mine targets since coastal traffic could not stray far from friendly coastlines before being attacked by other means. The RAF also conducted aerial mining in the Mediterranean, with waters around Sicily attracting particular attention prior to the Allied landings. Similarly, after mid-1941, almost every Axis port in the Mediterranean received some attention from RAF aerial minelayers, often in conjunction with bombing raids.

Defensive Mining

The RAF and Luftwaffe conducted defensive aerial mining, but the USAAF did not. The British effort sought to interfere with U-boats and a potential invasion fleet (fig. 4).[27]

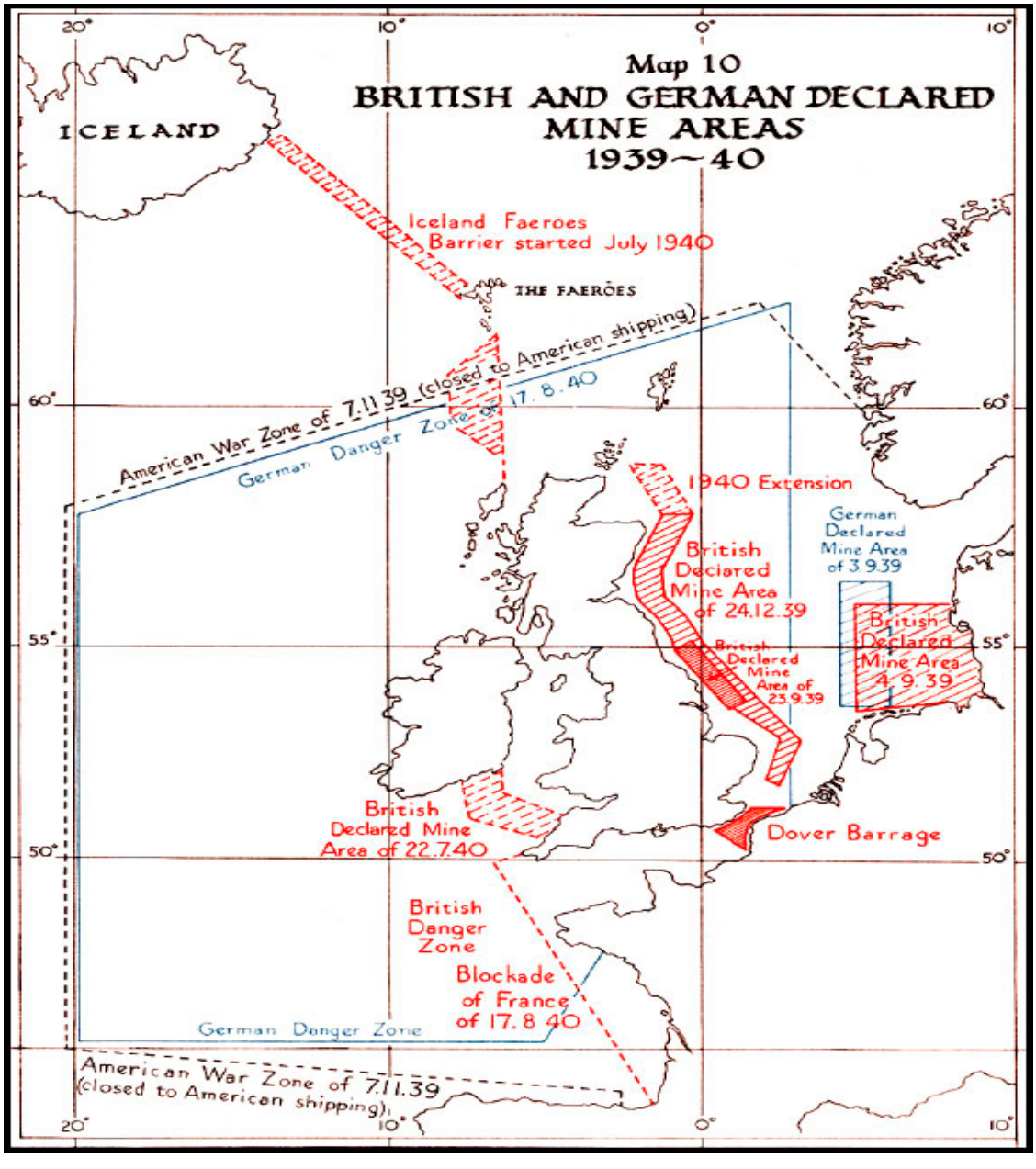


Figure 4. British and German declared mine areas, 1939–1940. (Reprinted from S. W. Roskill, *The War at Sea, 1939-1945*, vol. 1, *The Defensive*, History of the Second World War, United Kingdom Military Series [London: Her Majesty's Stationery Office, 1954], 97, http://ibiblio.org/hyperwar/UN/UK/UK-RN-I/index.html.)

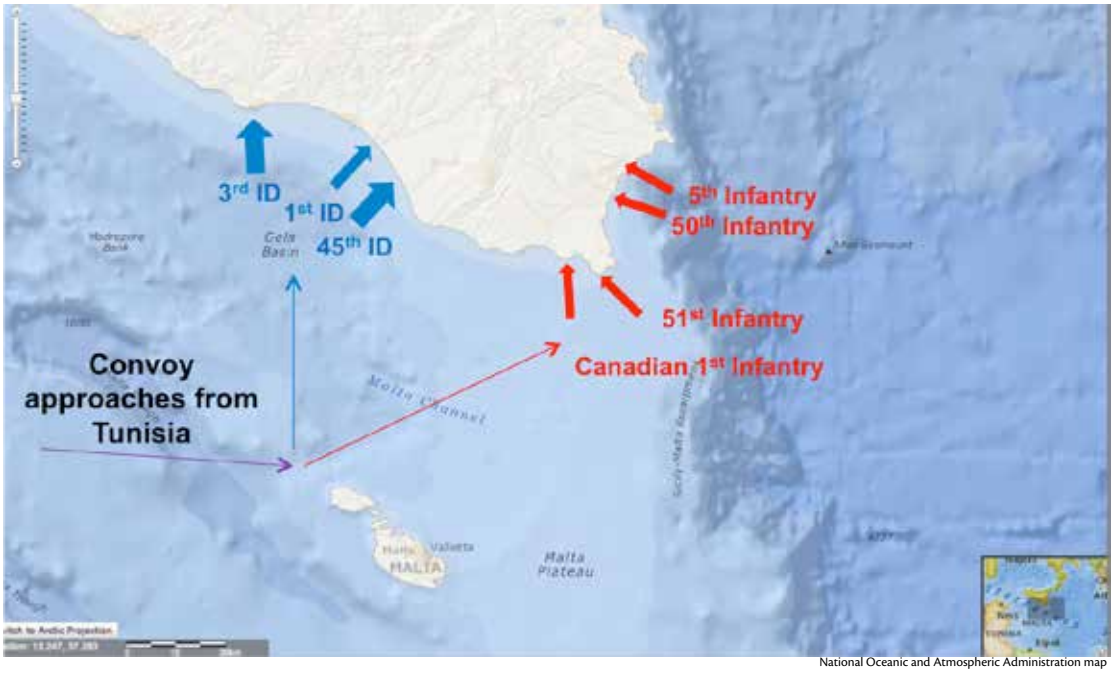
Defensive mining to counter amphibious assault remains relevant. The number of countries facing an amphibious threat is low, and no country is willing to maintain a permanent emplaced minefield in peacetime. In effect, this reluctance has resulted in a de facto disarmament with respect to defensive mine laying, which demands a sustained effort and specialized forces. Furthermore, trying to protect against an assault when the offense gets to choose the time and place after long preparation means that defensive mining efforts are likely to be ineffective in practice.

That calculation might change with Quickstrike-ER. With very little strategic warning and some timely intelligence, it should be possible to emplace a defensive minefield to impede the establishment of a beachhead. In reality, one cannot count on timely intelligence and strategic warning, and the first wave of any amphibious assault will probably make it ashore. In this case, the applicability of a modern aerial minefield becomes apparent.

The key to any amphibious landing is not the original assault but the follow-up waves. At Tarawa, had follow-on waves been successfully interdicted on the first day, the assault might have failed. At Omaha Beach, the first wave likely would have never made it past the seawall without follow-on waves to support. Even in cases in which landings occurred with little opposition (Anzio, Inchon, and Suez), the follow-up delivery of reinforcements and materiel is essential. In an environment where Overlord-scale invasion fleets are not feasible, the ability to interdict follow-on waves may prove an effective counter to amphibious assault.

Prior to the arrival of an invasion force, the actual landing location remains unknown. After the first wave arrives, the arrival location of follow-on forces becomes known, and the port facilities necessary to support disembarked assault troops are easily derived. Similarly, the origin points of amphibious transports are known, and it may be possible to successfully isolate both the landing beaches and the ports where follow-on waves must embark and disembark. A modern replay

of Operation Husky—the Allied Invasion of Sicily (fig. 5)—clearly reveals the potential for rapidly emplaced defensive minefields.



National Oceanic and Atmospheric Administration map

Figure 5. US (blue) and Commonwealth (red) landing beaches on Sicily. Shading contours, from light to dark, are 50-meter depth lines.

The landing fleet approached from Bizerte and Tunis, some 350 miles distant and almost due west of the landing beaches. For deception purposes, the convoy headings tended southeast toward Malta, turning north at a point 5 nm due west of the Gozo light at Malta. Follow-on waves were scheduled for D + 1 (one day after D-day), D + 3, and D + 4; empty landing craft had to return to Tunisia.[28] All of the Commonwealth landing craft crossed the Malta Channel, an area of shallow water (less than 300 feet) extending all the way to Malta, while the American divisions crossed the deeper Gela Basin. Potentially, the US forces were in easily mined waters for the last 10 nm of travel; the Commonwealth forces, for at least 50.

US forces landed and established 3 beachheads. The unloading of the first wave of support ships was not completed for 60–88 hours. The total offload for the first 3 days amounted to 22,554 personnel; 2,179 vehicles; and 7,801 tons of materiel. The port at Palermo did not open until D+18 and even then was at 30 percent of capacity due to combat damage. In the next 6 weeks, a total of 736 voyages supported US forces ashore, the vast majority of which were landing ships.[29]

Fortunately, no mines were laid to interdict the transport areas because minesweeping assets were in short supply and had not trained for night operations. Had the Luftwaffe been able to mine the invasion beaches or captured ports, Allied soldiers fighting well-equipped Wehrmacht forces in the interior might have found themselves with inadequate rations, fuel, and ammunition—a supply situation that became tenuous at times as it was. Within hours of the landings, the beachheads were known to Axis forces, and the ports that the Allies would have to use were easily identified by proximity. Palermo, heavily damaged prior to the landings, might have been rendered entirely unusable with aerial mines.

Because Sicily is a large island, Operation Husky required a staggering logistical effort. Even had substantial losses occurred, Allied forces possessed sufficient excess capability to accept a grinding war of attrition in the island interior. The duration and cost of an operation might well have been increased and might have looked like Anzio did later—with enough sealift capability available to support a toehold but not enough to contemplate a major offensive. For smaller islands, aerial mining might be capable of providing an ad hoc defense (for friendly islands) or a method of isolating island garrisons after an island seizure. Aerial mining as a response to a provocative action (such as the de facto seizure of Mischief Reef in 1994) might offer an option for incremental escalation short of direct counterattack.

Reactive Mining

An untried concept, reactive mining relies on the ability to emplace "instant" minefields from standoff. Precision allows for emplacement patterns that can be changed prior to launch—just like any other JDAM release. Interdicting beachheads offers an obvious application. In restricted littorals, instant minefields could target task forces by mining a probable route. Antiship missile attacks must penetrate a warship's air defenses, but a mine bracket dropped 30 or 50 nm in front of a task force will not be intercepted and may not even be recognized. If the mines are directed against a ship, the captain may have to use scarce missiles for defense. For navies that cannot reload at sea, this situation amounts to a resource-allocation challenge. Unlike a Harpoon or other cruise missile, *Quickstrikes do not stop being dangerous when they are shot down*. Shooting down a mine probably would not affect the TDD (in the tail well) or the bomb body itself—a forged steel casing half an inch thick. A bomb that splashes into the water short of a target ship is still likely to arm and constitute a threat.

Additional measures might be feasible with reactive mining. The naval equivalent of "delousing" a friendly vessel being pursued might involve laying a minefield across the path of the pursuing ship or submarine. It may also be possible to use this technique deliberately when an unmanned underwater vehicle mimics a friendly submarine, inviting pursuit that is drawn into a reactive minefield.

Powered Standoff

Quickstrike-ERs are launched from medium to high altitude and glide to their destination. With this weapon, mine laying in the vicinity of long-range SAM systems can be conducted only by low observable aircraft or at some distance from the threat. Adding an engine to Quickstrike-ER expands the employment envelope, especially in defended airspace. Raytheon demonstrated the feasibility of doing so by fitting a TJ-150 turbojet from the miniature air-launched decoy into an

AGM-154C1 joint standoff weapon, extending the range from 70 to 260 nm.[30] Similarly, Boeing has performed a wind tunnel test of a powered JDAM-ER using a compact turbojet. Called a powered JDAM (P-JDAM), the proposed system is expected to have a range of well over 100 nm when launched from medium altitude. With this kind of distance, a powered Quickstrike (Quickstrike-P) could be launched from beyond the limits of most long-range SAM systems.

Increased standoff is not the only benefit of a powered mine. An engine allowing the weapon to maintain level flight makes a 40 nm low-to-low shot possible, permitting the shooter and the weapon to remain below the radar horizon up to release, even over water. Assuming a mast-mounted radar (such as a Type 381 Sea Eagle) at a height of 80 feet, an ingressing aircraft at 500 feet remains below the radar horizon until 38 nm. For the weapon itself, if it can fly at an altitude of 50 feet above the water, it will not break that same radar horizon until 20 nm.[31] For a surface-mounted radar, the horizon closes in to 12 nm or less. This low-flight capability would allow a Quickstrike-P to come very close to defended targets without risk of intercept—and in some cases, without risk of detection from a surface threat.

Wrap-Up

Aerial mining has been dramatically effective in the Pacific, reaching its height in the Second World War as part of Operation Starvation against Japan. The value of this low-cost, persistent weapons system has been enhanced over time with increased specificity of the mines, which can be programmed to function against specific targets. The addition of an off-the-shelf precision guidance kit (JDAM) with a brand-new wing kit offers an innovative application for aerial mining, further enhancing the value of airpower against maritime nations.

The development of precision, standoff aerial mining capabilities should serve to restore the impact of aerial mining, particularly in defended airspace. Given the fact that potential adversaries are dependent

or partially dependent on maritime logistics for trade and support to military operations, the renewed capability to deploy mines while maintaining platform survivability will allow the laying of aerial mines in locations practically off-limits for decades. Maritime interdiction, antisubmarine warfare, and counteramphibious operations will all be enhanced by the option to lay custom-tailored minefields in high-traffic waterways. The long-overdue matching of precision-delivery capability to advanced undersea weapons will grant US air and naval forces a low-cost, asymmetric warfare capability unmatched by any other country and will provide the president and secretary of defense with additional strategy options for a large variety of operations. ✪

Notes

1. "Damn the torpedoes; full speed ahead!" This oft-misquoted comment by Adm David Farragut at Mobile Bay refers to mines, which at the time were referred to as torpedoes. Samuel Colt demonstrated the moored, command-detonated mine in 1844.

2. Maj John S. Chilstrom, *Mines Away! The Significance of US Army Air Forces Minelaying in World War II* (Maxwell AFB, AL: Air University Press, 1993), 13.

3. H. L. Thompson, *New Zealanders with the Royal Air Force*, vol. 2, *European Theatre, January 1943–May 1945* (Wellington, New Zealand: War History Branch, Department of Internal Affairs, 1956), chap. 5, http://nzetc.victoria.ac.nz/tm/scholarly/tei-WH2-2RAF-c5.html.

4. Chilstrom, *Mines Away*!, 25.

5. Ibid., 21.

6. Ibid., 22.

7. Ibid., 29.

8. Wesley Frank Craven and James Lee Cate, eds., *The Army Air Forces in World War II*, vol. 5, *The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945* (1953; new imprint, Washington, DC: Office of Air Force History, 1983), http://www.ibiblio.org/hyperwar/AAF/V/AAF-V-21.html; and CAPT Gerald A. Mason, USN, "Operation Starvation," AU/AWC/2002-02 (Maxwell AFB, AL: Air War College, 2002), 7, http://www.au.af.mil/au/awc/awcgate/awc/2002_mason.pdf.

9. Craven and Cate, *Pacific: Matterhorn to Nagasaki*, 674.

10. Chilstrom, *Mines Away!*, 43.

11. Edward J. Marolda, "U.S. Mining and Mine Clearance in North Vietnam," in *Encyclopedia of the Vietnam War: A Political, Social, and Military History*, ed. Spencer C. Tucker (Santa Barbara, CA: ABC-CLIO, 1998), http://www.history.navy.mil/wars/vietnam/minenorviet.htm.

12. Sabrina R. Edlow, *U.S. Employment of Naval Mines: A Chronology* (Alexandria, VA: Center for Naval Analyses, 1997), 7.

13. Ibid., 11.

14. Mason, "Operation Starvation," 12.

15. Depths of 10–40 feet are considered very shallow, and less than 10 feet is considered the surf zone.

16. "Figure from XXI Bomber Command Tactical Mission Report, Field Order No. 16, Mission No. 47, 313th Bombardment Wing, May 19, 1945," in Mason, "Operation Starvation," 18.

17. Mason, "Operation Starvation," 14.

18. The stock GBU-38 tail kit will not fit on a Quickstrike mine with an Mk-71 TDD. An Mk-57 TDD might fit with a minor modification, but it is not a field modification.

19. To be fair, the USS *Constitution*, homeported on Boston, is still a commissioned vessel in US Navy service. Because she is a wooden sailing ship with no magnetic, acoustic, or seismic signature, she will be unaffected by bottom mines.

20. Joint Army-Navy Assessment Committee, *Japanese Naval and Merchant Shipping Losses during World War II by All Causes* (Washington, DC: Joint Army-Navy Assessment Committee, 1947), http://www.history.navy.mil/library/online/japaneseshiploss1.htm.

21. "The Strategic Importance of the Yangtze River" (video transcript), Stratfor, 29 March 2013, http://www.stratfor.com/video/strategic-importance-yangtze-river.

22. Edgar Martin, "International Waterway in Crisis: The Case of the River Danube" (paper presented at the International Association of Maritime Economists 2002 Conference Proceedings, Panama, 13–15 November 2002), http://www.cepal.org/transporte/perfil/iame_papers/proceedings/Martin.doc.

23. Strangely enough, during Operation Carolina Moon, the US Air Force attempted to destroy the Than Hoa bridge in 1966 using 3,750-pound parachute-retarded, magnetic floating mines dropped upriver by a C-130E. Four of five mines detonated on the bridge to no effect. The project was cancelled after the loss of a C-130 on the second attempt.

24. "Minefield in the Dardanelles (August 4, 1914–March 9, 1915)," Naval Operations in the Dardanelles, accessed 2 May 2014, http://www.navyingallipoli.com/teksty/mines.pdf.

25. US Energy Information Administration, *World Oil Transit Chokepoints* (Washington, DC: US Energy Information Administration, 10 November 2014), http://www.eia.gov/countries/analysisbriefs/World_Oil_Transit_Chokepoints/wotc.pdf.

26. LTCDR Geoffrey B. Mason, "Royal Navy Minelaying Operations, Part 1 of 2," World War II at Sea, accessed 2 May 2014, http://www.naval-history.net/xGM-Ops-Minelaying.htm.

27. See S. W. Roskill, *The War at Sea, 1939–1945*, vol. 1, *The Defensive*, History of the Second World War, United Kingdom Military Series (London: Her Majesty's Stationery Office, 1954), http://ibiblio.org/hyperwar/UN/UK/UK-RN-I/index.html.

28. Historical Section, Bureau of Naval Personnel, *The Sicilian Campaign: Operation "Husky," July–August, 1943*, Action Report, Western Naval Task Force (Washington, DC: Historical Section, Bureau of Naval Personnel, 1947), http://www.history.navy.mil/library/online/siciliancampaign_admhistory148c.htm. Document is now declassified.

29. Ibid.

30. "Raytheon Completes Free Flight of Joint Standoff Weapon Extended Range," Space War, 3 November 2009, http://www.spacewar.com/reports/Raytheon_Completes_Free_Flight_Of_Joint_Standoff_Weapon_Extended_Range_999.html.

31. The figure 50 feet was chosen because the BQM-167, a US Air Force target drone, is capable down to 50 feet above ground level, and this flight profile should be flyable with a jet-powered JDAM.

Col Michael W. Pietrucha, USAFR

Colonel Pietrucha (BA, Pennsylvania State University; MA, American Military University) is the individual mobilization augmentee to the Pacific Air Forces A5/8 at Hickam Field, Hawaii. Commissioned through the AFROTC program in 1988, he has served at Spangdahlem AB, Germany; Nellis AFB, Nevada (twice); RAF Lakenheath, United Kingdom; Langley AFB, Virginia; and the Pentagon. As an instructor electronic warfare officer in the F-4G Wild Weasel and, later, the F-15E, he has amassed 156 combat missions over 10 combat deployments. Colonel Pietrucha had two additional combat deployments on the ground in Iraq and Afghanistan in the company of US Army infantry, military police, and combat engineers.

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Reawaken the American Spirit of Innovation in Your Organization

Col Stephen B. Waller, USAF

Necessity is the mother of invention.

—Plato

Many people could argue that American national security and the development of airpower in particular have always depended on innovative individuals. Our service has a deep well of achievement from which to draw.[1] The chief of staff of the Air Force has consistently stressed the need for all Airmen to embrace innovation. Have you asked yourself how to become innovative, or have you, as leaders, worked to create a culture conducive to innovation, simply defined as "the introduction of something new"? Today we typically use the word in the context of solving a problem, meeting a need, or doing something better. Encouraging others to extend themselves beyond the present accepted paradigm and to think creatively may seem perplexing. It is easier than it first appears and can prove to be a rewarding experience. Beyond that, remaining satisfied with the status quo can lead to potentially grave consequences. This article addresses the importance of reinvigorating the innovative spirit that has historically marked the American people, particularly aviation pioneers. Furthermore, it provides methods that leaders, organizations, and

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individuals may use to foster such efforts in the defense of our great nation and the furtherance of our Air Force.

Why Is It Important That We Innovate?

Innovation is valuable, both personally and organizationally. It enables us to solve problems, enhance our quality of life, boost productivity with fewer or more affordable resources, and strengthen our economy and security. For example, the US Air Force and the Department of Defense face serious fiscal and security challenges that require creative ideas beyond our current solution set. Innovative teams and individuals able to integrate current resources in new ways or to creatively make the most of technological advances are critical for corporate and government success in solving wicked problems.

If we cannot find those solutions, others will do so and lead the way into a disruptive future. Advancements in information technology have empowered many persons around the world, offering easy access to advanced tools and the means to pursue an array of new possibilities. Adversaries will continue to create and develop ways to attack our cyber infrastructure and deny access to areas of national interest. Terrorists will imaginatively use resources in new ways, as they did in the 2008 Mumbai attack.[2] Latin American drug cartels creatively use emerging technologies and develop novel ways to employ not-so-new delivery vehicles.[3] We must have innovative Airmen who can successfully deter, dissuade, and counter these formidable challenges.

Simon Sinek, author of the book *Start with Why*, has said that the Air Force core—the "why"—emphasizes innovation with a culture in which "every Airmen is an innovator."[4] Gen Mark Welsh III, the Air Force chief of staff, embraced this idea in his *Vision for the United States Air Force* of January 2013, noting that "the story of the Air Force is a story of innovation. Airmen . . . have long stood for and pioneered innovative ways to win the fight while shaping the future. Airmen characteristically view security challenges differently—globally, without boundaries. . . .

Now, more than ever, we need bold leaders at every level who encourage innovation, embrace new thinking, and take prudent risks to achieve mission success."[5]

General Welsh provides clear, top-down emphasis to pursue innovation, but a disconnect exists with the service's bottom-up effort. When I served as a group commander, this disconnect became noticeable as I sought to cultivate a culture of innovation. After stressing my desire for ideas and feedback, most Airmen were either hesitant or reluctant to offer them. We emphasized Air Force Smart Operations 21 concepts as well as the Air Force Ideas program, which makes available monetary incentives for cost-saving ideas. My personal experience revealed that the process didn't inhibit their creativity; rather, these Airmen had a perception that they couldn't influence change. I visited with hundreds of them in a variety of settings and asked whether they believed they could change the Air Force or present an idea that would alter the way we did something. Consistently, fewer than 10 percent raised their hands.

I've asked Airmen, from junior enlisted members to field grade officers, what they think the phrase "fueled by innovation" means. I've yet to hear anyone translate those words into a personal challenge to participate in such innovation. I've queried Air War College students—Air Force lieutenant colonels and colonels who represent our future senior leaders—about their reaction to the statement "every Airman an innovator." Many remark, "Well that isn't me."

Mostly through their lack of response, these Airmen told me that they were not connecting how and what they do in the Air Force to our "core" of innovation. Using Sinek's methodology from *Start with Why,* I suggest that this disconnect reflects an improper alignment of the Air Force's "how" and "what" with the innovative "why."[6] Todd Henry, author of *The Accidental Creative*, explains that dissonance kills creativity and complicates people's ability to make sense of how to affect organizational problems or understand why they're doing what they're doing. Rather, they feel that they are following some mysterious

direction from above without a clear view as to why.[7] Thus, if Airmen don't believe they can introduce new ideas, then their "what" and "how" aren't connected to the Air Force "why."

What is the main factor causing this disconnect and dissonance? It's primarily organizational bureaucracy. As any agency matures, bureaucracy and complexity, if not countered, will discourage innovative effort. Air Force bureaucratic managers (antibodies to innovation) inclined to say "no," along with layers of bureaucratic complexity, are stifling the "why" connection and flow of creative ideas from the bottom up.[8]

Without question, the Air Force has innovative Airmen and stresses the importance of efficiency and creativity, but most Airmen won't innovate until they believe that their ideas will make it through the bureaucratic quagmire. I am not suggesting a total debunking of bureaucracy because some oversight is necessary to synchronize effort and ensure the accountability of resources, but the good news is that leaders may take steps to overcome or balance bureaucracy to avoid organizational disconnects.

Six Leadership Methods to Spur Innovation

1. Schedule Time to Think and Exercise Imagination

> *We have run out of money; now we have to think.*
>
> —Winston Churchill

Leaders and their organizations may overcome the productivity paralysis of sitting for hours looking at e-mail or attending routine meetings by scheduling time to think. Leaders, teams, sections, and individuals should set aside time to consider how they may solve organizational problems and improve their quality of work and life. As the bane of e-mail, meetings, and low-priority minutiae quickly fills the workday, we have to make a concerted effort to unencumber the mind and reflect

on problems, priorities, and goals. Although the Air Force has some brilliant commanders and thoughtful problem solvers, I have not seen many of them emphasize taking time to ponder issues; consequently, they limit opportunities to pursue critical, innovative thinking. Given this time of sequestration and resource cuts, all leaders should stress the need to think and innovate. As leaders, we have the option of maintaining the status quo and watching our resources and capabilities decline, or we may consider new ways of thinking smartly to sustain, change, or eliminate redundant capabilities.

Personally, if I hadn't made "taking time to think" a priority, then it wasn't likely anyone else would have either. Like most commanders, I found myself endlessly busy with decisions, meetings, events, and e-mails, but with focused effort and help from a great staff, I was able to schedule time to think by giving more responsibility and authority to my staff and squadron commanders. Doing so not only gave me time to imagine and evaluate new ideas but also empowered my staff and commanders to make our organization stronger and more resilient. Carroll Zimmerman's description of Gen Curtis LeMay captures this point:

> LeMay's reliance on the people he selected for senior positions [allowed] him time to be available on short notice. By concentrating on basic strategies and major decisions, while depending on his staff to formulate them, he escaped the trap of a bulging schedule that would have made mature planning difficult. As a result, he was able to stay in complete control of SAC's operations, while being one of the most available persons in the headquarters.[9]

Taking time to reflect and imagine can have far-reaching benefits, even upon our national security and economy. The *9/11 Commission Report* identified imagination as one of the US government's failures in assessing the terrorist attacks of 11 September 2001 (9/11): "Imagination is not a gift usually associated with bureaucracies. . . . It is . . . crucial to find a way of routinizing, even bureaucratizing, the exercise of imagination."[10] The commission's point about making the "exercise of imagination" routine appears influenced by a historian's observation of the

Japanese attack on Pearl Harbor: "In the face of a clear warning, alert measures bowed to routine."[11] In an interesting parallel, air-minded innovator Gen William "Billy" Mitchell warned in an official report submitted in 1924, after visits across the Pacific, that "Japan's expansionism would lead to conflict with the United States," starting "with a surprise attack by Japanese forces on Pearl Harbor, Hawaii, in conjunction with an assault on the Philippines."[12] Given the 9/11 terrorists' use of airpower in a unique yet diabolical way, one has to wonder if an imaginative, innovative Airman could have helped predict and prevent such a scenario.

2. Remove Layers of Organizational Bureaucracy

As commander of Tactical Air Command, Gen Wilbur "Bill" Creech took steps to remove bureaucratic layers by reducing regulations. He created "working-level groups from operations, maintenance, supply," and other functional areas to review "all the regulations that pertained to their activities" and to "get rid of at least half of them—and even more if they thought appropriate."[13] Creech acknowledged other senior leaders' arguments that "the rules were there for a reason . . . saving us from our past mistakes," but he replied that "they are also saving us from our future accomplishments."[14] Over time, most organizations—including the Air Force—build a mountain of rules in reaction to accidents and incidents to centralize control and drive desired decision making. General Creech, however, stressed decentralized leadership or empowerment, explaining that "centralizers always add rules as they go along in the futile effort to force compliance."[15] Rather than follow stifling layers of regulations, he took a risk by trusting his people and their creativity to improve the Air Force. His confidence in them paid off with impressive validation in the Gulf War.[16]

Leaders may also reduce bureaucracy by removing layers of command and supervision. With flatter organizations, innovators closest to problems have more freedom to interact with the right people to pursue creative solutions. Less hindered by hierarchical choke points and

stovepipes, they can maneuver in a decentralized environment to influence change.[17] Ori Brafman and Rod Beckstrom, authors of *The Starfish and the Spider*, call such agents of change "catalysts." Contrasting bureaucratic chief executive officers (CEO) with catalysts, they paint the latter's creative environment. The CEO is at the top of the hierarchy exercising command and control in a directive manner whereas the catalyst's peer approach exercises trust in a collaborative manner. The CEO is "rational, powerful, in the spotlight" with a focus on organizing while the catalyst is "emotionally intelligent, inspirational, behind the scenes" with a focus on connecting.[18]

Some Air Force leaders have successfully removed layers of command over the years, mostly in response to fiscal constraints or required force shaping. Gen Merrill McPeak, former Air Force chief of staff, did so in the 1990s, reorganizing numbered air forces, reducing major commands, and eliminating administrative staffs.[19] Even today the service is conducting manpower cuts and consolidating staffs. Imagine deliberately taking these steps with the intent of developing an innovative service culture. Air Force leaders could utilize the current fiscal constraints as an opportunity by leveraging cuts and consolidations to encourage a more decentralized, creative environment.

3. Foster a Creative Environment

To help make the exercise of imagination more routine and inspire an environment that pulls new ideas and solutions from the bottom up, leaders should communicate their desire for creative ideas and define an acceptable level of risk by setting boundaries to avoid unacceptable degradation to core functions in case of failure. They may spark creative ideas by empowering others to initiate change.

How can leaders pursue these steps? First, they should express their desire for new ideas to everyone in the organization. Next, leaders should charge lower levels of leaders and supervisors to survey and pull creative solutions from their folks while providing a simple process to express their ideas. A leader should emphasize that the organi-

zation needs to trust, respect, and respond positively to any suggestion presented. Senior commanders can communicate to subordinate commanders that they "have their backs" and want them to take some chances in pursuing beneficial change. Thus, commanders empower their supervisors with authority to act on their ideas and not just "mind the store." Mark Abramson and Ian Littman's research on successful, innovative environments in the public sector supports this approach and concludes that respect, trust, and empowerment of employees are crucial to fostering innovation.[20]

To focus the organization's creative spirit and counter organizational dissonance, leaders should communicate the organization's goals and define what success looks like. To ensure that goals are clearly defined and understood, they may encourage their personnel to ask questions about why, how, and what they are doing and then have them reiterate what they have been asked to accomplish.[21] Leaders reduce dissonance by communicating to individuals and squadrons their vital role in carrying out the mission and achieving success.

Leaders should highlight success and reward ideas even if they lead to failure. In my commander calls with group personnel, I highlighted each squadron's creative ideas and problem solving and recognized teams or individuals behind the effort. If leaders go even further to recognize or reward those who put forth an idea that failed, then more people will be willing to risk presenting their thoughts. By recognizing failure as part of the innovative process, leaders may condition their organizations to prepare for and overcome it, building individual and organizational resilience and agility.

Recognition of creative teams and individuals illustrates an important progression from the innovative environment to creative action. As leaders work to cultivate such an environment for the entire organization, they should inspire teams and people to exploit that atmosphere for creative benefit. The leader simply works from big to small, encouraging the innovative spirit across the organization down to teams and individuals.

As leaders hone the emphasis on innovation from big to small, another key to success in pursuing ingenious solutions involves inspiring the individual. By encouraging people to solve problems personally (e.g., at home), leaders help empower them to pursue innovative solutions where they work. Most personnel don't consider themselves innovators, or they pass off work problems as "that's just the way it is." Leaders may need to kick-start their creative juices by tailoring a variety of methods to encourage individuals in their pursuit of creative problem solving.

In his book *The Back of the Napkin*, Dan Roam presents a method of drawing out the aspects of problems to visualize factors that influence the challenge at hand and then tapping our brain's strength in recognizing patterns to spark new ideas. He explains that "visual thinking means taking advantage of our innate ability to see" through visual tools such as "our eyes, our mind's eye, and our hand-eye coordination." Following a process of "look, see, imagine, and show," we can open our mind's eye by addressing five questions: "simple or elaborate, qualitative or quantitative, vision or execution, individual or comparison, change or status quo." Roam says we can "see" and "show" the last part of the visual thinking process through illustrating "who/what, how much, where, when, how, and why."[22]

4. Establish Small, Diverse Teams

A small team made up of members from a diverse cross section of the workplace can solve the difficult problems facing all of the organizations represented as well as help unravel even higher, more senior-level dilemmas. For example, my wing commander directed me to lead a small team—the Nellis Strategic Planning Cell (NSPC)—to find solutions to the most difficult problems threatening our mission success. I decided to expand and hone our emphasis on short-, mid-, and long-term results. I also ensured that I had sufficient representation of decision makers balanced with a manageable number of people to cultivate a creative spirit and shared vision. NSPC team members con-

sisted of a varied mix of representatives from airspace, range, operations, test, maintenance, and support across multiple wings and agencies. The team came up with brilliant new ideas and solutions that I never would have thought of. Amazingly, many creative suggestions came from members outside the functional problem area (e.g., maintainers proposing a different way to approach and solve an operations problem).

This NSPC team saved the Air Force hundreds of thousands of dollars in the first year of its existence and paved the way to saving millions. It crafted new ways to conquer our most substantial challenges, such as bedding down F-35s at Nellis AFB, Nevada; overcoming a lack of funds and resources to provide the adversary air needed to train the service's elite Airmen at the USAF Weapons School; cooperating to ensure that all users of the Nevada Test and Training Range received the airspace required (needs exceeded airspace available) to complete their missions successfully; collaborating with higher headquarters to optimize the training and deployment preparation for Air Force warfighting units, providing an annual $4 million cost-savings plan; and creating a variety of new concepts and methods to improve our processes across competing organizations.

This NSPC small-team approach also allowed us to maintain continuity in the midst of frequent turnover due to job assignments or changes. New assignments and frequent moves complicate the progress of innovative projects in large organizations such as the Air Force. As team members finally developed momentum on their idea or project, they were typically assigned to another location or position. The small-team approach produced a shared vision so that the other members could see the effort to completion.

Organizational or team leaders may spark or start a team's innovative effort by "developing the operational approach," as covered in Joint Publication 5.0, *Joint Operation Planning*, which notes that the commander or leader should "encourage discourse and leverage dialogue and collaboration to identify and solve complex, ill-defined prob-

lems." In developing the operational approach, the team collaborates to identify "where we are" ("a common understanding of the situation"), "where we want to go" (the goal), and the "problem" ("what prevents us from going where we want to go?").[23]

Small, unfettered "red teams" offer an adversarial or contrarian view to typical organization processes, thereby sparking creative thinking. Joint Publication 5.0 explains that these teams provide a means to challenge traditional thinking and "to see things from varying perspectives; . . . to avoid false mind-sets, biases, or group thinking; or use inaccurate analogies to frame the problem."[24] The 9/11 Commission also recommended the use of red teams to improve imaginative analysis.[25] From a business perspective, IBM followed suit by sending a small group to Florida, away from corporate influence, to reevaluate its personal computer interests.[26] Clayton Christensen and Michael Raynor, authors of *The Innovator's Solution*, point out that "the only times that established companies succeeded in staying atop their industries when confronted by disruptive technologies were when the established firms created a completely separate organization and gave it an unfettered charter to build a completely new business with a completely new business model."[27]

5. Visit Nontraditional Organizations

Given the corporate focus on innovation, leaders can pursue team or individual visits to industry, science and technology labs, or other diverse organizations to bolster ideas on innovation that lie outside their traditional viewpoint. Entities such as the Defense Advanced Research Projects Agency, Sandia National Labs, and Air Force Research Labs supply outstanding help in pursuit of innovative, nontraditional solutions. Leaders can also use sabbaticals or periodic events with other communities or companies to give people a different perspective on ways and means for brainstorming creative answers. Department of Defense leaders could push for a merge of such sabbaticals into the existing professional military education system, such as some of the Air

Force Fellows programs, to complement military academic development with creative broadening.

6. Mentor and Encourage Individuals to Communicate Their Ideas

Leaders should counsel their people to form an argument in communicating their innovative ideas. Sometimes a person's great idea doesn't go anywhere because the reason or evidence behind it isn't communicated well to leadership. Leaders can recommend resources, such as *The Craft of Research*, to assist their innovators in thinking through their great ideas and build the case for its implementation. For example, *The Craft of Research* explains that when you make a claim, you should "back it with reasons based on evidence, acknowledge and respond to other views" and, if necessary, "explain your principles of reasoning."[28]

Conclusion

Innovation is vital to organizations. It offers a means to solve problems, enhance quality of life, boost productivity, and strengthen the economy and security. Leaders and organizational members may take the steps discussed above to spur innovation in organizations.

Air Force innovation is essential to continued development and sustainment of future American airpower and the military advantage needed for national defense. Given the magnitude of fiscal reductions and security challenges we face as a nation, our innovation and ability to create new solutions to triumph over these difficult issues are essential to America's future security requirements and prosperity. ✪

Notes

1. Airplanes didn't exist over 110 years ago, but today the United States has sent men to the moon and back and successfully landed rovers on Mars; moreover, the Defense Advanced Research Projects Agency is currently attempting to develop the means to fly at Mach 20. Countless individuals have played innovative roles in the development of aircraft

used to win wars, change global logistics, and bolster the American economy and security. Army Air Corps and US Air Force innovators creatively met needs that boosted American airpower, productivity, and security. Gen Billy Mitchell created an Army Air Corps. Great Airmen such as generals Henry "Hap" Arnold, George Kenney, Curtis LeMay, and many more blazed new paths in developing the organization, structure, tactics, training, capabilities, and culture needed to form the world's premier air force.

2. Ten terrorists used the Global Positioning System, Google Earth, and Voice over Internet Protocol communication to complicate law enforcement's abilities to locate or identify them. Jeremy Kahn, "Mumbai Terrorists Relied on New Technology for Attacks," *New York Times*, 8 December 2008, http://www.nytimes.com/2008/12/09/world/asia/09mumbai.html?_r=0.

3. For example, drug traffickers' submarines have evolved from crude, semisubmersible, metal vessels to fiberglass, submersible, self-propelled, diesel-powered vessels to deliver cocaine to the United States. Demonstrating that innovation includes more than just high-tech solutions, smugglers also use a continuing evolution of catapults, pneumatic cannons, speedboats converted to smaller but faster "go-fast" boats, ultralights flown at night with no lights to avoid detection, and seemingly endless new methods to deliver their contraband. Kelsey D. Atherton, "5 Crazy Machines Smugglers Use to Get Drugs across the Border," *Popular Science*, 19 April 2013, http://www.popsci.com/technology/gallery/2013-04/how-do-smugglers-get-drugs-across-border?image=2.

4. Simon Sinek, "What Makes the United States Air Force So Innovative?," video, 2:02, YouTube.com, 11 April 2011, http://www.youtube.com/watch?v=aSoDSkj6aOo.

5. Gen Mark A. Welsh III, *The World's Greatest Air Force: Powered by Airmen, Fueled by Innovation; A Vision for the United States Air Force* (Washington, DC: Headquarters US Air Force, 15 August 2013), [4], http://co.ng.mil/News/PublishingImages/13-01-10-USAF-Vision.pdf.

6. Simon Sinek, *Start with Why: How Great Leaders Inspire Everyone to Take Action* (New York: Portfolio, 2009), 66–67, 137–38.

7. Todd Henry, *The Accidental Creative: How to Be Brilliant at a Moment's Notice* (New York: Portfolio/Penguin, 2011), 82–84.

8. Phil McKinney, a former Hewitt Packard vice president, explains in his podcast titled "Killer Innovations" that organizational leaders and members who are risk averse and resistant to change become corporate antibodies and bureaucratic roadblocks that kill innovative ideas. Phil McKinney, "How to Fight and Survive the Corporate Antibodies: Killer Innovations," podcast, 13 February 2012, http://philmckinney.com/archives/tag/corporate-antibodies.

9. Carroll L. Zimmerman, *Insider at SAC: Operations Analysis under General LeMay* (Manhattan, KS: Sunflower University Press, 1988), 34.

10. National Commission on Terrorist Attacks upon the United States, *The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks upon the United States*, 1st ed. (New York: W. W. Norton & Company, [2004]), 344.

11. Ibid.

12. "Brig. Gen. William 'Billy' Mitchell," fact sheet, National Museum of the US Air Force, 11 February 2010, http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=739.

13. Bill Creech, *The Five Pillars of TQM: How to Make Total Quality Management Work for You* (New York: Truman Talley Books / Dutton, 1994), 314.

14. Ibid., 315.

15. Ibid., 314.

16. "In the hours before the start of Operation Desert Storm on 16 January 1991, the Air Force chief of staff, Gen Merrill A. McPeak, wrote a letter to one of his old bosses. In it, he said, 'We are about to harvest the results of years of hard work and leadership by you and a handful of other great Airmen. We will do well. But we need to recognize that we are beholden to you, because you really built this magnificent Air Force we have today.' The Air Force did well, and McPeak was correct. In fact, after leading his air forces to such stunning success in Desert Storm, Lt Gen Charles A. 'Chuck' Horner, the joint force air component commander (JFACC), echoed McPeak's sentiment: 'General Bill Creech gave us the organization and training that made the success of our crusade possible. I can't thank him enough for that.' " Lt Col James C. Slife, *Creech Blue: Gen Bill Creech and the Reformation of the Tactical Air Forces, 1978–1984* (Maxwell AFB, AL: Air University Press, 2004), 1, http://www.au.af.mil/au/aupress/digital/pdf/book/b_0095_slife_creech_blue.pdf.

17. The term *stovepipes* refers to the Napoleonic vertical structure common in large military organizations. Rank-conscious bureaucratic entities typically flow information up and down a chain of command or vertical structure rather than exchange information horizontally across other organizations.

18. Ori Brafman and Rod A. Beckstrom, *The Starfish and the Spider: The Unstoppable Power of Leaderless Organizations* (New York: Portfolio, 2006), 129–31.

19. General McPeak emphasized three main operating principles in his organizational restructuring efforts: (1) streamline the organization by eliminating layers of command, (2) eliminate activities that add little value, and (3) combine authority and responsibility with accountability for performance at every level. Merrill A. McPeak, *Selected Works, 1990–1994* (Maxwell AFB, AL: Air University Press, 1995), 6.

20. Mark A. Abramson and Ian D. Littman, eds., *Innovation* (Lanham, MD: Rowman & Littlefield Publishers, 2002), 3.

21. Some of the wording I use here is influenced by Todd Henry's comments in his "The Accidental Creative" podcast, 26 September 2013, http://www.accidentalcreative.com/podcasts/ac-podcast-65-process-vs-product/.

22. Dan Roam, *The Back of the Napkin: Solving Problems and Selling Ideas with Pictures* (New York: Portfolio, 2008), 4, 254–55.

23. Joint Publication 5.0, *Joint Operation Planning*, 11 August 2011, III-3, http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf.

24. Ibid., III-5.

25. National Commission on Terrorist Attacks upon the United States, *9/11 Commission Report*, 347.

26. Clayton M. Christensen and Michael E. Raynor, *The Innovator's Solution: Creating and Sustaining Successful Growth* (Boston: Harvard Business School Press, 2003), 66.

27. Ibid.

28. Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams, *The Craft of Research* (Chicago: University of Chicago Press, 2003), 114.

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EMPLOYING INTELLIGENCE, SURVEILLANCE, AND RECONNAISSANCE: ORGANIZING, TRAINING, AND EQUIPPING TO GET IT RIGHT

In the January–February 2015 issue of *Air and Space Power Journal*, Capt Adam Young in his article "Employing Intelligence, Surveillance, and Reconnaissance: Organizing, Training, and Equipping to Get It Right," astutely presented a model for employment of airborne surveillance and reconnaissance capabilities similar to the close air support (CAS) structure. The article proposed *how* airborne collection assets should be employed and explored *who* should be qualified to task sensors for the supported commander, even with the land component. Captain Young presented the case for creation of ISR tactical controllers (ITC) within the tactical air control party (TACP). We would like to clarify the roles and responsibilities of current TACP members discussed in Captain Young's ITC proposal.

His article summarizes some doctrinal issues of tactical airborne sensor tasking, but the problems are systemic to the collection-management process. The author's comparison of CAS and collection management to contextualize the problems is sound but requires qualification. The joint tactical air strike request (JTAR) process facilitates CAS effects like dropping bombs. The collection-management process governs surveillance and reconnaissance operations. Many years ago, the joint community institutionalized the JTAR process but failed to do the same for collection management.

For its part, the US Air Force created two career fields to handle CAS planning and execution with the land component: the air liaison officer (ALO) and the TACP. ALOs and joint terminal attack controllers (JTAC) integrate CAS into the ground scheme of maneuver to avoid fratricide. JTACs draft CAS requests and staff them through the air support opera-

tions center. When the air and space operations center tasks the air requests to Air Force squadrons, aircrews at the squadrons plan the mission to produce requested effects. Simultaneously with aircrew planning, ALOs and JTACs plan the mission with ground units to ensure that approved air requests are reflected in the ground scheme of maneuver. From a tactical operations center or a forward position, the JTACs call in air strikes to avoid fratricide during execution. Finally, the JTACs provide inputs on battle damage assessment. The JTAR process streamlines CAS employment, but such is not the case for collection management.

Airborne collection management is split into two different categories: collection requirements management (CRM) and collection operations management (COM). CRM is the authority to determine *what* assets collect, based on priority. COM is the authority to determine *which assets* will collect requirements and *how* they collect priority requirements. Collection-management responsibilities are spread across persons from different services. Usually the ground element determines what information needs collection, and the supporting unit—often the air component—determines how best to attain the collection. The integration of Air Force ISR liaison officers (ISRLO) into the TACP addressed the air component's ISR integration into the ground scheme of maneuver.

For land operations, the supported ground commander delegates airborne collection management to a mixture of S2 and S3 staff members—most often the S2. The latter oversees such activities as plotting orders of battle, managing human intelligence teams, and coordinating ground-based ISR collection systems. Simply, airborne collection is one of many S2 responsibilities. More experienced individuals usually lead the intelligence sections while such matters as airborne collection management, at lower echelons, are often left to inexperienced personnel. The US Army first recognized the deficiency in its real-time airborne ISR integration, and the US Marine Corps followed.

Bad experiences with allowing untrained people to request and control airborne sensors, in part, led to implementation of the Air Force's

ISRLO program in 2006. The Army and Marine Corps needed individuals to advise them during operational planning, help them with the request process, and then execute ISR operations alongside them when needed. This model is the current *function* of the Air Force ISRLO; however, Captain Young's article does not accurately reflect this service agreement.

The author's problem is the equivalence of the ALO and the ISRLO. ALOs have an advisory-only function. ISRLOs have a threefold mission: advise, *assist,* and educate. Gen G. Michael Hostage, former commander of Air Combat Command, ensconced these roles in the command's *Air Support Operations Squadron (ASOS) Intelligence Operations Enabling Concept* in 2012. This document mirrors ISRLO roles implemented in the 2011 Air Forces Central (AFCENT) ISRLO concept of operations (CONOPS) when General Hostage was the combined force air component commander for US Central Command.

Most confusion about ISRLOs has to do with their assistance role, which includes sensor tasking authority (STA). Captain Young's article fell victim to this misunderstanding, referencing the Air Force's theater ISR CONOPS and the AFCENT ISRLO CONOPS: ISRLOs are not "to act as terminal controllers" (p. 33). The article incorrectly presumes that terminal control extends to STA. It does not. The above reference means that ISRLOs should not employ kinetic weapons. Joint Publication 3-09.3, *Close Air Support*, 25 November 2014, defines terminal control as "the authority to direct aircraft to maneuver into a position to deliver ordnance, passengers, or cargo to a specific location or target . . . [or] any electronic, mechanical, or visual control given to aircraft to facilitate target acquisition and resolution" (p. GL-14). No Air Force ground operator other than JTACs is allowed to conduct *terminal control*. However, ISRLOs most certainly exercise STA in their assistance function and have done so for at least the last six years in nearly every contingency operation. Consequently, ISRLOs are not like ALOs in this respect. ALOs cannot employ weapons unless they are JTAC qualified. ISRLOs can employ sensors if the supported commander al-

lows them to do so as members of their intelligence team. The challenge ahead for the ISRLO community is to formalize planning, execution, and assessment tactics, techniques, and procedures for this function; these efforts have been under way for several years and are nearing fruition.

Captain Young's observation that current doctrine on ISR has "yet to materialize into usable, tactical-level guidance" (p. 30) is absolutely correct and continues to be a source of frustration for ISRLOs and other individuals. The ISRLO program is the Air Force's initial answer to help with this joint problem. These first efforts are by no means a final answer, but it is important to realize that improvements to the execution function of collection management have already begun. Undoubtedly, the Air Force has a part to play in the joint effort to fix collection-management problems. However, fielding Air Force ITCs to correct a joint problem is a resource-intensive Band-Aid. Although the Air Force should bolster its STA capability with ground units through a modest increase in ISRLO manning and lead the way in building a training program for those who exercise STA over airborne ISR assets, it is neither realistic nor desirable for the service to completely take over this function for the other services. This problem is inherently joint, and both the Army and Marine Corps must seek solutions of their own to overcome issues with collection management.

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THE AUTHOR RESPONDS

Captain Snelgrove and Captain Haley have added valuable insights to the ongoing and important discussions to optimize ISR employment. Getting this right is not only critical for the most effective employment of air, space, and cyber power but also pivotal to the success of

our joint and coalition partners. The fact that both authors have extensive operational ISR experience and have deployed as ISR liaison officers in support of the land component makes their insights particularly valuable. In essence, I agree with them about the lack of authoritative, tactical-level tactics, techniques, and procedures and doctrine; furthermore, I concur that the joint force needs uniquely trained ISR Airmen who can leverage and integrate resources across the entire ISR enterprise. Whether these ISR specialists are called ISR liaison officers, ISR tactical controllers, ISR coordinators, or something altogether different (e.g., ISR tactical directors—an initiative proposed by Twenty-Fifth Air Force) is less critical than the more important discussion concerning how to best implement this function to advance and improve ISR operations. I remain hopeful that the Air Force will recognize the need for these ISR specialists and that our service's leaders will continue to drive towards prioritizing and standardizing this ISR requirement. The dynamic nature of the modern battlefield will require nothing less than superbly prepared ISR forces to meet the threat.

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Operation KE: The Cactus Air Force and the Japanese Withdrawal from Guadalcanal by Roger Letourneau and Dennis Letourneau. Naval Institute Press (http://www.usni.org/navalinstitutepress), 291 Wood Road, Annapolis, Maryland 21402, 2012, 416 pages, $42.95 (hardcover), ISBN 978-1-59114-446-5.

Roger and Dennis Letourneau offer a revisionist look at a unique Japanese operation from the Guadalcanal campaign. Their book, *Operation KE*, covers the highly successful withdrawal of the Japanese 17th Army from the island in early 1943 and attempts to determine if the operation's success stemmed from careful Japanese planning, the failure of American interdiction forces, or just plain luck on the part of the 12,000 evacuees. As often happens with military operations, the authors identify multiple factors that run the gamut of issues identified, each contributing to Operation KE's success.

The Letourneaus do not limit themselves to a dry discussion of strategies and large unit movements. Instead, they mine unit reports and memoirs from both sides of the conflict for descriptions of air action from every day of the operation. The result is a rich description of aerial combat covering the terror of bombing raids, the tension of long-range reconnaissance missions, and the thrill and horror of intense dogfights. An early discussion of American and Japanese aircraft and their respective tactics helps to enrich the lengthy description of each aerial encounter.

Unfortunately, the copious descriptions of air combat detract from the bigger issues that the book addresses. The reader is left with a work that tries to read like one of Stephen Ambrose's popular histories of World War II but comes up short. The authors cover the higher-level aspects of the operation but expect the reader to possess a basic under-

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standing of the Guadalcanal campaign since the book does not adequately explain the events leading up to Operation KE. The work's attempt to connect the reader to the common Airman also proves inadequate since the breadth of aerial encounters discussed fails to allow the reader to identify with any of the individuals. Instead of producing a history that blends high-level concepts with human stories, the Letourneaus have created two books and fail in their attempts to combine them.

Nevertheless, readers interested in World War II should not discount this work but should understand what it is and then concentrate on the aspect they are most interested in. Scholars will appreciate the authors' theories of the Japanese success. Modern military strategists and planners could also draw lessons from each side since KE is an excellent example of a complex joint operation conducted in the Pacific—the latest strategic focus of the American military. Finally, history buffs and pilots will revel in the stories of the Cactus Air Force's efforts to own the skies and control the seas of the South Pacific. Overall, *Operation KE* has a little something for everyone, but not everyone will enjoy the book in its entirety.

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Rudder: From Leader to Legend by Thomas M. Hatfield. Texas A&M University Press (http://www.tamupress.com), John H. Lindsey Building, Lewis Street, 4354 TAMU, College Station, Texas 77843-4354, 2011, 528 pages, $30.00 (hardcover), ISBN 978-1-60344-262-6.

One can be forgiven for assuming that a biography of Earl Rudder published by Texas A&M University Press would be a hagiography that appeals only to an Aggie audience. Luckily this is not the case; instead, Thomas Hatfield has written a thoroughly researched and balanced biography of Rudder that highlights his service in the Second World War and his presidency at Texas A&M. Focusing on the life of his sub-

ject, Hatfield shows the reader "the triumph of humane and purposeful leadership in war and peace" (p. xiii). Rudder successfully used this leadership in two completely opposite organizations—the military and academia—and offers a model for the challenges facing leaders in today's ever-changing Air Force and society.

The book begins with Rudder's early childhood in West Texas where he grew up in a family of modest means. His athleticism made him a natural for football and led to a scholarship at Tarleton College and Texas A&M. Unlike today's scholarships, his did not cover room and board, so Rudder worked full time while he played football, studied, and participated in the Corps of Cadets. He met all of these obligations and managed to graduate a year early. Hatfield concludes that A&M taught Rudder to manage his time and balance commitments. After graduation and commissioning in the Army Reserve, he coached high school football and worked as a teacher, planning to settle down and raise a family. War was looming in Europe, however, and Rudder dedicated time to his duties as an Army Reserve officer.

When activated in June 1941, he spent the next three years training throughout the United States and England, getting ready for the assault on Normandy during D-day. Preparation for the invasion and Rudder's heroic leadership of the members of the 2nd Rangers Battalion as they scaled Pointe du Hoc comprise the most compelling section of the book. Anyone interested in the Second World War will enjoy Hatfield's readable account of Rudder's battlefield experience from Normandy to the Battle of the Bulge and the surrender of Germany. The author shows how Rudder used his experience as a coach and teacher to size up volunteers and decide who had the physical endurance and intelligence to be a Ranger. He also had a vision for the Rangers and set a tough standard that he enforced fairly. Rudder excelled because he looked after his men, involved himself in the details of planning operations, and gave his subordinates the independence to carry out orders without micromanaging. Success in battle seemed to guarantee a career

in the Army. Instead of staying in the service, however, Rudder chose a civilian career but maintained a commitment to the Army Reserve.

After the war, he returned to Texas where he established a business and became involved in local politics. He was appointed the president of Texas A&M College in 1958 during a critical period. Admissions were declining, and Rudder recognized that A&M had to modernize or become irrelevant—but it still had to preserve its traditions. Toward that end, he sought to establish A&M as a premier research university and do away with the perception that it was merely a military college. Accordingly, he changed the name to Texas A&M University, eliminated compulsory membership in the Corps of Cadets, and approved coeducational enrollment. These changes were met with hostility from the powerful Former Student Association, which opposed all of them. Rudder used his reputation as a war hero and former student to make these alterations and lessen opposition. His tenure at A&M was not without faults, though, highlighted by an ill-conceived feud with the campus newspaper over articles that criticized the university administration. In the end, Rudder transformed Texas A&M and placed it on the road to becoming a major university.

Rudder: From Leader to Legend offers some valuable insights for today's Air Force reader. The obvious lesson is Rudder's leadership skills. He led from the front and took pains to interact with his subordinates, whether as a battalion commander or university president. He sought out both privates and students, talking with them individually and understanding their needs. Rudder developed a clear vision for his organization, set a high standard, and worked to meet it. With the recent paradigm shifts such as repeal of the "Don't Ask, Don't Tell" policy and lifting of the ban on women in combat, the military faces challenges similar to those Rudder encountered as president of Texas A&M. One can take a page from Rudder and approach these issues in a pragmatic fashion, using humane and purposeful leadership.

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On Point II: Transition to the New Campaign; The United States Army in Operation IRAQI FREEDOM, May 2003–January 2005 by Dr. Donald P. Wright and Col Timothy R. Reese with the Contemporary Operations Study Team. Combat Studies Institute Press (http://usacac.army.mil/cac2/csi/csipubs.asp), US Army Combined Arms Center, Fort Leavenworth, Kansas 66027, 2008, 718 pages, $35.00 (softcover), ISBN 978-0-16-078197-1. Available free from http://1.usa.gov/1eJG5M1.

May 2003 through early 2005 was one of the more tumultuous periods in Iraq's recent history. Events coming on the heels of the downfall of Saddam Hussein's regime as a result of Operation Iraqi Freedom had not yet transpired as envisioned by key US and coalition planners. What followed in this new campaign—known in US planning jargon as phase four (stability operations)—were 21 turbulent months during which coalition forces began to hand control of Iraq back to the Iraqis, using what appeared to be an ill-prepared plan executed nearly ad hoc. The US Army, a key player during this time, contributed tactical forces to enable this transition as well as staff elements to form the cores of multiple prominent headquarters guiding the effort. Dr. Donald P. Wright, Col Timothy R. Reese, and the Contemporary Operations Studies Team at the US Army Combined Arms Center published *On Point II* as the exhaustive, unclassified results of a study spanning the period in question. Because I was on one of the staffs examined during this time, I took a personal interest in the study. *On Point II* covers these 21 months in 14 chapters, each covering a specific topic. The authors logically group several chapters into larger themes (parts 1 through 5), and seven appendices round out the book.

The authors repeatedly stress that US and coalition forces lacked a unified, comprehensive plan for phase four. Reese's team emphasizes that several such plans existed in a variety of forms, few of which were mature or final, albeit some were in motion during the first months of this period. Additionally, the authors impress upon the reader that almost six months elapsed before V Corps (the nucleus of what became

Combined Joint Task Force [CJTF] 7) began to receive sufficient augmentation to effectively take on the role of a CJTF. Lt Gen David D. McKiernan, the combined land force component commander at the time, best summarized the first six months: "What is the lesson learned out of all that? You have to put as much effort into the back end of the campaign as you do into the front end" (p. 165). The authors conclude by reiterating that "the transition to the new campaign was not well thought out, planned for, and prepared for before it began" (p. 568). They then follow through by summarizing each chapter's highlights in the greater context.

In particular, I enjoyed the depth of the examination of individual topics. I had piecemeal knowledge of some of the subjects mentioned in the study, all of which fell in lockstep with my background. In fact, the book helped fill in the information I lacked. Furthermore, the authors do a fantastic job of refraining from assigning blame; instead, they simply report events recorded and recalled by the participants. However, the study missed some opportunities by not including input from prominent coalition senior officers such as Canadian general Walter Natynczyk, who deployed with III Corps in January 2004 as the corps's deputy commanding general and served in Iraq first as the deputy director of strategy, policy, and plans (CJTF-7/CJ5) and then as the deputy commanding general of Multi-National Corps–Iraq.

Some readers may be put off by *On Point II*'s heavy focus on the Army's role both at the tactical level and in fleshing out the higher headquarters operating in Iraq. The authors point out that they wrote the study to begin establishing the historical record of that service in Iraqi Freedom. Despite the Army-centric focus, I recommend *On Point II* as a relevant read for Air Force officers and senior enlisted personnel, especially those who could someday find themselves on the staff of a CJTF.

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Adak: The Rescue of Alfa Foxtrot 586 by Andrew C. A. Jampoler. Naval Institute Press (http://www.usni.org/navalinstitutepress), 291 Wood Road, Annapolis, Maryland 21402, 2011, 240 pages, $17.95 (softcover), ISBN 978-1-59114-410-6.

Adak: The Rescue of Alfa Foxtrot 586 by Andrew C. A. Jampoler, a former naval aviator, is an exhilarating story of a US Navy P-3 Orion patrol plane whose crew is forced to ditch over the Pacific Ocean after losing control of the aircraft's engines. The men spend most of the ensuing day battling for survival while waiting for rescue. The uncertainty faced by the crew continues from when the survivors are plucked from the sea by a Soviet fishing trawler until they depart the Soviet Union several days later. In addition to the ditching and rescue, Jampoler describes the events leading up to the tragedy as well as the subsequent investigation. In doing so, he provides the reader a technical analysis of the accident while also delving into the lives of the naval aviators involved. The result is a true story of survival that is accessible and enjoyable to both aviation enthusiast and casual reader alike.

Jampoler's account of the incident itself, as well as the surrounding events, is based on original documents, recordings from the time of the crash, and interviews conducted with both survivors and participants in the subsequent search-and-recovery operation. His careful research and frequent references to the investigation into the incident give the reader a detailed play-by-play analysis of the events that led to the ditching.

The author's description of those occurrences is well researched and flows nicely. Although Jampoler focuses on many of the technical details of the catastrophe, the book is still relatively easy to read and quite accessible to those who lack a technical or aviation background. He begins the story by examining the lives of the crew members stationed at Naval Station Adak, giving the reader a sense of their living conditions as well as the excitement and difficulties of being a naval aviator flying out of an isolated airstrip in the Aleutian Islands. However, the author's account of Lt Cdr Jerry Carson Grigsby's (the senior

officer on board the plane) skillful sea "landing" under extreme weather conditions is the highlight of the narrative. One minor error or miscalculation in ditching the plane on the choppy seas could have easily resulted in the death of the entire crew. Jampoler's take on the events leaves no doubt that Grigsby, who would perish at sea after exiting the aircraft, is the hero of the tragic story.

One minor quibble with *Adak* is that it lacks an index, which would have proven helpful in locating specific individuals and events. The book also could have used a good editor to smooth out some of the rough edges. At times Jampoler sets aside his careful research and injects his own opinion into the narrative, especially when he strays into discussions of the political climate between the United States and Soviet Union. This practice tends to be cumbersome and detracts from the emphasis on the technical aspects of the crash and the crew's survival. For example, at one point the author characterizes the Soviet Union as a "geriatric kleptocracy" (p. 162) that survived by stealing the economy's output for itself. In reality, the nature of the Soviet regime, which cooperated with the United States in rescuing the survivors and sending them home, was more complex than Jampoler's one-dimensional analysis implies.

Adak: The Rescue of Alfa Foxtrot 586 forcefully depicts the many dangers faced by naval aviators who flew hazardous missions at the height of the Cold War. The author successfully introduces the reader to a little-known plane crash and surrounding political tensions. His ability to interweave the technical details of the crash with the lives of the heroic flyers and to depict the heartache suffered by their families makes for a work that will satisfy readers looking for a technical overview of the accident as well as those desiring an exciting tale of survival at sea.

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David and Lee Roy: A Vietnam Story by David L. Nelson and Randolph B. Schiffer. Texas Tech University Press (http://www.ttupress.org), Box 41037, Lubbock, Texas 79409-1037, 2011, 288 pages, $23.96 (hardcover), ISBN 978-0-89672-694-9.

David and Lee Roy: A Vietnam Story is a memoir of the lives of two men. David Nelson recounts his experiences with best friend Lee Roy Herron as they grew up in west Texas and attended Texas Tech University before getting caught up in the fray of Vietnam. Both men ended up joining the Marines (Nelson as part of the Marine Corps judge advocate general program and Herron as an infantry officer). After graduation, their lives diverged, Nelson receiving a delay in joining the Corps to complete his law degree and Herron deploying to Vietnam and dying in action in 1969. David never did make it to Vietnam, serving in Okinawa as the war drew to a close. Eventually, Nelson settled into life in Houston as a successful lawyer for a financial firm and nonprofit organization. However, a chance meeting with Lee Roy Herron's former commanding officer sparked Nelson to track down what exactly happened to his old friend, culminating with a dedication to Herron at their alma mater.

Clearly, this work is a deeply personal one for David Nelson, weaving his personal story into the narrative of his friend. A number of Nelson's stories come from memory, but he also took great pains to contact various people in Herron's life to complete the picture of what happened after the two went their separate ways. From west Texas to Mexico to Vietnam, Nelson spent several years researching the life story of his friend. Early on in the work, Nelson is candid with the reader, indicating that a good bit of the dialogue is re-created since no full, word-for-word transcript of Herron's interactions exists. Still, based upon personal experience and interviews with people associated with Herron, the dialogue/interaction seems a genuine reflection of his personality.

Although this story concentrates on the Marine Corps, some themes/concepts apply to the Air Force reader. Key among them is Nelson's sense of "survivors' guilt." Nelson does not say so directly, but the theme appears, nevertheless, especially as he comes to grips with

the fact that while he lived his life, raised a family, and dealt with various trials and tribulations, Herron never got that chance. From time to time, as Nelson thinks of his friend, he believes that he somehow failed him—that he lived, but Herron did not. The eventual quest to uncover the full story about what happened to Herron is a much as tribute as a cathartic act for the author.

Given the high deployment rates for all members of the armed forces since 2001 and the various mission sets those deployments entail, such a feeling would not be uncommon among today's Airmen. The counterterrorism wars of Afghanistan and Iraq found many Airmen not only working in a joint/coalition environment but also conducting missions (convoy duty, forensics of improvised explosive devices) that traditionally are the realm of Soldiers or Marines. Numerous stories of survivors' guilt can be found in accounts of returning Airmen, and the US armed forces will continue to deal with those issues for the foreseeable future.

Overall, *David and Lee Roy: A Vietnam Story* is quite readable. The military aspect does not dominate but still plays an important role. Readers who grew up in Texas can probably relate a little easier to the narrative, but Nelson does well enough describing life in west Texas that anyone can comprehend it. The book does not rate as required reading for all service members, but for those who pick it up, it will be worth the time.

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The Final Mission of *Bottoms Up*: A World War II Pilot's Story by Dennis R. Okerstrom. University of Missouri Press (http://press.umsystem.edu/catalog/CategoryInfo.aspx?cid=152&AspxAutoDetectCookieSupport=1), 2910 LeMone Blvd., Columbia, Missouri 65201, 2011, 272 pages, $29.95 (hardcover), ISBN 978-0-8262-1948-0.

Author Dennis Okerstrom has done all of us a very great favor. Lee Lamar, the primary figure in Okerstrom's book *The Final Mission of "Bottoms Up,"* is now 91 years old and, like his contemporaries, will not be with us in the flesh forever. The author has caught his story before it slips away into oblivion, recording it for everyone. This is a story worth sharing, even savoring, especially because of its unique time and distance-spanning context. It is not simply a World War II story about the crew of *Bottoms Up,* a B-24 Liberator; rather, it paints a vivid picture of a much larger tale that includes Yugoslavian (Croatian) partisans, contemporary archaeology, and Croat veterans of their own more recent conflict.

We generally fail to appreciate the very wise and certainly enormous readiness effort that took place in the United States in the years preceding its entrance into World War II. While Congress dithered over whether or not to reinstate the draft, the executive branch—especially the War Department—made extensive preparations that proved to be prescient. Prior to the war, the Civilian Pilot Training Program (CPTP), for example, established the basis for a real war effort, putting thousands of young men through flight training. Between 1939 and 1944, the CPTP and its successor, the War Training Service, trained a total of 435,165 pilots who recorded nearly 12 million flying hours. Lee Lamar was one of those CPTP participants who saw an opportunity to expand his world beyond the confines of his family's farm in northwest Missouri and embark on a course that included not only flight training but also a college education.

Many veterans of World War II's conflict in the air followed similar paths. A large number also experienced getting shot down, bailing out over enemy-held territory, and spending the duration of the war in a

prisoner of war (POW) camp. Not many, however, visited their crash site years later, found the precise location of their parachute landing, marked the spot where they were captured, or visited with now-elderly partisans who helped some of their crewmates escape. That is what makes this book unique and a delight to read.

The incredible confluence of a modern Croat archaeologist discovering the scattered remains of a wartime B-24 and the ability and determination to track down the identity of that aircraft's crew, ultimately arranging a visit for the copilot, is nothing short of incredible—a superb example of "history detectives" at their finest. Okerstrom captures that story and masterfully weaves it into a narrative of Lieutenant Lamar's journey from CPTP cadet to B-24 copilot to POW in Stalag Luft 1. The modern part of the story highlights the determined curiosity of Luka Bekic, Croat archaeologist and veteran of his country's war for independence. Perhaps only a soldier could appreciate the potential story associated with the scraps of aluminum he found near Pula, Croatia. Only a skilled, determined researcher could trace their definitive origin, associate them with a specific crew, and ultimately contact the survivors. This is a case of the right person being in the right place at just the right time.

I must admit, I enjoyed this book so much that I took a little detour across the river one day just to see Lamar's home town of Faucett, Missouri, and to visit Rosecrans Field near St. Joseph, Missouri, where he did his CPTP training. It was like a short trip through history. Thank you, Professor Okerstrom, for your book that prompted the tour.

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Evidence from Earth Observation Satellites: Emerging Legal Issues, vol. 7, Studies in Space Law, edited by Ray Purdy and Denise Leung. Martinus Nijhoff Publishers (http://www.brill.com/), Plantijnstraat 2, 2321 JC Leiden, Netherlands, 2012, 466 pages, $215.00 (hardcover), ISBN 978-90-04-19443-4.

Former National Security Agency contractor Edward Snowden claims he released classified information to highlight his concerns with purported government invasions of privacy for the average American. Whether one considers him a hero or a traitor, the issue of personal privacy is important any time a government gathers information on its citizens. The contributors to *Evidence from Earth Observation Satellites* address issues of privacy, data handling, admissibility, and reliability related to the gathering and use of data from earth observation (EO) satellites as evidence within the legal sector. To accomplish the task, the editors gather a number of national and international experts in the field of law and policy regarding space and remote sensing (a term synonymous with EO in the space law community). The book's six parts provide a layperson's description of the technological issues related to using EO data as evidence, national and international efforts to utilize it to support prosecutions, and privacy and policy concerns. It concludes that making use of such data as evidence is immature and that national governments and international institutions should carefully consider the proper national and international policy changes required to develop effective law and legal practices ahead of advances in EO technology.

The text effectively frames the discussion within the limits of current technology and policy, identifying the key unresolved and ambiguous issues related to the use of EO data as evidence at the national and international levels. It also offers an excellent treatment of technological issues related to maintaining the validity and admissibility of evidence when the data is in a digital format, is processed and potentially manipulated, and exists only as a copy of the original.

The book's parts and, occasionally, individual chapters are disjointed, lacking clear connections. Fortunately, Purdy closes the book with a chapter that fulfills the promise of its title "Pulling the Threads Together and Moving Forward." He summarizes the major issues raised throughout and proposes a way ahead to resolve them.

The fact that environmental law dominates much of the book may cause some military professionals to balk at a claim of relevancy. However, *Evidence from Earth Observation Satellites* offers two discussions that make it important for Airmen working in national security and intelligence policy as well as for those in the legal profession. The first is found in chapter 9, regarding the use of EO data in the International Criminal Court to assist in cases such as the prosecution of war crimes in the former Yugoslavia. As the availability and employment of such information in criminal proceedings grow, the likelihood that judge advocates or Air Force leaders could find themselves involved in cases for the prosecution or defense increases. Therefore, understanding the challenges of presenting EO data in court and the potential pitfalls related to ensuring its admissibility may become more important.

The second important discussion concerns privacy laws. In the final chapter, Purdy adds to the examination of personal privacy related to the collection of EO data and rightly identifies a gap in international policy and its complicating effect as EO technology improves and proliferates. What constitutes a violation of privacy by EO satellites? According to the authors, no standard exists. As highlighted in the Snowden case, terrorism often resides at the border between military and law enforcement jurisdictions. During conflict with the conventional army of another nation, little legal ambiguity exists. In a struggle against an international terrorist organization, both inside and outside our own borders, the line between what is justified to ensure national security and what meets legal standards often blurs. The book's contributors indirectly open the discussion on privacy as it relates to EO satellites—one that might influence both the Air Force's collection of information on known and potential terrorist adversaries

and national choices on whether to pursue the same through legal or military instruments.

Written for members of the legal profession and focused on space law, the book's commentary can be difficult to endure at times. However, the discussions about the contribution to prosecutions of war crimes and issues of privacy related to EO data could make *Evidence from Earth Observation Satellites* significant for national security policy, intelligence policy, and legal professionals within the Air Force.

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Strategic Thinking in 3D: A Guide for National Security, Foreign Policy, and Business Professionals by Ross Harrison. Potomac Books (http://www.potomacbooksinc.com), 22841 Quicksilver Drive, Dulles, Virginia 20166, 2013, 224 pages, $23.96 (hardcover), ISBN 978-1-59797-706-7.

Ross Harrison, a professor in Georgetown University's Edmund A. Walsh School of Foreign Service, believes that "the concept of strategy has become diffused and devoid of any real clarity" (p. x). He presents a solution to this problem in his book *Strategic Thinking in 3D*. This primer strives to deliver a general framework for thinking strategically, developing "universal principles," and identifying "common conceptual underpinnings" applicable to a wide array of strategic domains, including national security, foreign policy, and business (p. xiii). In this regard, I believe that Harrison succeeds.

He begins by delivering an excellent historical account of the definitions of strategy, classifying them as inward or outward facing. Inward-facing strategy sets goals and manufactures capability, creating the "internal energy and muscle" needed to support its outward face (p. 165). Capabilities are a core component, giving organizations the potential to act. The author discusses inward-facing strategic definitions in the context of leveraged resources, sets of mutually reinforcing decisions,

and process. Outward-facing strategy applies the "energetic muscular capability created internally" to shape the organization's external environment in a beneficial manner (p. 164). From this perspective, Harrison offers a review of strategic definitions focused on managing uncertainty and risk, orienting towards competitors, and shaping the external environment.

From this analysis, he concludes that "strategy is about adapting to or shaping one's environment so that what otherwise would be improbable becomes possible—it is about creating a multiplier effect on resources and actions" (p. xii), asserting that resource scarcity should not be seen as a limitation. Instead, an effective strategist should develop strategy that leverages scarce resources to achieve "outsized goals" (p. 5). This point is particularly relevant, given the current fiscally austere environment.

Having established this foundation, Harrison presents us with his 3D strategic framework, whose external environment consists of three dimensions: systems, opponents, and groups. By concentrating on them together, the author notes that "the power of integration and the resultant multiplier effects can be realized" (p. xii). Furthermore, he asserts that success depends upon analyzing and acting in all three dimensions of the strategic environment simultaneously.

A system is composed of a web of relationships in which a change in one part affects the other parts. Strategy in this dimension is indirect, and the strategist attempts either to disrupt the external environment as a means of reducing the opponent's leverage or to enhance that environment as a means of improving one's own leverage. In the systems dimension, leverage is affected by key relationships, vital system properties (e.g., patterns of interaction), and geographic position. This approach is reasonable for a midterm to long-term planning horizon.

Regarding analysis of the opponent, Harrison addresses the need to assess his capabilities, motivations, and strategy (p. 89) and to design one's strategy expressly for him. Specifically, the author speaks of

attacking the opponent's capability, dissuading him from exercising his capability, and disrupting his strategy (p. 102). Because of the likelihood of an adversarial response in this dimension, one must adapt strategy on the fly—a necessity that markedly contrasts the systems dimension, in which the opponent does not directly counter every action.

Harrison then defines a group as "a collection of individuals that can affect the leverage dynamic between an organization or country against its opponents" (p. 122). He argues that either formal or informal groups derive their power from globalization and the "ubiquity of social media"; consequently, they can "challenge authority in ways that were unimaginable even twenty years ago" (p. 122). Like the systems strategy, that for groups is indirect, aiming at the environment in which they operate. Thus, one must think in terms of a midterm to long-term planning horizon, and actions in this dimension benefit greatly from reinforcing actions in the other dimensions—similar to the say-do gap typical of strategic communications. Harrison suggests "think[ing] of the aim as the behavior your strategy is designed to elicit from the group, while the goal is the impact that behavior should have on the opponent" (p. 125).

The book presents an effective strategic framework that can certainly complement a senior leader's experience and intuition. It is approachable and easy to understand, making no demands for previous knowledge of or experience with strategy. Moreover, its choice of dimensions is reasonable, having parallels in the strategic literature (e.g., political, military, economic, social, information, and infrastructure [PMESII] systems-thinking related to describing the operational environment). Although some of the author's examples are quite cursory, he nevertheless integrates aspects of national security, foreign policy, and business strategies into the text. However, his creation of a "new" vocabulary, introducing terms such as *linchpin capabilities, primary goals, subsidiary goals, core interests*, and so forth, is problematic. Perhaps by drawing seminal examples from the existing language (e.g., Clausewitz's critical

capabilities), Harrison could have eliminated this somewhat redundant terminology.

Anyone interested in strategy should read this book. For individuals new to strategy, it serves as a good primer, offering an approachable, understandable framework for strategic thinking. Even experienced readers might appreciate Harrison's historical analysis of strategy in the introduction, his organizational scheme of inward- and outward-facing strategies, and his 3D approach. *Strategic Thinking in 3D* certainly warrants consideration for inclusion in the strategist's tool box.

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