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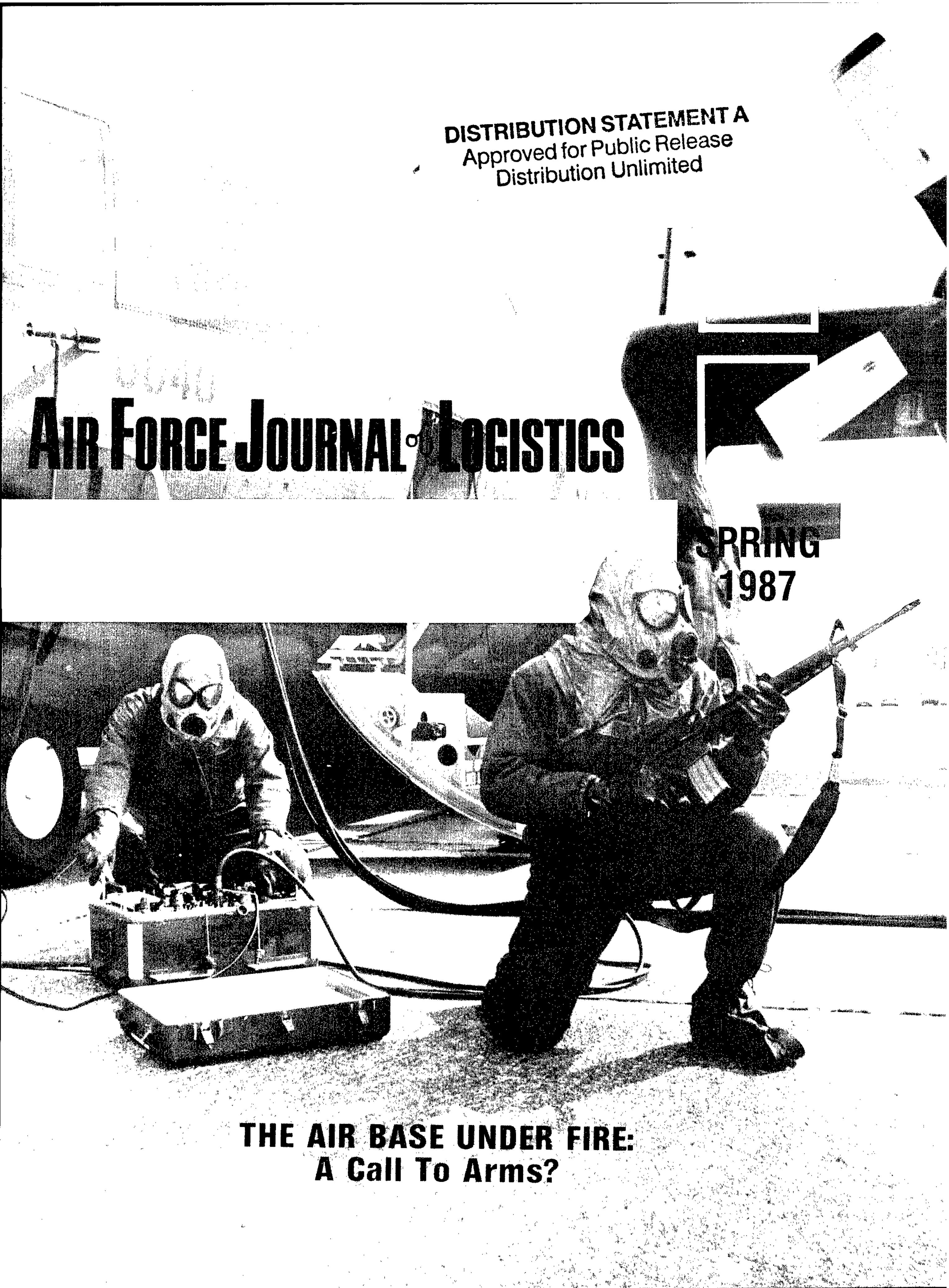

THE AIR BASE UNDER FIRE:
A Call To Arms?

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Cover

Launch aircraft or defend the flight line? MSgt Thrasher Jones, Jr., and TSgt Phil House of the 908th Tactical Airlift Group appear reconciled to doing both. (USAF photo by Robert Martin)

Purpose The *Air Force Journal of Logistics* provides an open forum for the presentation of issues, ideas, research, and information of concern to logisticians who plan, acquire, maintain, supply, transport, and provide supporting engineering and services for military aerospace forces. It is a non-directive, quarterly periodical published under AFR 5-1. Views expressed in the articles are those of the author and do not necessarily represent the established policy of the Department of Defense, the Department of the Air Force, the Air Force Logistics Management Center, or the organization where the author works.

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Logistics Under Fire—A Call for Combat Arms

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"Logisticians need not be combat infantrymen, but an organic combat capability such as that which Red Horse units possess would change our men and women from potential battlefield victims to players—serious factors for an enemy to consider in the calculus of war."

A few years ago, the commander of a bombing range support base briefed his staff on a pending "attack" by an Army special forces unit. The operation was to be conducted at night, on a date of the "enemy's" choice. Base personnel were not to be involved and the staff was told that nobody would even be aware that an operation was underway. The commandos were supposed to slip onto base and place placards reading "DESTROYED" at key locations such as the control tower, communications center, and aviation fuel tanks. There was some joking about raising a "People's Militia" to provide token resistance, but this was brushed aside and more serious matters discussed.

When the Army assault finally came, it was not quite what was promised. The Army team helicoptered onto the base without advising the control tower. They attacked the Security Police office, discharging over 100 blanks in the lobby, which provoked the lone desk officer to draw his weapon. That target neutralized, they struck the base fire department and blasted a half dozen sleeping firemen out of their beds. The mission completed, their helicopter exited the base—flying low over family housing with the door gunner opening fire with blanks—concluding this drama with an act out of *Apocalypse Now*. Regardless of the fact there was not supposed to be any involvement by base personnel, they became unwilling participants. In spite of elaborate rules of engagement the "enemy" drew up, events failed to go off as planned. Rather than hit specific targets, they opted to leave their mark and go for the body count. Just as in war, the unpredictable raised its ugly head.

A 56th Security Police Squadron armored personnel carrier (APC) defends Nahkon Phanom Air Base (NKP), Thailand, in 1972. The base housed 7th AF headquarters elements, which coordinated the 1975 airlift evacuation of Saigon. Do we count on "sanctuaries" such as NKP being available in future conflicts?

What, if any, are the implications for Air Force logisticians? What would have happened if this exercise had occurred not at a small support base but at a major installation? What if it had not been "our" side, but a SPETsNAZ team bent on destructon? Could our officers, NCOs, and airmen have defended themselves, or would they simply have dived for cover? Is this even an issue that we in logistics should consider, confident that the Army and Security Police will provide protection for shops and materiel in wartime? Armed resistance is an issue that needs to be addressed and, while not boosting daily unit productivity, may serve as the ultimate ace in the hole if we are ever called to practice our profession under fire.

Logistics Infantry?

The definition of combat support states that it is the "art and science of creating and sustaining combat capability."[1] How we logisticians transition from a peacetime establishment to a war footing will have an immediate and drastic impact on the execution of an air war in Europe and, ultimately, whether or not the Western Allies can slow or halt a Soviet offensive. Important strides in contingency planning are being made, and new approaches to the execution of our combat support duties are forthcoming. Still, there is always one more area which calls for attention and action. Amidst efforts at procuring new weapon systems, herculean efforts to keep current systems in service, or even the daily grind of clearing in-baskets, the latent combat arms capability of logistics personnel is an esoteric consideration. Yet, if war comes, the ability of logistics formations to function not only as combat support elements, but integral combat units as well, may make the difference in preserving lives and vital equipment or surrendering via default to the unpredictability and lethality of interdiction by Soviet ground forces.

The trauma and friction of war are givens. Confusion, danger, and the demands of a fluid wartime situation call for professional readiness to handle virtually any situation. Logistics personnel must be trained to react to war both as individuals and combat units to prevent degradation of mission capability short of total unit destruction.[2] Combat support should be viable whether conducted from a multimillion dollar complex in England or out of a tent in Germany, 20 miles from the forward line of troops (FLOT). The quality and scope of our daily operations and training pattern should ease the transition to war, not conflict with it. The time to plan, organize, and reorganize is before hostilities start, not when the C-141 lowers its loading ramp. Air Force Manual 2-15, *Combat Support Doctrine,* states our training "must be designed to press the combat support elements to the limits possible in a peacetime environment.[3] We must push ourselves in every aspect and develop the war skills of personnel as a vital part of wartime mission accomplishment.

During the 1944 Ardennes offensive, General George S. Patton came across several troop carriers stalled on an icy grade. A group of officers milled about, unsure of how to get the vehicles started again. To their chagrin, Patton intervened and had the troops dismount and start the trucks rolling again with a hearty shove.[4] Today, a war in Europe will not permit three-star involvement just to get a hundred troops moving. We must remain flexible in executing our duties and in preparing for the literal defense of the support structure from enemy assault. We cannot wait to be told what to do; we must simply be ready to act when the need arises.

Logistics is the key to success in war.[5] Therfore, our support bases, operational sites, and lines of communication are prime targets for interdiction. Tactical air forces do their part in self-defense by countering the threat of enemy air interdiction, yet the fluidity of the Soviet offense may prevent Allied air resources from stopping all enemy ground attacks directed at the support structure. The potential for such interdiction demands action designed to reduce the efficacy of operations by Soviet land forces. We need to establish for maintenance, supply, and transportation, the objective of creating viable defense forces possessing the ability to defend themselves and their shops and resources, and, if needed, the skill to redeploy via improvised means. This capability will deny enemy forces the assurance of battlefield victory simply because the targeted base structure was neutralized or occupied. The element of meaningful resistance, coupled with the ability to redeploy without airlift, would give Soviet commanders something extra to consider before initiating an attack and would give American commanders an extra option once engaged. Logisticians need not be combat infantrymen, but an organic combat capability such as that which Red Horse units possess would change our men and women from potential battlefield victims to players—serious factors for an enemy to consider in the calculus of war.

The European Threat to Logistics

The only assumption one need make about a conventional war in Europe is that "something has gone wrong"—the fog of war will take over from there. Current wartime tasking calls for many combat support personnel to go to full-service support bases while others are deployed to spartan operational sites. Great planning has gone into where these forces will be needed and timetables for their arrival. As more than one office wag has said, some of it may even go off as planned. In a European War there will be no sanctuary for support personnel, no replay of World War II. Air Force doctrine recognizes the need for operating in a variety of ways under diverse operational conditions and combat environments.[6] We should stand ready to do our jobs in the strategic arena, tactical sphere, or hand-to-hand setting.

"Since General Close presented this scenario in the late 1970s, further changes in Soviet organization and tactics have warranted the attention of Air Force logisticians."

A few years ago, General Robert Close, a Belgian Army officer with considerable experience in mobile warfare, and past Director of Studies at the NATO War College in Rome, shocked his contemporaries with publication of his theory that Soviet forces could be West of the Rhine River within 48 hours of the start of an offensive.[7] He saw this made possible through a triad of forces operating ahead of the main body of Warsaw Pact units. It consisted of regular airborne troops, helicopter borne special forces, and fifth column action groups. These advance cadres would strike at the command and control system, weapon storage areas, and combat support facilities.[8] Rapid success through commando action would induce extra momentum in the main Soviet offensive, which would then be able to inflict even greater damage to NATO. Geared toward delivering decisive blows prior to mobilization of NATO reinforcements and reserves, this would, in effect, win the war before NATO Governments could decide upon nuclear first use. Remember, the Soviet objective in a European offensive would not be the destruction of Western Europe, but rather its conquest and occupation. Having bet on the impotence of the nuclear deterrent, they will strive to present NATO with a *fait accompli* and show the futility of the Allies resorting to an atomic exchange, preserving both their homeland and territorial gains. Since General Close presented this scenario in the late 1970s, further changes in Soviet organization and tactics have warranted the attention of Air Force logisticians.

The Soviet Tactical Threat

The ground threat our forces will face crystallizes around the Soviet doctrine of unreinforced attack. These forces will be conventionally armed, but specially organized. When coupled with the potential for mischief by underground terrorist and revolutionary groups, the defenses upon which we rely appear a bit more porous. Soviet doctrine calls for a relentless effort to disrupt or destroy services in rear areas. Since the Allies have determined not to match the Warsaw Pact man-for-man and tank-for-tank, crippling the logistical and technological foundation of our "high tech" forces becomes essential for the Soviets in pursuit of victory. Fifth column cadres and terrorist cells will disrupt lines of communication, while special forces concentrate attacks against high value targets. Finally, operational maneuver groups (OMGs) will exploit breakthroughs in the line of battle and deeply penetrate rear echelons.[9] Operational sanctuary cannot be guaranteed given such determined opposition. What are the defensive forces through which these Warsaw Pact units must pass in order to strike us?

Our defense is constructed in three layers of varying strength. First are United States and host nation regular armed forces. Although these are the most powerful protective element, forces which may be available for defense of our bases will be in great demand elsewhere as Soviet forces penetrate the frontier.[10] Next, the availability of national paramilitary police and border units is of primary concern, since they would have the tactical capability of defending our sites against light attack forces, but would have to spend time performing an internal security mission and committing combat resources to our defense. The fighting characteristics of these light and mobile combat units, while erecting a satisfactory screen against the terrorist and SPETsNAZ threat, simultaneously make them unsuitable for repelling an attack from regular Warsaw Pact forces. The final line of defense for our bases is the air base ground defense (ABGD) forces of the Security Police.

Air base ground defense is not designed to engage main Soviet military forces any more than are national paramilitary units. Weaponry is light—the M-16, M-60, grenade launchers, and light anti-tank weapons. AFR 206-2, *Ground Defense of Main Operating Bases, Installations, and Activities,* prescribes the ABGD mission. Briefly, it is to defeat level I (agent, saboteur, terrorist) and level II (special operations forces) threats, and delay larger level III (battalion) forces until major maneuver force support arrives. However, Security Police capabilities limit what can be defended, and one Security staff officer has said that the objective is to hold out until the last plane gets away. ABGD is very limited in scope and we should take our lead from this and build a combat force suitable for limited defense operations. The first factor of opposition with which this logistics defense force would have to contend is the fifth column danger presented by terrorist cells and Soviet saboteurs.

"Irregular Soviet forces, either fifth columnists or Russian-backed terrorists, may be expected to rise up and challenge the operation of NATO's logistics conduits."

Irregular Soviet forces, either fifth columnists or Russian-backed terrorists, may be expected to rise up and challenge the operation of NATO's logistic conduits. One figure estimated 15-20,000 Soviet agents are active in the Federal Republic of Germany alone,[11] and the number of radical political groups which would willingly support a Soviet campaign is an open question. These forces will use sabotage, bombings, disinformation, and assassination of key officials and commanders in their campaign against the West. In a way, these may be the easiest to defend against, insofar as their ability to penetrate our defensive parameter is concerned, since their firepower will be limited. Allied counterintelligence and anti-terrorist actions may also impede the offensive action of this source. A greater danger lies in the action of Soviet special forces units which will attempt overt penetration of facilities with the intent of maximizing damage and casualties.

Recalling the defeat of Allied forces on the Continent in 1940, Winston Churchill disputed the popular image of it being caused by a sweeping armada of German armor. Churchill said that the defeat was due to advance cadres of special operations troops who neutralized key targets in advance of regular forces. "The defeat of France was caused by an incredibly small number of highly equipped elite, while the dull mass of the German Army came on behind, made good of the conquest and occupied it.[12] Much Soviet tactical development goes back to their examination of German military operations, and this lesson was not lost on them, as witnessed by their creation of SPETsNAZ units, which are truly *special,* special forces.

An aircraft crew chief reports that mounting grenade and sniper fire is shutting down flight line maintenance operations. Should he and his crews be trained to help defend the threatened aircraft and facilities?

SPETsNAZ groups will try to hold few facilities; instead their job will be to neutralize aerospace vehicles and supporting elements. Using deception, surprise, and precisely controlled violence, they will strive to eliminate airframes, command and control systems, and the base logistics structure.[13] Our people must be prepared to defend work areas with little or no expectation of support from any other organizations. Even if there is a viable security force presence after penetration, the flow of the battle may cause SPETsNAZ to hit secondary or tertiary targets, such as supply buildings, petroleum, oil and lubrications (POL) tanks, vehicle yards, and munitions buildup areas. To have logistics personnel truly combat-ready is to place an extra layer of resistance in the path of any enemy and increase the overall defense capability of the base. If Soviet forces have to "pay" for every building or office they pass, we can help dissipate their momentum before they reach their primary target. Do not underestimate the damage that can be caused by a small cadre of trained commandos in a sensitive area.

One incident from the history of special operations illustrates this point. The Belgian fortress of Eban Emael was a significant impediment to the German invasion force in 1940. A mere 71 parachutists and glider troops forced the 700-man garrison to surrender after one day's combat. Their highly innovative and very effective raid opened the road to Liege and moved the fall of Western Europe to Hitler that much further ahead.[14] The Soviets realize that well-trained forces can accomplish tasks beyond the scope of normal small unit combat, and it is our duty to be ready to counter that threat.

Training men and women in combat skills would have great value in opposing SPETsNAZ action; the war skills they learn, however, will be of greater value in preserving the unit as a whole, once confronted with the final land threat to our support forces. This capability would bring combat support directly into harmony with the Clausewitzian principle of defense being a shield of blows to the enemy, since we will strike the enemy even as they attack us.[15]

"The Operational Maneuver Group is the end product of correct Soviet logistical thinking."

We will find our greatest threat, and the most important challenge to our flexibility, in the Soviet OMG. Ironically, the OMG is the end product of correct Soviet logistical thinking. The group is designed to exploit sudden breakthroughs in the static front, carry all its own support materials, and disrupt rear areas.[16] Whereas the most insidious danger may be SPETsNAZ, the presence and firepower of OMGs will be one that can deal decisive blows against operational bases. Although a handful of transporters and suppliers might be able to stand their ground against a terrorist or SPETzNATZ attack, resistance by such a small force to an OMG assault would be injudicious. Edgar Ulsamer, Editor, *Air Force Magazine,* summed up the mission of the OMG as one of conducting mobile warfare in rear areas "designed to isolate NATO's front line, defending forces, disrupt rear area logistics service and resources."[17] This will be no simple reconnaissance in force, but a hard-hitting flying column with staying power. Under the worst circumstances, our forces could nevertheless hope to inflict significant losses upon Soviet forces before retiring from the battle. As unpleasant as it might be, a rear guard action to delay enemy forces and permit the evacuation of essential people and materiel could very well be an option that a besieged commander could need and use.

"There is precedent of recognizing stiff odds, yet preparing to inflict significant damage on enemy forces."

The Soviet OMG will present an almost irresistible force, yet combat readiness for our people will give us an ability to strike back even as we ourselves are being attacked. Considering the dramatic 1941 assault on British airfields on Crete by the German 7th Airborne Division, there is precedent for recognizing stiff odds, yet preparing to inflict significant damage on enemy forces. Crete was a major logistics and defense factor in the structure of British forces in the Near East and North Africa. Though there were many combat personnel in Crete's Imperial garrison, the combat skills of Royal Air Force (RAF) support personnel were nil. The Germans swiftly struck Crete, the first airfield becoming operational for German use three days into the attack.[18] Their use of airborne and glider troops was daring and innovative, but costly. Resistance and reprisal by Imperial troops was so stiff that it broke the back of Germans for further airborne operations and the invasion of Crete was a victory from which they never recovered.[19] Though purely conjecture, if RAF ground personnel had possessed an effective ground-fighting capability at Crete, the tide of the battle may not have turned, but such capability might have delayed the inevitable and allowed withdrawal of more forces from the doomed island. By having just such skills that the RAF lacked in 1941, we too might be able to deny Soviet forces a quick and easy victory.

Unlike resistance to special forces, we should not hold our position. Instead, we should use our combat skills to cause delay, saving ourselves and our war-making capability. Unlike a major breakthrough by conventional forces, the OMG is able to exploit the battle situation *now,* without waiting for supply trains or anti-aircraft guns to catch up. This in turn reduces our own ability to counter their thrust. Rather than allow our forces to be overwhelmed, we should ensure our logistics personnel are able to retain unit identity and resources, and know how to forcibly disengage from the battle at hand. Thus a knowledge of combat skills for logisticians must be coupled with an understanding of what critical materiel should be marshalled and moved to safer confines via available transportation.

Even the collapse of the Western Front in 1940 saw the British maintain control of their retreating forces, meld together composite units, and exploit local conditions and counterattack. This allowed much more time for the bulk of the British Expeditionary Force to gather at Dunkirk for extrication.[20] Artillerymen were mixed with infantry, armored units with service units, and RAF with mechanized infantry. Their objective was to retain some control over personnel and equipment—even though they were involved in a retrograde movement. The same capability to break down, move, and reassemble to prosecute the war should be present in our logistics units. What happens if the aircraft move but the logistics support is lost? The more people and equipment which can be saved, en masse, from imperiled bases, the more rapidly weapon systems can be brought to bear against the enemy. Rather than this being a doctrine of defeat, this is a call for ensuring the ability to continue the war on more favorable terms.

Logistics Combat Training: Square Peg in a Round Hole?

All Air Force personnel are exposed to small arms upon entering the service. For many, this is their only such experience. Some, such as Security Police, receive additional training in a variety of weapons to support security and base defense objectives; still others are trained to satisfy unit mobility requirements. The majority, however, lack anything beyond the most basic skills with a rifle or revolver. As a group, logisticians are probably as qualified as most other career fields. Even those few who have had advanced classes lack individual combat skills training or combat convoy operations exposure. This is unlikely to change since the daily battle over sortie rates, vehicle out-of-commission time, and mission capability (MICAP) requisition requirements preclude such "extravagant" training. Many units find that simply scheduling mobility training and semiannual small arms qualification firing can seriously cut into shop productivity. The ultimate obstacle, though, is probably funding. In an era when congressmen call for reductions in the quantity of live fire munitions used due to cost and theft,[21] there is little possibility of buying an extra million rounds or so of M-60 ammunition just to train logistics infantry! As the ultimate realist/cynic would say, why waste time training for a war that may never come when the director of operations is calling for more sorties *today?* The most effective response, however, is the simple truism that all the effort and money supporting the military in peacetime are wasted unless those forces can effectively operate in combat.

We should be able to deny victory to the Warsaw Pact by not abandoning critical spares and vehicles because of their action. We should train to defend our ground and, if the odds are against us, withdraw as an operating entity to a more secure operational site. This saves lives, keeps aircraft in the air, and raises the nuclear threshold by giving NATO commanders the ability to identify and use combat support units wherever needed in the wake of a reversal. Remember the simple truth that, once the Soviet Union has launched an attack on Western Europe, the initiative will be with them until air, land, and naval superiority are attained. The more able our support forces are to face reversals on the field and still remain a viable component, the less pressure to resort to nuclear arms. After all, a consolidated aircraft maintenance squadron with 65% personnel and 40% equipment would be of greater value to an air commander than a group of stragglers who happened to find their way back to Allied lines. One course of action is by choice and the other by chance, and we owe it to ourselves and the mission to be ready to assume the role of combat leaders. The time for this training cannot easily be found, nor are financial and material resources easily procured. But if taking the time to develop a comprehensive logistics war skill program helps to save one's life or to inflict one more casualty upon enemy forces, then it will have paid for itself.

Logistics Defense: A Starting Place

Training Air Force logisticians in combat skills would be an immense task, requiring significant funding and considerable expertise beyond the scope of our profession. The following might be considered in the development of a Logistics Defense Force (LDF) for wartime use. Approximately 200,000 airmen and NCOs and 7,800 officers in Air Force logistics equate to roughly 13 army divisions, which is a staggering number of people to run through any training program. Even if all other variables cooperate, a 100% combat arms qualification could only be attained over a period of years. The place to start may be in overseas theaters with a high threat factor. Training personnel in combat support organizations with the most immediate need for defense during contingency operations is probably the best solution for this problem. The program could gradually be extended to CONUS installations in general, or perhaps a single LDF training site. Combat expertise goes well beyond the realm of Air Force logistics but, as a minimum LDF, personnel should have combat skills promoting safe and effective weapons use, understanding of defensive positions, and elementary small unit tactics.

> ***"Our objective is not to turn logisticians into combat infantrymen, but some advanced skills will be needed if we are to make effective use of weapons and people."***

The arms areas to be taught should include basic skills with the M-16 rifle and M-60 machine gun, with grenade launcher and light anti-tank weapon training reserved for selected LDF fire team members. Arms qualification should only be a portion of the instructional package, with elementary fire control techniques, demonstrations on improvising defensive positions, and methods of personal defense. Logistics should take the lead in developing procedures for convoy operation, and all functional areas should receive in-house training on what to move and what to destroy if the need arises. All officers and NCOs should receive additional training on their responsibilities in directing LDF operations, such as tactics, establishment of perimeters, posting pickets, and methods of counterattack to reoccupy facilities. As stated earlier, our objective is not to turn logisticians into combat infantrymen, but some advanced skills will be needed if we are to make effective use of weapons and people. Maximum use should be made of both Air Force and Army ground defense instructors and training aids. Eventually, the logistics community should be able to perform this training itself. There are many shapes that the LDF could take, but a flexible defensive force structure would be mandatory—one that would simultaneously allow for accomplishment of defense action but not at the cost of sortie generation.

Operationally, the LDF should be composed of a number of teams, one for providing full-time general security during periods of advanced readiness and another to augment the primary defense team during the attack phase of any operation. A final team would be comprised of logistics experts from all areas and would be directly involved in both emergency launch of aircraft and the mobilization or destruction of key resources. Putting defense in the proper perspective, it should provide the security we need to accomplish our duties in a hostile environment. Conversely, we should not be shackled to it at the expense of first and foremost doing our primary job. Only through a balanced examination of threat assessment and the ability of our people to meet it, then contrasting both of these with the requirements we will face in terms of supporting the air war, can we decide the type and depth of organic defense we need and how we go about achieving it.

Whither Readiness for Combat?

In 1944 the unexpected happened when the Germans launched a winter offensive in the West and the surprise was fatal to men in both combat and support units. General Patton scavenged among anti-aircraft, anti-tank, and service units for infantry, causing many "rear area" troops to be suddenly thrust into fierce combat.[22] In 1950, on the eve of the Korean War, Field Marshal Sir Gerald Templer directed all British Army support members to qualify as infantrymen as a hedge against a sudden reversal in battle. He thought enough of this to send his own household military staff to a firing range to qualify as marksmen.[23] Surprise and deception are recognized facts of war; can we as Air Force logisticians do any less than prepare ourselves or the people in our charge for combat duty since we are no longer a back-of-the-lines service? Radar, the guided missile, and satellite photography render time, distance, and weather as problems for either guided weapons or trained cadres to overcome.

The eminent scholar-soldier, General Sir John Hackett, reminds us that we are not just the practitioners of the mechanical art of strategy and tactics, but we must also be concerned with the mixture of ordinary people in extraordinary circumstances—the pysycology of the human group under extreme stress of combat.[24] If we train to function during war, we must not exclude the ability to lead our people in battle. We should stand ready to keep planes in the air, move cargo on the ground, expedite priority resupply, and guarantee to ourselves and subordinates the capability of self-defense in the field. A

> ***"People must believe they have the ability to influence their own lives and it cannot be a false hope—they must be ready and able to fight."***

major land war in Europe, if it comes, will be unlike any war America has faced. Physical resources must be ready; we must be mentally up to the job and possess the leadership ability to instill confidence and preempt the development of a "we're doomed" attitude which may well arise in the face of an offensive by the numerically superior Warsaw Pact forces. People must believe they have the ability to influence their own lives and it cannot be a false hope—they *must* be ready and able to fight.

The call by Lieutenant General Leo Marquez to evolve intellectually from managers to Logistics Warriors must be carried further.[25] We, as members of the profession of arms who specialize in logistics, must be ready to accomplish our duties amidst impossible combat situations and ensure the survivability of people and resources. We should react to the flow of the battlefield, not become its victim. Only through the survivability of the Air Force logistics system can we guarantee our ability to support and sustain aerospace combat operations fully and be assured of victory.

Notes

[1]Air Force Manual 2-15, *Combat Support Doctrine*, Department of the Air Force: Washington D.C., 15 December 1985, p. 1-1.

[2]Air Force Manual 1-1, *Basic Aerospace Doctrine*, Department of the Air Force: Washington D.C., 16 March 1984, p. 2-9.

[3]Air Force Manual 2-15, p. 3-3.

[4]Blumenson, Martin. *The Patton Papers* 1940-1945 (Boston: Houghton Mifflin Company, 1974), p. 627.

[5]Air Force Manual 1-1, p. 4-9.

[6]Ibid. p. 4-10.

[7]Close, General Robert. *Europe Without Defense?* (New York: Pergammon Press, 1979), p. xiv.

[8]Ibid., p. 184.

[9]Bort, Major Roger E. "Air Assault Brigade: New Element in the Soviet Desant Force Structure," *Military Review*, October 1983, p. 26.

[10]Petraeus, Captain David H. "Light Infantry: Strategic Flexibility and Conventional Deterrence," *Military Review*, December 1984, p. 26.

[11]Close, p. 184.

[12]Churchill, Winston S. *Their Finest Hour* (Boston: Houghton Mifflin Company, 1949), p. 466.

[13]U.S. Department of Defense, *Soviet Military Power* (1986), p. 72.

[14]Close, p. 181.

[15]Clausewitz, Karl von. *On War*, trans. and ed. Michael Howard and Peter Paret (Princeton: Princeton University Press, 1976), p. 357.

[16]Bort, p. 28.

[17]Ulsamer, Edgar. "The Potential Checkmate in Europe," *Air Force Magazine*, November 1986, p. 54.

[18]Churchill, Winston S. *The Grand Alliance* (Boston: Houghton Mifflin Company, 1950), p. 287.

[19]Ibid, p. 302.

[20]Churchill. *Their Finest Hour*, pp. 86-87.

[21]"Senator Urges Fewer Live Shells In Training", *Air Force Times*, 1 December 1986, p. 31.

[22]Blumenson, p. 602.

[23]Cloake, John. *Templer: Tiger of Malaya* (London: Harrap Limited, 1985), p. 185.

[24]Hackett, General Sir John. *The Profession of Arms* (New York: Macmillan Company, 1983), p. 215.

[25]Marquez, Lt General Leo. "The Logistics Warrior," *Air Force Journal of Logistics*, Spring 1986, p. 11.

AFJL UPDATE: Air Base Ground Defense

Air Base Survivability System

A triad now exists in the definition of our combat capability: the weapon system, the combat support system, and the air base system. As identified in a 1981 General Officer Air Base Survivability Broad Area Review, air base survivability is highly dependent on the integration of many functional areas which are best treated as a system.

Since 1981, many management initiatives to treat the air base as a system have begun. An Air Base Operability (ABO) General Office Steering Group was established to provide overall guidance on air base survivability.

The DCS for Plans and Operations established a central ABO management office (AF/XOORB) in the Pentagon to manage all Air Force ABO planning efforts. Air Force Systems Command's Armament Division is developing analytical tools to help integrate the many and varied ABO elements.

The first air base survivability demonstration, Salty Demo, conducted in 1985, realistically exercised these integrated ABO elements (existing capabilities and new technologies) and an air base's capability to survive and recover from attack. An ABO Implementation Plan resulted from this intensive demonstration and is the first Air Force document to direct a comprehensive approach to planning for air base operability.

All these actions culminated in the recent publication of Air Force Regulation 360-1, *Air Base Operability*. This regulation institutionalizes and integrates the air base survivability planning process for the various ABO functional areas including C^3, medical, transportation, fuel operations, civil engineering, and Explosive Ordnance Disposal.

It establishes an ABO Division, an ABO Steering Group, and an ABO Working Group at each base. These organizations will involve all functional areas in the planning for the base's wartime ABO mission.

This planning will require the development of a Base Capability Acquisition Plan which will define the base's survivability objectives, goals, and time-phased actions required to support MAJCOM readiness requirements.

To assist the base in this planning, every wing has a video tape produced by AF/XOORB on "operational insights" (lessons learned from Salty Demo). Most importantly, the bases' Acquisition Plans will assist the MAJCOMs in generating their need statements and funding requirements for the POM submittals through which long-term air base survivability improvements can be programmed.

For questions concerning Air Base Operability or AFR 360-1, contact your local ABO Division Chief or AF/XOORB at AUTOVON 225-3201.

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Army/Air Force ABGD Agreement

The latest step in the air base defense Army/Air Force joint force development process was publication in July 1986 of Army PAM 525-14/Air Force PAM 206-4, the Joint Operational Concept (JOC) for Air Base Ground Defense (ABGD). It describes actions required by Army and Air Force elements to plan and execute the joint defense of an air base. These procedures will be used in conducting joint contingency planning, training, and exercises.

> ***"The JOC first recognizes that aircraft sortie generation is integral to the success of the air-land battle."***

A Memorandum of Agreement dated May 1984 was the kick-off in the joint development process, which committed the Army and the Air Force to concentrating on the basic missions for which each service is organized, trained, and equipped. In June 1985, the Joint Service Agreement for Air Base Ground Defense formalized responsibility of the Army for *external* ABGD; recognized the importance of host nation support; and rededicated the Army and Air Force to a joint program.

The joint operational concept focuses on operations to defend air bases from attack by enemy ground forces. The JOC first recognizes that aircraft sortie generation is integral to the success of the air-land battle. It states that the enemy will devote a high degree of effort to disruption of sortie generation. The concept provides an unclassified overview of the threat, which is divided into three threat levels for the planning process.

The concept provides the guidance to integrate the Army's responsibility for the rear battle and the *air base commander's* responsibility to provide for local defense. To satisfy these requirements, the concept tasks the Army to provision the forces under the operational control of the base.

If the host nation retains responsibility for the rear battle, then external defense of the base can be provided by host nation forces. Additional flexibility is provided in that the Air Force may employ external safeguards to provide early warning and detection of, and reaction to, enemy threats.

The JOC describes the internal defense conducted in the close defense area under the chief of security police as the *air base ground defense force commander,* and then details the external defense. Centralized tactical planning and control of the rear battle are provided by the Army's rear area operational center.

Where host nation forces are not available, Army military police will conduct external ABGD. Doctrinally, the MPs perform the area security mission in the rear area and will be the most available for ABGD.

> ***"The concept states these forces must be in place before the threat forces arrive."***

Once it is decided the MPs are needed for external defense at a base, they are provided to that base under the base's operational control. The chief of security police, as the ground force commander, exercises operational control for the base. The concept states these forces must be in place before the threat forces arrive.

The base defense operations center will coordinate directly with the rear area operations center. This is critical since bases do not exist in the rear area in isolation. All assets available are integrated to enhance the security rear of area bases.

The exception to these procedures comes with the most dangerous threat, the level III (regular forces) threat. As soon as possible, a tactical combat force will be employed to destroy this threat. The tactical combat force commander will need all the combat power possible, so external ABGD forces may be transferred to the operational control of the tactical combat force commander. Once the threat has diminished, external forces will then return to the operational control of the base.

> ***"The Army theater commander knows how important air power is to the air-land battle."***

The Army has begun the process of raising, organizing, and equipping MP units to do this mission. This will take time. Air Force assistance in setting priorities for this mission is essential. Just as important, the Army is teaching throughout its school system, and in its literature on doctrine, that external ABGD is an Army mission.

This is the telling point in the long run, as ABGD becomes a fact of life in Army planning and programming. Air Force people must be equally educated about ABGD and the part it plays in the rear battle. Coordination is the key.

The Army theater commander knows how important air power is to the air-land battle. A knowledgeable translation of what that means in ABGD terms within the rear battle context will ensure coordinated plans and necessary resources are available to defend air bases.

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Attack on Ouadi Doum Air Base—Sign of the Future?

"In a ditch beside the former office of the base commander, the bodies of five Libyans in bronze-colored aircraft mechanics' overalls lie topsy-turvy, as though flung there. . . . Twisted, blackened aircraft lie beside the runway. But seven Albatross L-39 fighter-bombers are lined up undamaged, near an Mi-24 Hind armored attack helicopter in working order. . . . Surrounding the base were batteries of new 20-foot long SAM-6 missiles, also undamaged." (Michael Goldsmith, Associated Press, 13 April 1987)

" 'I had to surrender. It was all over,' said the soldier who was now a prisoner, recounting how he survived a lightning assault by Chadian troops on March 22 (1987) that claimed many of his comrade's lives and shattered Libya's military presence. . . . Equipped with a 12,500-foot runway made

from interlocking aluminum plates, Ouadi Doum was the linchpin of Muammer Gaddafi's efforts to control Chad . . . (and) served as a crucially important base for Libyan combat aircraft, a command Center, and a logistical crossroads.

"Unlike the Chad Army's makeshift encampments beneath clusters of trees across the desert, Quadi Doum boasted an irrigated market garden, water coolers, a football field, and even cows to meet the taste for milk of (its commander). . . . 'The battle was very rapid. We gave the enemy no time to do anything at all,' the Chadian Commander told reporters. Only hours before the base fell, one Libyan officer . . . drafted a memo to the base commander detailing the fighting capability of his troops." (Andrew Higgins, Reuter News Service, 13 April 1987)

Civil Engineering Combat Support: Are We Ready? Have We Learned?

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This year marks a milestone of sorts in the relatively short but rich history of Air Force Civil Engineering. The National Security Act which created the Air Force in 1947 also marked the beginning of Air Force Civil Engineering. In the 40 years since, civil engineers have met every challenge. Initially, the job meant scraping together airfields in Korea for a war that literally appeared overnight. Later, it developed into creating a basing infrastructure to support the massive infusion of troops into Southeast Asia. Now, civil engineering is meeting civic action, contingency support, and disaster relief needs around the globe. In retrospect, each of these achievements occurred in relative obscurity from the day-to-day mission of maintaining Air Force facilities worldwide. Consequently, Air Force civil engineers can reflect on this fortieth anniversary with a strong sense of pride in a history built on a wide variety of achievements.

Civil engineering has met this constant challenge through able leadership and clear vision. In the 1960s, Brigadier General Tom Meredith's Prime BEEF (Base Engineer Emergency Force) and RED HORSE (Rapid Engineer Deployable, Heavy Operational Repair Squadron, Engineer) concepts, which appeared revolutionary but were in fact evolutionary, were responses to valid contingency and force projection needs around the world. During the 1970s, Major General Robert C. Thompson integrated "services" into the engineering career area, which proved to be a real boost to Air Force people sorely in need of quality of life improvements.

As we move through the 1980s, our sights are now set on the twenty-first century and the challenges will be tougher than ever. Much has been said about the direction in which support forces are headed. Also, there is a call from senior leadership to revitalize a "warrior" ethic and to focus on sustaining fighting forces in what is commonly termed "a-come-as-you-are" war. Major General George E. Ellis, the current Director of Engineering and Services, HQ USAF, is meeting that call by directing Engineering and Services personnel to their vital combat support role and true purpose—warfighting. (5:7) This is the challenge of our next 40 years.

Fundamentally as a superpower, the United States (US) faces the full spectrum of potential conflict. This spectrum could include theater nuclear war in Europe, conventional warfare in the Middle East, or low-intensity conflict in Central America. Each threat is real, and each demands a dramatically different response.

The Trinity of War

The US learned vividly in Vietnam that fighting a war is much more than just arriving on the battlefield. In the classic book, *On War*, Clausewitz declares that war's dominant tendencies create a "remarkable trinity," composed of violence and passion; uncertainty, chance, and probability; and political purpose and effect. (8:89) Therefore, our first task for the next 40 years is to learn of war and deal with it intellectually.

This trinity of war can be viewed as a scale of justice delicately balanced by three supports. Each support represents one element of the trinity. Violence and passion are the people, with their emotion and commitment. Uncertainty, chance, and probability are key factors to military professionals because they represent creative challenge to the warfighter. Clausewitz believes the fog and friction of war (the notion that war is totally unpredictable and full of the unexpected), when countered by the creative genius of the commander, are the decisive elements. Political purpose and effect, the third support, incorporate his overriding theme that war is always a continuation of politics by other means. In short, war is an element of subordination, an instrument of policy. Only when there is strength at each support will the scale be effective.

So it is with modern war; it will always be tempered by influences over which the military has little or no control. The true nature of warfighting is influenced in exactly the same way as combat support—by conditions that are inherent in the broad nature of warfighting.

In order to limit those influences, or at least to narrow their intolerances, civil engineers now direct their attention to warfighting, doing so in an environment which is highly complex and where military effectiveness is often camouflaged and difficult to quantify. To complicate matters, the physical nature of tomorrow's battlefield will further add an interesting degree of complexity to this challenge.

> ***"The idea that weapons platforms will eventually become self-sufficient is not beyond belief."***

For example, weapon systems are slowly being drawn away from their support complexes. As fixed sites become increasingly vulnerable to standoff weapons, chemical and biological warfare, and space systems, the aircraft themselves are equally as vulnerable. It is therefore inevitable that theater warfare will move toward more dispersed operations. Weapon systems now also offer much greater lethality. *Project Forecast II* offers insights into how advanced technologies might further revolutionize warfighting. The idea that weapons platforms will eventually become self-sufficient is not beyond belief and fits many future support models. How does this affect our warfighting engineers?

Even before dealing with more revolutionary concepts, civil engineers must first integrate their combat support role into successful space operations. Launch complexes, space stations, and lunar facilities all require specialized technology and expertise, even though the idea of conflict from and within space remains novel to many. It is no clearer at this point how space might affect combat support engineers.

With this maze of complexity, is it even wise to anticipate how the next war will be fought? General Ellis said:

> . . . a nuclear exchange, at least a strategic nuclear exchange, is a bankrupt international strategy and an unacceptable political option for us or our nuclear armed enemies. If one accepts this conclusion, then conventional war and low-intensity conflict are the international political instruments with which we will have to deal successfully . . . . (5:8)

Does such a prediction help or hinder planners?

One proven method of dealing with the uncertainty of the future is through history. In every previous war, great leaders have looked back to measure success before moving forward. Liddell Hart spent a lifetime assessing and appraising history, MacArthur did the same prior to Inchon, and Eisenhower looked back before jumping off in World War II. Civil engineers can also benefit from a look back to gain a sense of where they are headed.

Measuring Effectiveness

It is also important as we build this model to grasp what really constitutes military effectiveness. This is certainly true when looking in a combat support context, where the troops seldom train in a true warfighting medium and almost never have a true battlefield environment. How then does one measure combat support effectiveness under these circumstances?

Sam Sarkesian has long studied military effectiveness and its relationship to combat. In one of his most recent works, he states that "however difficult to define and measure, military effectiveness can only be obtained through control of an increasingly complex system of people, machines, organizational structure and operational doctrine. Effectiveness therefore depends on how well the overall system is integrated." (10:36)

For civil engineers, then, it may be that success in combat support roles can be measured through an equation which contains each of these factors—people, machines, organizational structure, and operational doctrine—as variables. In addition, using history as the baseline is an excellent means to look ahead on the basis of past measurements. Thus, in this way, civil engineers do have a method of responding to General Ellis' challenge.

People

Sarkesian's first variable is people. Civil engineering people have always been on the hot seat. Success has not come easily as evidenced in Korea and Vietnam where the lack of adequate training severely impacted combat support efforts.

For example, a number of serious problems characterized the Korean conflict. The most significant one was that the US had demobilized much of its fighting force after World War II. There simply were not enough engineers, let alone experienced engineers, in 1947 when the Air Force became a separate service and professed self-sufficiency. The transfer agreement calling for Army support left many problems for civil engineering such as no centralized control, no training concept for personnel, and very clumsy operational procedures. Even worse, the Army often assigned personnel with little or no engineering background to the Engineering Aviation Brigades that were tasked to support airfield operations during the transition years. Compounding this people problem was another one arising from a total lack of intelligence regarding airfield soil conditions and aircraft operating characteristics. General Hoyt Vandenberg called the entire effort a "shoestring Air Force . . . hardly in a condition to wage war in the summer of 1950." (7:116-124)

Again, when civil engineers were thrust into Vietnam, they encountered roles and missions for which they were not prepared. The sheer magnitude of the job at hand, which varied from rehabilitating old French and Japanese airfields to constructing facilities like Tuy Hoa, was overwhelming. Many assigned personnel had little real experience in the trades because of previous subordination to civilian master tradesmen. There were serious shortages of experienced supervisors. Additionally, many of the problems faced by engineers were ones they had not encountered in the US such as major supply delays, severe deficiencies with power distribution systems, and unending water contamination. (7:205-215)

From these early experiences, a technically competent civil engineering contingency force evolved, characterized by enthusiasm, commitment, and esprit de corps. It had become clear very early that the Army could not meet Air Force construction needs as they had been chartered to do. It was becoming even clearer that they were not able to set priorities for Air Force construction because of what appeared to many air observers a half-hearted response to contingencies in Lebanon in 1958 and Berlin in 1961. Air Force civil engineers, as they took control, quickly learned the meaning of flexibility, innovation, self-sufficiency, and resolve. It is a lesson that made an indelible mark on the collective memory of Air Force Civil Engineering.

A Prime BEEF concept of small teams was developed to provide minimum numbers of civil engineering people specifically trained for combat support. Training, career progression, experienced supervision, and mobility were to be key ingredients in the emerging career field.

"Prime BEEF and RED HORSE established a warfighting mindset, an ethic for civil engineering people that remains today."

As the Vietnam War intensified, these small Prime BEEF teams, relying on personal tools and in-country resources, could not cope with the rapidly escalating conflict. RED HORSE Squadrons were devised in 1965. These 400-person self-contained units carried their own heavy equipment and supplies, but more importantly their own identity. Teams included medical, food service, vehicle maintenance, and supply personnel to ensure operational self-sufficiency and guarantee effectiveness.

In retrospect it is easy to concentrate on the sheer magnitude of the many accomplishments of civil engineering contingency teams over the years. Historical documents do that in great detail—numbers of shelters, square yards of earthwork, and volumes of horizontal and vertical construction. However, quantification misses the enduring, intangible qualities that emerged. Prime BEEF and RED HORSE were the basis for identity, commitment, and tradition in combat support operations. They alone established a warfighting mindset, an ethic for civil engineering people that remains today.

Current research proves this. An Air Command and Staff College student performed a research study in 1986 that compared the potential for combat effectiveness of Air Force civil engineers to other support forces. Based on four key components—cohesion, leadership, morale, and willingness to fight—the study revealed that civil engineers were more psychologically prepared for combat. The author stated that civil engineering personnel "have significantly more confidence in their combat abilities than fellow support personnel." (9:34)

Machines

Sarkesian's second factor is termed "machines." For the pilot or infantryman, the word "machine" has a clear meaning. It is the medium through which warfighting takes place. Very simply, the pilot flies an airplane and the soldier uses a rifle. But what does the civil engineer use? The best analogy seems to be the airfield or, more specifically, the runway. Certainly, a civil engineer's ability to sustain combat operations is vividly represented by an operational runway.

"Runway construction or upkeep may well become one of the world's most dangerous occupations."

Many Air Force personnel have grown accustomed to repairing runways in a rather benign and uncluttered environment; air bases have frequently been seen as sanctuaries. Even in Vietnam, civil engineers worked in relative safety. But those days are over and the collective mindset needs to change. Runway construction or upkeep may well become one of the world's most dangerous occupations as it was earlier in the Pacific campaigns of 1942-1943.

General Ellis talks of conventional war and low-intensity conflict as the most likely scenario for future operations. Assuredly, the possible futures we foresee require planning for every possibility; but let us assume the war we plan for most, a conflict in Central Europe, is the one we fight. A prolific writer of defense issues, Stephen Cimbala postulates that conventional and theater operations are complementary in Soviet doctrine and are clearly aimed at disrupting the enemy's mindset.

"If we engineers are planning on deep sanctuaries in this war, we are dead wrong."

Cimbala states that Soviet operations would include the classical blitzkrieg elements of "surprise, disruption of the opponent's game plan, confusing his command and communications and striking deep while maintaining a high tempo of operations." Vital elements will include "airborne and heliborne forces, spetsnaz units, [and] raiding detachments. . . ." (3:73-4) Get the message? If we engineers are planning on deep sanctuaries in this war, we are dead wrong.

Airfield survivability, therefore, is receiving much attention. The Air Force took a significant step forward when it conducted a major air base survivability exercise at Spangdahlem Air Base, West Germany, in May 1985. Termed SALTY DEMO, it was the first attempt to simulate a fully integrated, high-tempo battle scenario that measured survivability and combat regeneration after attack.[1]

Civil engineers learned some valuable things. Rapid runway repair received considerable attention. Several quick-fix methods showed promise as interim repair concepts in lieu of the usual AM-2 matting. Enhanced spall repair, night-time portable lighting, and mobile arresting barrier concepts all emerged and will significantly enhance recovery after attack in the intense scenario that Cimbala depicts.

But an old nemesis, the lack of wartime training, also emerged again. "The repair crews, their supervisors and the managers had not experienced and were not adequately trained for a crater repair effort of the scope of SALTY DEMO." As a result, operational sorties were severely reduced.

This resulted in a major exercise recommendation that *all* combat support forces focus on and train in the same intense environment in which they can expect to fight. It specifically recommended overseas and CONUS training sites "away from the peacetime artificialities of home bases," which is what civil engineers have done for years.

Organization

SALTY DEMO also offered insight into the third effectiveness factor, the organizational structure itself. Simply put, organizational structures provide the basic framework for effective force employment during the heat of combat. It only makes good sense that under pressure, the troops will do best the things that come instinctively. That is why civil engineers train and train and train.

Civil engineers are one step ahead in their combat orientation by the very nature of the Prime BEEF program. The structure has been dynamic with three major revisions since 1975. The latest improvement seeks to meet and adjust to evolving technology and ever-changing planning guidance and project recovery concepts into the early 1990s.[2] The many SALTY DEMO lessons learned are included. A subtle but poignant sign of the times is renaming Prime BEEF forces as "combat support" teams.

"Combat support forces have never been organized with an integrated focus on warfighting."

The latest conceptual thrust has resulted in greater emphasis on base recovery *after* attack. The reality that air bases will not be sanctuaries is finally emerging. Further, the conviction that civil engineering forces are a critical link in keeping operational air forces flying comes out loud and clear. It also recognizes the intensity of warfare which will exist on the modern battlefield. And, civil engineers are told to expect the unexpected, to be prepared to deny the enemy access to critical base facilities, and to anticipate operations in an environment laden with unexploded ordnance and chemical munitions.

Civil engineering has, in fact, faced up to the reality of modern warfare.

But can the same be said for the rest of the Air Force? Combat support forces have never been organized with an integrated focus on warfighting. General Ellis said it well:

> There are serious functional and organizational disconnects. The combat support group as a deployable combat support element is mythology. Key combat support elements do not report in peacetime to the . . . commander nor do they practice deploying and employing as a combat support task force. . . . Base communications, ground transportation, and combat medicine are not [even] organizational parts of the combat support structure. (5:9)

SALTY DEMO vividly demonstrated the lack of cohesion that results when activities do not practice and train in an integrated format. A strong case can be made that if the Air Force truly expects air bases to survive in wartime, it must structure itself accordingly in peacetime. The time has come for a champion at the Air Staff to worry about combat support top to bottom.

Doctrine

In the intensity of conflict, effective performance is highly dependent on sound operational doctrine, the final variable. Much has recently been written criticizing the lack of useful doctrine in the Air Force. This is certainly true of logistics and civil engineering.

AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force,* is the basic starting point. It provides fundamental beliefs and principles that every Air Force member should understand. It offers only the most essential elements of logistics which pertain to warfighting; e.g., do it simply, sustain it over the long haul, and be flexible. AFM 1-1 therefore and rightfully so remains abstract enough to encompass all forces in its theory.

The recent publication of AFM 1-10 (formerly AFM 2-15), *Combat Support Doctrine,* is a milestone document because it focuses all support elements on warfighting. The onus is now on each organization to develop meaningful and useful supporting doctrine that will integrate its forces in concert with this theory and reduce the level of abstraction.

This begets a crucial issue for civil engineers. Historically, engineers have a poor record in the maintenance of accurate and meaningful documentation. In fact, engineers are not often great writers and few, when good, have the patience to do an effective job. Those engaged in Southeast Asia argued that they had little enough time to plan for the next day, let alone reflect on past ones.

On the other hand, our warfighting experience is quickly evaporating. One major war and a few contingencies over a 25-year period offer a limited window of experience on which to build. In that respect civil engineers missed countless opportunities by not turning to the other services, other wars, and even our adversaries for historical experiences that might provide useful models. For example, much tactical air perspective has been gained from past Arab-Israeli wars; it follows then that there might be fruitful engineering and other combat support lessons worth learning as well. In addition, not many civil engineers have studied in detail Soviet and Warsaw Pact engineering practices in order to better counter our enemies during wartime. For civil engineers to synthesize war and reduce abstraction, we must give more attention to past events.

Meeting the Challenge

Thus, several challenges need to be met, and it is fair to say that civil engineers have a way to go in meeting them. But a start has been made. Over the past few years, several civil engineering officers attending service schools have seized the initiative and documented the evolution and warfighting experiences of their career field. The major studies have been sent to the field.

Recognizing the importance of momentum in this effort, General Ellis recently approved "Project Foundation," a significant initiative to develop and institutionalize doctrine within Engineering and Services. This project will take several years to accomplish, but in the long run civil engineers are heeding the eloquent words of General Curtis E. LeMay who said that "doctrine is of the mind, a network of faith and knowledge reinforced by experience which lays the pattern for the utilization of man, equipment, and tactics. . . . It is fundamental to sound strategy." (2:i) Those words from a great warrior offer encouragement to those civil engineers who are becoming serious about doctrine.

Under the influence then of Professor Sarkesian's views on effectiveness as a model, civil engineers are in fact preparing for the challenges they face. The road ahead may be long and difficult and, granted, there is still plenty of work to do, but a foundation indeed has been set.

But even with the confidence of a solid warfighting machine, we are reminded of Clausewitz' remarkable trinity and the complex nature of warfighting. The notion of the three interrelated elements makes the decision to fight a delicate one at best. But once that decision is made, the overarching element leading to success on the battlefield is innovative and decisive leadership. Clausewitz calls it "the genius of the commander." It is the individual who must take these variables; understand, synthesize, and apply them in precisely the correct formula; and bear the responsibility to win battles and, ultimately, wars.

"The idea that this is a 'one mistake' Air Force must be eradicated immediately."

To train engineers for that role, the service must demand innovation, creativity, and flexibility—a point that is particularly important today because there is an idea among many junior people, those who will lead in tomorrow's conflicts, that this is a "one mistake" Air Force, an unforgiving service that stifles innovation. Many junior officers think that, if they step out and make but a single mistake, they will be "burned" and their careers will be ruined. How this perception evolved is unclear, but it must be eradicated immediately. Our young people are the key to future success on the battlefield. They need to be encouraged, not stymied, in their leadership role.

Civil engineers are clearly pointed in the right direction to meet the major challenges ahead. They are also well qualified to lead the entire combat support community in this undertaking. With leaders who are willing to be innovative, to step forward and take the throttle, civil engineering will not only sustain the legacy of the first 40 years, but create the vision to lead the way of the foreseeable future.

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Combat Support Doctrine: Coming Down to Earth

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IRA C. EAKER SECOND-PRIZE ESSAY

The United States Air Force has historically had its corporate "head in the clouds" when it comes to debating the great doctrinal issues of aerospace power. Until recently, this preoccupation with the aerospace medium and the employment of forces within this medium was both natural and proper. However, the Air Force has reached a critical juncture in its relatively brief existence. In the past, aerospace forces have always been able to exploit the characteristics of speed, range, and flexibility to a degree far greater than any surface force.[1] The capacity to maneuver freely in three dimensions has permitted the Air Force to put an enemy's political, economic, and military resources at risk. Today, however, the Air Force is in the process of forfeiting its flexibility. Moreover, this forfeiture can be traced to an unbalanced doctrine that gives inadequate emphasis to those earthbound activities which create and sustain aerospace power.

"Current doctrine expresses a 'post-launch mentality,' assuming away logistics, focusing on activities that begin at 20,000 feet/Mach 1."

Currently, Air Force doctrine is almost exclusively employment oriented.[2] It expresses a "post-launch mentality," and largely assumes away logistics, focusing instead on those activities that begin at 20,000 feet at Mach 1. Furthermore, joint or combined logistics doctrine is virtually nonexistent despite the reality that most logistics functions require multi-Service and allied participation.[3]

To fill this doctrinal vacuum, the Air Force has recently published a manual that offers the commander a basis to begin thinking about war preparation as a coherent, comprehensive process. The new Air Force Manual 1-10, *Combat Support Doctrine,* describes those fundamental support tasks that must precede the employment of aerospace forces. In essence, this manual prescribes an exhaustive process to create and sustain aerospace forces by defining, acquiring, maturing, distributing, integrating, preserving, restoring, and disposing combat capability.[4] Familiarity with this support process gives the commander an understanding of the pervasive and crucial nature of logistics in warfare. However, logistics cannot effectively support combat operations without a definitive joint or Service doctrine to point the way. Therefore, with AFM 1-10 as a guide, this article describes the iterative, step-by-step process needed to prepare for combat. In so doing, it raises broad issues with regard to the organizational and functional effectiveness of the Department of Defense.

Defining Combat Capability

The Roman historian Vegetius wrote: "If one wants peace, one should prepare for war."[5] The first step in preparation is to provide a clear definition of combat capability: what it is and how to measure it. Although the *Dictionary of Military and Associated Terms* describes *military capability* in terms of *readiness, sustainability, force structure,* and *modernization,* these terms lack specificity.[6] Nonetheless, the Department of the Air Force, like all the Services, expends considerable energy pursuing military capability via the Planning, Programming and Budgeting System (PPBS). Senator Barry Goldwater has even claimed that ". . . more time is spent preparing plans for the next budget than for the next war."[7]

Other critics contend that programming and budgeting dictate military strategy rather than the reverse. As a consequence, strategy evolves through ". . . a piecemeal, irregular, highly informal process driven by cumulative program decisions influenced more by budget constraints . . ." than by deliberate war planning."[8] The PPBS process seems to facilitate the Services' proclivity to buy new, exotic weapons platforms rather than less glamorous items like support equipment and spare parts—those support items critical to readiness and sustainability. This imbalance in combat capability can be partially explained by the dominance of the Services in logistics activities and their inclination for "equipping" their forces in preference to "organizing" and "training" them.[9] Moreover, the unified and specified commanders have only a limited influence in logistical matters despite their responsibility to deploy and employ military force.[10] These warfighting commanders lack significant programmatic authority which helps perpetuate the imbalance between modernization and force structure on the one hand, and readiness and sustainability on the other.

"The Maginot Line had no significant cost or schedule overruns during construction, but neither did it deter nor stop the Nazis.

Furthermore, a military program's success is often erroneously measured by inputs such as costs, schedules, manpower, and equipment. Although these items are quantifiable, military capability is often determined by those predominately qualitative outputs such as leadership, cohesion, discipline, and courage. In short, combat effectiveness cannot be ascertained by numbers alone. As Edward Luttwak has argued, the infamous Maginot Line of World War II had no significant cost or schedule overruns during construction, but neither did it deter nor stop the Nazis in their blitzkrieg through Europe.[11]

While efficiency is important in establishing public trust, the Air Force cannot become distracted by alleged fraud, waste, and abuse issues—$7,000 coffee pots and $9,000

(This article was selected by the *Air University Review* as first runner-up in the 1986 Ira C. Eaker Essay Competition.)

wrenches.[12] The problems of inefficiency are endemic to the entire federal bureaucracy and the way it does business. For example, in Fiscal Year 1985, the Congress and the Executive Branch "stretched out" the development and production schedules of 22 weapon programs, thereby multiplying the costs of these programs by $3 billion without any increase in combat capability.[13] Clearly, the Air Force and other Services need a doctrine that gives definition to the concept of *military capability* and offers guidance on how to achieve a balanced plan for creating a modern force structure that is both ready and sustainable.

Acquiring Combat Capability

Once the Air Force defines combat capability, the second step is to obtain that capability: acquire people, materiel, facilities, and information, and transform them into weapon systems. However, this task is becoming more difficult as the United States changes from an "industrial" society to a "services" society. To demonstrate this fact, the number of aircraft spare parts produced by foreign sources rose from 13% in 1980 to 25% in 1984. Moreover, 50% to 65% of all new weapon systems are comprised of subcontractor parts. For illustrative purposes, the F-15 fighter can be thought of as 75,000 component parts flying in close formation. These components are produced by 300 major contractors and thousands of vendors. To add one additional F-15 aircraft to the current production schedule would take 39 months because of the nonavailability of component parts.[14] Furthermore, this inability of the manufacturing base to increase production significantly is not confined to fighter aircraft. The aerospace industry cannot even triple its productive output within a year for transport aircraft, helicopters, or aircraft engines. Most alarming is industry's incapacity to surge or sustain tactical missile production.[15] So, without industrial mobilization, the next war will be a "come-as-you-are" affair, like it or not.

"The doctrinal principle of simplicity is as relevant to weapons acquisitions as it is to employment operations."

Not only is American industry losing its manufacturing capacity, but aerospace systems have become increasingly complex. These sophisticated aerospace systems, according to a senior defense analyst, Franklin Spinney, exhibit low combat readiness because of reliability and maintainability deficiencies. Increased complexity exacerbates combat vulnerability due to the dependence on a large logistics support structure. This support structure, in turn, undermines the efficiency of plans and degrades warfighting skills by fostering inadequate and unrealistic training. Moreover, Spinney contends that complexity increases susceptibility to the frictions of war and slows modernization by lengthening development and procurement lead time. Finally, weapons complexity escalates costs, thus reducing overall force structure and the stockpile of sustaining supplies. All these facts add up to diminished combat capability.[16]

As one Israeli general observed: "U.S. weapons are designed by engineers for engineers whereas Soviet weapons are designed for the combat soldier."[17] More precisely, the doctrinal principle of simplicity is as relevant to weapons acquisition as it is to employment operations. Logistics doctrine must stress simplicity on the flight line, in the port, at the depot, and in the factory. Engineers must be indoctrinated so they do not design an aerospace vehicle. Instead, they must design an aerospace *system*. Their specific objective should be to reduce the people, materiel, facilities, and information needed to employ a vehicle in war.

Maturing Combat Capability

When the acquisition process is complete, the next step is to refine the aerospace system. This refinement may lead to equipment modifications or operational and logistics procedural changes. However, for a system to reach full maturity, people must be trained and educated to employ the system at the tactical, operational, or strategic level. For war is essentially a human activity—a contest of wills between intellectual and emotional creatures. It is not a battle of machines. The commander must ultimately destroy the will, mind, or body of the enemy to prevail in combat.

In contrast, most Air Force people today are technicians or managers rather than warriors. Their experience has been confined to a single Service, usually at the base or unit level. Very few officers and noncommissioned officers have had joint or combined assignments. Logisticians, in particular, have normally been associated with producer (wholesale) logistics or consumer (retail) logistics, but not both. Yet more damning is defense critic Jeffrey Record's accusation that the distinguishing characteristic of the American military is a singular lack of interest in the art of war.[18]

Certainly, the purported lack of interest for the logistician can be directly attributed to a peacetime environment that does not foster a warfighting mentality. To begin with, the paucity of information on combat logistics is evident when surveying any military library or school curriculum. Commanders have rarely documented their logistics activities in their preparation for or conduct of warfare.[19] Moreover, realistic logistics training is marginal at best. Most joint and Service exercises begin after deployment and end well before sustainment becomes an operational constraint. The magnitude and complexity of a major force deployment or sustainment have not been rigorously tested in either a field training exercise (FTX) or command post exercise (CPX). The reasons for these deficiencies are understandable but should not be tolerated. In essence, the unannounced FTX, involving a major force, would be cost-prohibitive and the CPX lacks the interactive computer simulations that can replicate realistic logistics phenomena. The real danger of these training inadequacies is that commanders do not fully appreciate the impact of logistics on operations. And, logisticians will be unable to assist the commander because they have not been educated to handle the enormous detail of a major operation at the theater and global level.

Distributing Combat Capability

Once aerospace systems are ready for combat, they must be properly positioned so they can deter or engage the enemy. As a global power, the United States has to distribute its forces worldwide and into space. This requirement presents a monumental task when aerospace operations must be sustained over extended lines of communication. For example, in a

Southwest Asian conflict, resources will be moved 12,000 miles from origin to destination. The distribution of people, materiel, and information between and within theaters demands extraordinary coordination between the Services, unified commands, transportation operating agencies, and host nation. In addition, the preponderance of materiel (95% by weight) will travel by surface modes—ships, trucks, trains, and pipeline. Airlift will primarily be used to move people and time-critical supplies, but is not an effective carrier of fuel and munitions, the two classes of supply which are most needed in warfighting. Moreover, the opportunity for things to go wrong abound; resources can and will be lost, destroyed, damaged, spoiled, and misrouted. Therefore, information is crucial to controlling the distribution process.

Acknowledging this fact, the Air Force has begun to emphasize information, elevating it to a level of importance commensurate with people, materiel, and facilities. Ironically, concurrent with this emphasis has come the Clausewitzian view of the uncertainty of information. For instance, the demand for materiel is unpredictable, both in peacetime and war. Analyses of spare parts show that the "variance-to-mean" ratios are such that the demand for aircraft components cannot be ascertained in the aggregate or at specific operating locations.[20] This uncertainty of demand calls into question the Air Force's planning with regard to spares procurement, stockage, and allocation, especially in deployable war readiness spares kits (WRSK). Nor is this uncertainty confined to aircraft components. Uncertainty is the normal human condition in wartime. Therefore, the distribution system will have to be very flexible to mitigate the effects of uncertainty.

Integrating Combat Capability

After an aerospace force has been positioned in the combat theater, it needs to be integrated with the other Services as well as allied forces. This integration begins during peacetime with joint and combined acquisition programs leading to common weapon systems that enhance rationalization, standardization, and interoperability. In turn, these systems are exercised as they would be employed in any coalition warfare—with the full participation of the other Services and allies. Although joint and allied publications presently state that logistics is a Service or national responsibility, this statement applies only to fiscal accountability, not to the execution of military operations.[21] Of all military activities, logistics requires the greatest integration—between civilian and military economics, active and reserve forces, and deployed forces and host nations. As previously noted, the Air Force is almost totally dependent on surface modes for the intratheater movement of resources between bases. And the responsibility for surface movement belongs to the Army which is heavily dependent on host nation support since it does not have enough of its own transportation assets to move itself.[22]

Furthermore, in the Army, logistics (or combat service support) is dominated by reserve forces whose readiness has, at times, been suspect.[23] Whether the Air Force fights in Europe where there may be too much logistics infrastructure or in Southwest Asia where there is far too little, the Air Force will remain largely dependent on the host nation and other Services to sustain its aerospace forces. In short, unit self-sufficiency is a myth due to the lack of organic support structure. This reality is not debilitating as long as the Air Force is prepared to work its logistics tasks as part of a joint or combined military operation. Yet, without joint logistics doctrine, Service differences will be significant at the policy level and may be insurmountable at the procedural level.

Preserving Combat Capability

Perhaps, more difficult than distribution and integration is the task of preserving the combat support structure. Unlike the other Services, the Air Force has trained its warriors to fight primarily in the aerospace medium. It is ill-prepared to counter a ground threat to its air bases as might be carried out by a highly trained Soviet SPETsNAZ force.[24] Air Force people receive negligible small arms training and have not learned to work as a small arms team in conjunction with the security police or Army forces. (Ground launched cruise missile units are the notable exception.)

Moreover, aerospace vehicles have become "national treasures" since they can no longer be mass-produced. Today, less than 10,000 aircraft are in the Air Force inventory. At a 3.6% attrition rate, this number would be reduced by half before completion of the twentieth combat mission—a catastrophic loss, but not exceptionally high attrition in comparison with World War II statistics. In 1943, the Americans lost over 20,000 aircraft and some 5,000 aircrew members; and these figures were for noncombat activities conducted in the United States.[25]

On the other hand, technology is not the panacea to a small force structure. As one military observer has suggested: "Technology was indecisive in Korea, irrelevant in Vietnam, and unreliable in Iran."[26] Therefore, force "multipliers"—information systems, special munitions, and other enhanced platforms—are not an adequate substitute for quantity—especially against enemies, like the Soviets, who are capable of attrition warfare. Force "multipliers" become force "dividers" when lost to combat or inadequate logistics support. Lenin perhaps expressed it best: "Quantity has a quality of its own."[27]

Yet, the preservation of aerospace forces will remain problematical as long as these weapons platforms are tied to fixed facilities manned primarily by noncombatants with a "sanctuary" mentality. Trevor Dupuy has demonstrated in *The Evolution of Weapons and Warfare* that the only adequate counter to increasing weapons lethality is dispersion.[28] The capability to disperse is especially relevant in maneuver warfare where no front may exist and where the rear areas are continuously exposed to air and ground threats. However, while dispersion may enhance survival, it will complicate the logistician's distribution and restoration activities.

Restoring Combat Capability

In order for aerospace forces to sustain their warfighting effort, weapons platforms must be constantly restored: repaired, serviced, and configured for combat. Yet, if resources must be dispersed to survive, how does the distribution system get fuel and munitions to the aerospace platforms? Even when aircraft are confined to a main operating base, flight-line maintenance activities will challenge the most seasoned veterans during high-intensity conflict with or without chemical weapons usage.

For example, in the area of munitions maintenance, the Air Force has established a center to train supervisors to manage a munitions assembly line at base level to keep pace with high aircraft sortie rates in war.[29] In today's environment, the majority of munitions arrive in the battle area in a piecemeal fashion. For efficient distribution and safety, munitions are broken down into component parts—fins, fuzes, boosters, etc.—and must be assembled prior to loading them on aircraft. As a result, munitions maintenance people expend tremendous effort configuring these munitions for operations. In contrast, the Soviets transport their munitions in an "all-up-round" configuration having only to add the fuze at their operating sites.[30] They appear to understand the friction of war and try to minimize the work load of their maintenance troops. The necessity to assemble munitions in the battle area is typical of the problems faced by maintenance people that can and should be remedied by American engineers. It is the engineers that must design an "all-up-round" munition that does not unduly consume transportation assets or endanger flight-line maintenance specialists.

Of course, restoration is not limited to equipment. The operational commander at the unit level will have to generate people, pavements, utilities, and information along with aerospace platforms. It is conceivable that the loss of water, power supplies, medical triage, fuel dispensing equipment, avionics intermediate shops, or EOD (explosive ordnance disposal) personnel may affect aircraft sortie generation more than the loss of aircrews or aircraft. In effect, the Air Force must learn to sustain the entire air base and cannot become preoccupied with aircrew and aircraft availability.

Disposing Combat Capability

The war historian, Liddell Hart, declared that ". . . the only thing harder than getting a new idea into a military mind is getting an old idea out."[31] Divestiture is difficult for any large organization, especially the military. But the military must institutionalize the divestiture process if it is to remain a modern, warfighting organization. The Air Force must rid itself of concepts, doctrines, policies, functions, organizations, procedures, and weapon systems that can no longer effectively contribute to combat. However, people's careers are normally tied to organizations, functions, or weapon systems, and these people are reluctant to sever the "umbilical cord" that has promoted them.

Nonetheless, the Air Force is in a precarious predicament because its combat support structure—its basing and support systems—have not evolved along with its weapon systems. The Achilles' heel of aerospace power can be found within the organizations and functions that support operations. A prime example is civil engineering which is in the throes of a major restructuring effort to become more combat capable.[32] They are in the process of purging the word *civil* from their mission if not their title. Essentially, they are attempting to move from a peacetime focus to a wartime footing.

Conclusion

AFM 1-10, *Combat Support Doctrine,* offers the warrior a command perspective of logistics, but it does not go far enough. Each Air Force combat support function urgently needs to document its basic concepts, values, and operating principles in an official doctrinal publication.[33] Commanders will then have access to the mind of the logistician and can begin to gain insights into how to arrest the decline of aerospace flexibility. Otherwise, this doctrinal void in logistics will perpetuate the rigidity of the present combat support structure leading to operational paralysis in war. To preclude this catastrophe, Air Force commanders must begin to reexamine those support functions that create and sustain combat capability. But first, commanders must "come down to earth" in their doctrinal thinking, or tomorrow's aerospace vehicles will be unable to ". . . slip the surly [logistical] bonds of earth."[34]

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Maintenance on the Cheap: Air Force Logistics, 1907-1917

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During the period, 1907 to 1917, the history of logistics and the history of the Army's air arm are synonymous. And since the history of the Air Force is largely the history of equipment, even in this early period, examining the evolution of aviation logistics during these ten years might shed some light on the decisions made during both World Wars and after. It may even illuminate in a colorful way the growth of military aviation in the United States.

Established 1 August 1907, in the US Army's Office of the Chief Signal Officer, the Aeronautical Division (the forerunner of today's Air Force) experienced deprivation and neglect during its first few years. With only one aeroplane in its inventory, a smattering of personnel—including a borrowed civilian mechanic—and small appropriations, the young division adopted a logistics system that was both primitive and personal.

> ***"The division's one aircraft required three weeks in the repair shop for every week of flying."***

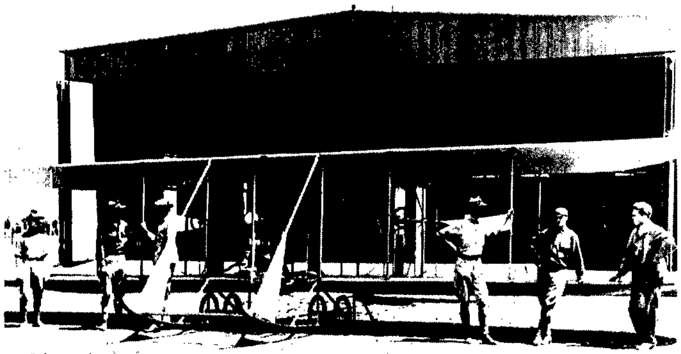
In 1909, for example, the Army allotted Lieutenant Benjamin D. Foulois, then its only flying officer, $150 for the upkeep of its single plane division: "It was the nation's first air force budget, and it was earmarked for one year's maintenance."[1] His funds quickly exhausted, the young pilot dipped into his own pocket, spending an additional $300 for materiel and parts for new wings, rudders, elevators, and propellers. The division's one aircraft, Wright Plane No. 1, "made of wood and cloth and held together by wire," required three weeks in the repair shop for every week of flying. "Crack-ups were common," reported Foulois, and "materiel hard to come by," forcing him to "beg, borrow, and steal materiel from the Quartermaster Department to carry out continual airplane repairs."[2] Writing in his official logbook, the young commander referred repeatedly to "repairing, replacing, reconstructing, reassembling, and dismantling" the division airplane.[3]

Foulois' papers and notes for this period, 1909 to 1910, make frequent reference to the paucity of spare parts, gasoline, and oil, and to countless other materiel frustrations associated with aviation. Between March and June 1910, for example, one logbook entry reported that Plane No. 1 spent 34 days in the repair shop.[4] Relief arrived the following year when Congress allocated $125,000 for aviation, $25,000 to be awarded immediately. The Signal Corps ordered five new planes at $5,000 apiece. In October, Plane No. 1 was retired to the Smithsonian.[5]

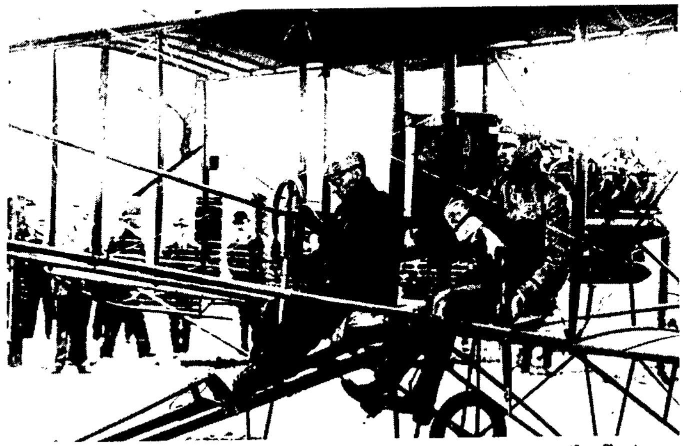
Eager to provide some formal structure for the new section, the Signal Corps assigned Foulois the task of drafting a regulation guiding pilots and mechanics on the fundamentals of aircraft maintenance and repair. *Provisional Airplane Regulations for the Signal Corps, United States Army, 1911* was published in July. With hands-on training as his guide, the lieutenant included information on the care, repair, and maintenance of an airplane on the ground; inspection duties; rules on assembly and disassembly of airplane, field, and tent hangars; a provisional aero company organization, with sections; and incorporation of the commissioned, enlisted, and civilian personnel required to repair, maintain, and operate assigned aircraft, airplane materiel, motor transport, and "other impedimenta." The regulation employed for the first time the term "Crew Chief" and cited the need for civilian professionals in repair, maintenance, and aircraft management.[6]

To implement this regulation, the Corps, on 1 June 1911, hired Henry S. Molineau, a prominent airplane technician, as the newly established Aviation School's Supervisor of Technical Repair. The same month, 19 enlisted mechanics serviced and maintained Corps aircraft; by November, their number had risen to 39.[7] Upon completion of the School's move to North Island, San Diego, in 1913, the Aeronautical Division started regular classes in construction, inspection, and maintenance of airplanes and the care and operation of engines. Student mechanics assumed responsibility for the School's maintenance and engineering work upon completion of the course. Eager to promote such essential labor, the Corps consigned the school $3,000 for equipment shelters and machine shops. Despite this largess, aviation maintenance remained at best "primitive."[8]

Benjamin D. Foulois was both the Army's first flyer and first maintenance officer. He learned early that the development and utility of the airplane was to be forever paced by the effectiveness of its logistics system.



The air arm's first aircraft, the Wright-B, with its original ground crew. Foulois is second from right, with goggles.



August 1910—Major J. E. Fickel prepares to demonstrate the first rifle firing from an aircraft. This pusher biplane is piloted by Curtiss pilot Charles F. Willard at Sheepshead Bay, Brooklyn, N.Y.

Makeshift and casual, aviation lacked formal recognition within the Signal Corps, forcing pilots and mechanics to rely exclusively on their own ingenuity and expertise to effect any logistic innovations. A major improvement in status occurred on 18 July 1914, when Congress created the Aviation Division in the Signal Corps, a major step in the evolution of air logistics.[9] Encouraged by this new stability, aircraft manufacturers focused their attention on new military designs. By year's end, several companies placed technical representatives at the Aviation School to keep abreast of changing section needs.[10]

The base secured, the new section turned its attention toward improving the internal operation, especially maintenance engineering. The period, 1914 to 1917, a "red letter" age for aviation logistics, witnessed the strengthening of procedures essential to properly functioning air forces. To emphasize this change, on 15 July 1914, the section hired one of the era's leading aviation experts, Grover Loening, as its Aeronautical Engineer, to reorganize its engineering maintenance and procurement organization.[11]

Loening and his assistant, Lieutenant Thomas D. Milling, established an Experimental and Repair Department at the San Diego School, which was responsible for all experimental work, including the development of new airplane construction, and for major equipment repairs. To help itself in these tasks, the Department launched a mechanical training course. In conjunction with this new emphasis, Milling received approval to hire nine additional civilian mechanics. Aircraft crews continued to perform their own minor repairs. Its technical staff much improved, the School opened a repair shop which rebuilt and overhauled wing sections and fuselages; this precluded returning them to the factories for mending.[12] This evolution marked the debut of the "engineering point of view" in aviation, the genesis of post-World War I research and development. On 18 July 1914, Congress approved the Aviation Mechanician rating for the Aviation Section; 7 months later, 20 aviators held this rank.[13]

Away from the School, however, field aviation logistics lacked cohesion and organization. From 1914 to America's entry into World War I, field correspondence proclaimed endless problems with spare parts, transportation, funding, inferior equipment, business arrogance, command indifference, frequent accidents, and poor supplies. Lieutenant Foulois, then Commander, First Company, First Aero Squadron, flooded the Section's Washington office with complaints about, and pleas for, equipment. Lacking a formal supply channel, the main office handled all logistics questions from the units. Stationed in Galveston, Texas, a major distance from aviation headquarters, the company relied primarily on its own ingenuity; local purchase; base quartermaster supplies; and, when available, equipment purchased through manufacturers' representatives. Most often, field logistics operated on a "hand-to-mouth" level, propelled by basic needs and fueled by dedicated personnel. Fortunately for aviation, this period before World War I required little more than pilot training and routine airplane maintenance.

Field logistics accomplished some innovative feats despite its perilous state. Moving from Fort Sill, Oklahoma, to Fort Sam Houston, Texas, on 17 November 1915, the First Aero Squadron conducted the first mass movement of an aerial unit by land and air in the history of the Air Force. With six planes in tow, each followed by its own truck-tender, ground crew, spare parts, and a unit of six motorcycles carrying mechanics with emergency repair kits, the squadron completed its action without incident. A newly-developed machine-shop truck, carrying a lathe and forge, accompanied the squadron for minor aircraft overhauls.[14]

Once resettled in Texas, the squadron began experiencing serious problems with Curtiss-made airplanes and auxiliary equipment. "I am getting thoroughly disgusted with the way the Curtiss Company does business, and sincerely hope that we can do business with some other firm," Foulois wrote the Aviation Section's officer-in-charge in 1915. "Three of our machines have been out of commission since 15 August due to lack of propellers and propeller bolts."[15] Five days later, he fired off another complaint, accusing the company of faulty motor crankshafts and main bearings, and of ". . . constantly delaying sending spare parts."[16]

The young commander shifted his focus to intra-service supply channels and complained of the "extraordinary amount of time" the Quartermaster Corps took to deliver gasoline and oil to the squadron:

> It is certainly a nuisance having to depend upon the Quartermaster Corps for supplies of this nature that are needed for immediate use. I made requisitions for spare parts for motor trucks four months ago and just received word yesterday that $400 had been allotted for their purchase. Great Business Methods.[17]

It took the 1916 Mexican Punitive Expedition to expose aviation's logistics weaknesses.

The Squadron arrived in Columbus, New Mexico, on 13 March 1916, with 8 Curtiss JN3 training planes, 11 pilots, 90

"Within one day the squadron had lost its truck to the Quartermaster Corps, who commandeered them for ground troop usage."

mechanics, 12 trucks, and 1 automobile. Within one day it had lost its trucks to the Quartermaster Corps, who commandeered them for ground troop usage, and, by 19 April, all but two of its aircraft. Anticipating this calamity, Captain Foulois had written the expedition commander, Brigadier General John J. "Black Jack" Pershing, informing him that ". . . the present aeroplane equipment of the First Aero Squadron is not capable of meeting the present military service condition . . . ."[18] Continuing, he requested the immediate procurement of ten new airplanes with motors and spare parts.

When aviation's debilitating condition became public, Congress voted on an Urgent Deficiency Fund of $500,000 for the Army air arm, the greatest appropriation yet awarded. This sum, and the $300,000 previously approved for fiscal year 1916, "marked a turning point second in importance only to the rapidly evolving doctrine of air power."[19] Four new Curtiss N8s arrived in Columbus on 19 April, but Foulois and his men rejected them as "unsafe and unsuitable" for Mexico.[20]

The Punitive Expedition, the first American experience in employing airplanes under wartime conditions, provided a stimulant for technical improvement within the Aviation Section and, "equally important, it was to emphasize the necessity for maintenance facilities in connection with aircraft in the field because of the limited number of airplanes available."[21]

Provoked by aviation's poor state, the Chief Signal Officer, Brigadier General George P. Scriven, appointed a Technical Aero Advisory and Inspection Board of officers and civilian engineers to study the aeronautical industry's productive capabilities "to insure the best equipment possible, and to improve and develop the general design of planes."[22] The board recommended the purchase of twelve 160- to 200-horsepower military tractor biplanes for immediate delivery to the aero squadron in Mexico. Writing in his 1916 Annual Report to the Secretary of War, Scriven cited proudly the acquisition of these new planes and assorted other equipment for making the First Aero Squadron ". . . a splendidly equipped organization complete in . . . aeroplanes, motor trucks, portable machine shops, automatic photographic cameras, machine guns, shoulder rifles, bombs, and other accessories."[23] Unfortunately, they came too late to make any noticeable difference in Mexico.

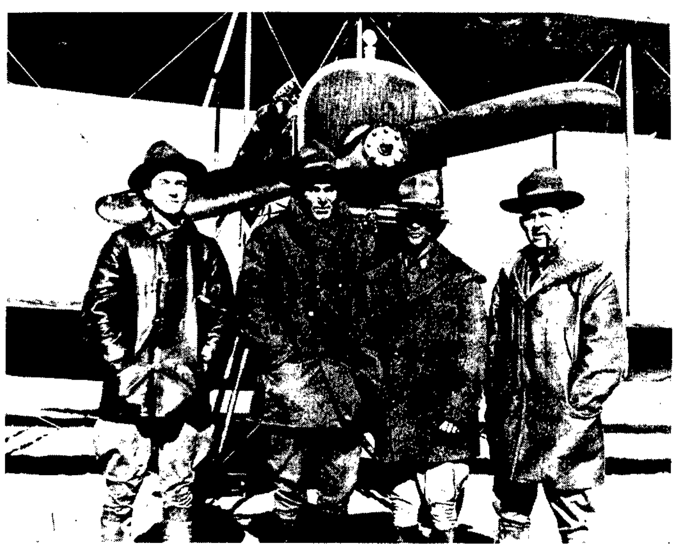
On 20 May 1916, Scriven's concern for the future of military aviation led to the appointment of Lieutenant Colonel George O. Squier, a forceful proponent of air power, as the Aviation Section's new officer-in-charge. As his first task, Squier directed Foulois to prepare an aviation unit equipment manual which called for a careful inventory of all materiel used by the squadron.[24] Squier's most difficult job, however, was to convince airmen, long accustomed to official neglect and shoddy equipment, that aviation's future would improve. Most aviators agreed with Foulois' misgivings about the quality and quantity of aircraft. First Lieutenant Henry H. Harms, who had served on Scriven's technical board and later became an inspector at Curtiss' Buffalo, New York, plant, complained bitterly and at length about the state of Army aeronautics in a 12 May 1916 letter to First Lieutenant Edgar Gorrell, the First Aero Squadron Supply Officer:

> I hope this present series of delays and troubles will convince our Washington friends that their pet theory of a possible production of 20 aeroplanes a day in case of necessity is another exploded idea with "nobody at home." All of our stuff so far has been taken out of British orders almost ready for shipment. If we were made to wait for complete production you would have received the first shipment next Xmas. The British Company has contracted for the complete output of the Curtiss Company for the next twelve months. Their inspectors here have been extremely courteous in giving us what we want thus far but I know it can't last forever. Our orders have certainly raised hell with their input and I look for government confiscation if we place many more orders.[25]

The procurement experience of World War I proved too well the accuracy of Harms's comments.

Procurement for the Mexican skirmish posed additional problems for the aero squadron, which was required to order equipment directly from Signal Corps headquarters in Washington. "If this organization is required to submit requisitions for emergency supplies to the Office of the Chief Signal Office," Foulois wrote in May 1916, "it will involve additional delay, in placing all new aeroplanes, in fit shape for active service. . . ." Operating miles from its base, the squadron required a constant supply of gasoline and oil. Only local purchases prevented the termination of its mission. The young commander urged his superior to grant the squadron leader ". . . authority to make purchases, to meet all emergencies as they arrive, and not be required to forward requisitions for articles of new equipment, that are needed at once."[26] This authority was not granted until the war in France, 3,000 miles from home, forced its acceptance.

A passing call to arms, the Punitive Expedition's effects were great and lasting. Not only did it provide a dress rehearsal for 1917's mass mobilization, but it also impelled Congress to begin a sweeping military reorganization in the 1916 National Defense Act. Effective 1 July, the Act authorized an Aviation Section strength increase from 60 to 148 officers, the number of enlisted men to be determined by the President. The Act provided for reserves, both officer and enlisted, a new aviator rating, flying pay, and approval for an experimental aviation proving ground near Hampton Roads, Virginia. Of strategic importance to wartime air logistics, the Act established an



1st Aero Squadron members with a new Curtiss R-2. The airplane saw little action due to propeller problems, contributing to a disappointing combat debut for airpower.

Advisory Council of National Defense which subsequently undertook a rudimentary study of industrial mobilization and procurement. Organizationally, the Army used the new law to issue General Order No. 55, which established air depots for each aero squadron. Comprised of 3 officers and 20 men, the depots were to follow the tactical units whenever they moved to the field.[27]

The Mexican experience proved invaluable to the young section, supplying them with the lessons in military realism. As aviation's battlefield initiation, the expedition provided a needed stimulus for technical improvements and, "equally important," pointed out "the necessity for maintenance facilities in connection with aircraft in the field because of the limited number of airplanes available." It reinforced a requirement for reserve aircraft as backup to those planes actively being employed in the field. At the same time, "it showed the necessity of allowing personnel in the field to make and submit their own recommendations to higher authorities for those improvements they believed necessary."[28]

In his after-action report on aviation's role in the 1916 excursion, General Pershing blamed its poor showing on weak equipment and inadequate field repair facilities.[29] Many years later, Foulois ascribed his squadron's unimpressive record to "the *utter inadequacy* of our *aircraft materiel* to meet the punishment, stresses and strains incident to the successful accomplishment of Military Air Missions in time of War."[30]

Disappointed by the air arm's performance south of the border and alarmed by the fighting in France, Congress awarded the War Department $13.3 million for aviation's 1917 expenses. Foulois' reaction, made after America's entry into the world war, was prophetic:

> Had these funds been properly distributed over the period from 1908-1916 Army Aviation could have kept abreast of Air development in Europe. As a result of this - Too Much and Too Late - Policy, we entered World War I (April, 1917) with not a single *Military type airplane* and an *aircraft industry* which had *never built one*.[31]

"The Army itself relied on nineteenth century techniques for twentieth century problems; the aviation section reflected this immaturity."

Air logistics for the years 1907 to 1917 mirrored the primitive and capricious state of military aviation in the United States Army. Plagued by small appropriations, inadequate technical personnel, shoddy equipment, a nonexistent supply organization, insufficient spare parts, and an Army hierarchy insensitive to their needs, the Aviation Section's pilots and technicians maintained and repaired their odd assortment of aircraft with personal dedication and amazing ingenuity. In the complicated and often misunderstood field of logistics, the Army itself relied on nineteenth century techniques for twentieth century problems; the aviation section reflected this immaturity.

If there were any valuable lessons to be learned from this ten-year period, it would be the necessity of devising a viable and reliable system of supply, maintenance, repair, and procurement. World War I proved the truth of that in a profound and deadly way. More than anything else, the prewar period provided the model and the impetus for the aviation section's technical personnel to pursue and, eventually, achieve a workable logistics system that proved surprisingly successful by the close of the Great War.

Notes

1 Foulois, Benjamin D. and Carroll V. Glines. *From the Wright Brothers to the Astronauts: The Memoirs of Major General Benjamin D. Foulois* (New York, 1968), pp. 2, 5.

2 Shiner, John F. *Foulois and the U.S. Army Air Corps, 1931-1935* (Washington, 1983), p. 6.

3 Log-Airplane No. 1, First Lieutenant Benjamin D. Foulois, 3 February 1910 to 22 July 1911, Benjamin D. Foulois Papers, Box 22, Library of Congress (LCM).

4 Ibid.

5 Goldberg, Alfred ed. *History of the United States Air Force*, Air Training Command Pamphlet 190-1, Randolph Air Force Base, Texas, 1 June 1961, pp. 1-6. See also Foulois and Glines, p. 85.

6 Frey, Royal. *Evolution of Maintenance Engineering, 1907 - 1920*, Air Force Logistics Command Study No. 327. AFCHO Microfilm Collection, K201-327, 16. Frey was the historian at the Air Materiel Command, Wright-Patterson Air Force Base, in the 1950s and 1960s.

7 Ibid, p. 19. See also Juliette S. Hennessy, *The United States Army Air Arm, April 1861 to April 1917* (Washington, 1985), p. 50.

8 Hennessy, Juliette S. *Army Air Arm*, p. 91. See also Frey, *Evolution*, p. 39.

9 "Aeronautics in the Army," Foulois Papers, Box 244, LCM, pp. 6, 7.

10 Mooney, Chase C. and Martha E. Layman. *Organization of Military Aeronautics, 1907 - 1935*, Army Air Forces Historical Studies, No. 25, December 1944, p. 19. See also Annual Report of Chief Signal Officer, U.S. Army, to the Secretary of War, 1914, RG111, National Archives (NA), p. 9.

11 Frey, *Evolution*, p. 44.

12 Ibid., p. 43. See also Hennessy, *Army Air Arm*, p. 122.

13 Frey, *Evolution*, p. 47. See also Hennessy, *Army Air Arm*, p. 112.

14 First Lieutenant Foulois to Lieutenant Colonel Samuel Reber, 5 May 1914 and 23 June 1914, Foulois Papers, Box 35, LCM. See also Frey, *Evolution*, pp. 51, 60.

15 Foulois to Lieutenant Colonel Samuel Reber, 6 September 1915, Foulois Papers, Box 35, LCM.

16 Foulois to Reber, 11 September 1915, Box 35, LCM.

17 Foulois to Reber, 6 September 1915.

18 Maurer Maurer, Ed. *The U.S. Air Service in World War I* (Washington, 1978), Vol. II, p. 78.

19 Ibid., Vol. II, pp. 37-38. See also Annual Report of the Chief Signal Officer, U.S. Army, to the Secretary of War, 1915, RG111, NA; and Memo, Officer of the Chief Signal Officer to the Secretary of War, 5 January 1915, sub: Appropriations for Aviation Section, RG111, No. 37348, NA.

20 Hennessy. *Army Air Arm*, pp. 172, 175.

21 Frey. *Evolution*, p. 73.

22 Annual Report of the Chief Signal Officer, U.S. Army, to the Secretary of War, 1916, RG111, NA, 26. See also Hennessy, *Army Air Arm*, pp. 165-6. The Board's officer members included Milling, Harms, and Capt. V. E. Clark, all early aviation pioneers. Among the civilians called to serve were S. G. Averill, a motor engineer; H. I. Pope of the Pope Manufacturing Company; Henry Souther, pioneer motor engineer; Howard Coffin; and Dr. Jerome Hunsaker, one of the country's greatest aerodynamic authorities. As a result of the Board, Army flying became increasingly safer.

23 Annual Report of the Chief Signal Officer, 1916, p. 26.

24 Foulois and Glines, *Wright Brothers*, p. 136. Squier, who had drawn up the specifications for the Army's first airplane, had been recalled from his position as Military Attache in London. He helped establish the first Signal Corps school at Ft. Leavenworth and, as a member of the General Staff in Washington, handled all important aviation information from Europe.

25 First Lieutenant Henry Harms to First Lieutenant Edgar S. Gorrell, 25 May 1916, Foulois Papers, Box 35, LCM.

26 2d Endorsement to 12 May 1916 Memo, Office of the Chief Signal Officer to Department Signal Officer, Southern Division, sub: Expenditures of 1st Aero Squadron, HQ, 1st Aero Squadron, Signal Corps, Camp Furlong, Columbus, New Mexico, 20 May 1916, to Chief Signal Officer of the Army, through military channels. Foulois Papers, Box 34, File: PUNEXP-6-Supply, LCM.

27 "United States Air Force History," undated, no author, Henry H. Arnold Papers, LCM, Box 222, File: H.H. Arnold Air Force History, Notes. See also Frey, *Evolution*, pp. 70-75.

28 Arnold History.

29 Frey. *Evolution*, p. 77.

30 The Inter-University Case Program, Comments by Major General Benjamin D. Foulois, United States Air Force, Ret., on the case study: "The Army Flies the Mails," by Paul Tillett, Department of Politics, Princeton University, 1953, dated 25 March 1954, Foulois Papers, LCM, Box 14, File: Adm-E-1, p. 3.

31 Ibid. The actual figure for the 1917 Congressional appropriation was $13,281,666.

USAF Logistics Policy Insight

Contractor Support

Because significant amounts of money are being spent for contractors to operate and maintain weapon systems, updated guidance for contracting, funding, and managing contractor support is included in the new revision of AFR 800-21, *Contractor Support for Systems and Equipment,* 20 March 1987. The original AFR 800-21 addressed interim contractor support only; the revision is expanded to include contractor logistics support (CLS), preoperational support, contract depot purchased equipment maintenance, and total contract training, a form of CLS being introduced for aircrew training devices. (Judy Cary, AF/LEYE, AUTOVON 227-0311)

Broader Logisticians

Last fall, HQ USAF/LE presented an initiative to the Air University and the AFIT School of Systems and Logistics (AFIT/LS) to design an education program which would develop a more professionally-broadened logistician capable of addressing logistics concerns/problems as an integrated whole rather than as a loosely-knit group of specialties. This initiative requested AFIT/LS to create a series of four professional continuing education (PCE) courses, each geared to a specific period of a logistician's career. These courses will provide fledgling, mid-level, and senior logistics personnel with in-depth information on logistics doctrine, concepts, strategies, combat operations, interrelationships, interoperabilities, and policy development as they move from novice to senior logistician levels of responsibility. The concept and program outline have already been briefed to several functional communities with great success. The first offerings of the initial two courses (Introduction to Logistics and Combat Logistics) will be available in FY88. (Major David Fortna, AF/LEXX, AUTOVON 227-8648)

Fuels Assessment

A definitive fuels capability assessment tool has been developed under the auspices of Project PETROL READY. The Aviation Fuels Capability Assessment Model (AFCAM) evaluates total fuels capability "inside the fence." AFCAM is a simplistic spreadsheet technique designed to produce "24-hour window" assessments using base-specific parameters. In addition to assessments, AFCAM has extensive application in fuels planning and programming. AFCAM is currently undergoing a 90-day field test prior to finalization and distribution later this year. This model provides a management tool heretofore nonexistent beyond the power of the "stubby pencil." AFCAM is also the initial building block in an AF initiative for a bottom-up, modular approach to modelling fuels support capability from the source of the refined product to the skin of the aircraft. The AFCAM concept, as well as the overall AF initiative, has wide interest in the DOD petroleum logistics community. (Major John Anna or Mr Jack Lavin, AF/LEYSF, AUTOVON 225-9798/0461)

New K-Loader

Watch for deliveries of a new larger and more versatile cargo aircraft loader over the next few years that will greatly boost our nation's strategic mobility strength. Potential contractors are now reviewing the Air Force specifications for the 60,000-pound K-loader that will be the first ever in the Air Force inventory to be able to load five 463L cargo pallets on both military aircraft and the elevated decks of widebodied commercial aircraft. It will also be the first five-pallet K-loader to be air transportable without the need for aircraft floor protection or mechanical assistance. Military airlift is one of America's most important wartime assets—and the 60,000-pound K-loader will be an important addition to our airlift system. (Lt Col Paul Arneson, AF/LETN, AUTOVON 227-3371)

CEMAS Progress

The Civil Engineering Materiel Acquisition System (CEMAS) is the automated inventory management system used for the identification, acquisition, and storage of materiel requirements to support the base civil engineer. CEMAS lead bases are being prepared for implementation/conversion (I/C) and MAJCOMs are establishing follow-on base schedules. In addition to the prototype bases (Tinker AFB OK and Kirtland AFB NM), TAC, SAC, and PACAF lead bases are operational. A multifunctional (LGS/LGC/ACF/DEM) I/C Plan 85-1 has been coordinated with the MAJCOMs and the Supply Policy and Energy Management Division (HQ USAF/LEYS) and Control Placement Division (HQ USAF/RDCL), and a new course training standard will be incorporated into the Base Civil Engineer Logistics Course at Lowry AFB CO. Testing will be conducted at Maxwell AFB AL for the base contracting automated system interface prior to going worldwide in September 1987. Future enhancements include interface with the standard supply system. Total Air Force implementation will take approximately three to five years. (Capt Bill Martin, HQ AFESC/DEMG, AUTOVON 523-6386)

USAF Fuel Facilities Engineer Panel

The newly created USAF Fuel Facilities Engineer (FFE) Panel consolidates the top petroleum, oil and lubricants (POL) expertise as an Air Staff sponsored technical group. They are task-oriented and responsive to major engineering concerns that impact the Air Force flying mission. Panel members were selected on the basis of their engineering training, experience, and POL expertise. They hold key command positions that permit making decisions for their organizations. The FFE Panel recently updated Air Force design standards for Type III and Type IV Pressurized Hydrant Fueling Systems and reviewed PACAF's fueling systems upgrade and certification program for overseas bases (a result of the Osan AB tank mishap). (E. Lee, AF/LEEEU, AUTOVON 297-6239)

JP-8 Progress

A joint Air Force and Army initiative to designate JP-8 as the single fuel for the battlefield was presented to the JCS Conference of Logistics Directors (COLD 87) in January 87. This concept involved replacing JP-4 and diesel fuel with JP-8 (a kerosene based fuel) in overseas theaters where combat is most likely. This would reduce the number of combat fuels required to two; achieving the single fuel objective would require the gradual phaseout of gasoline driven equipment. As JP-8 is a much safer fuel than JP-4 or gasoline, this initiative would enhance combat survivability and ground-handling safety. It would dramatically simplify battlefield logistics and enhance the flexibility of tactical commanders, as aircraft, ground support equipment, tanks, and vehicles would all use the same fuel. Our NATO Allies are also currently considering a conversion from diesel fuel to JP-8. The initiative was fully supported by COLD 87. Commercial Jet A-1 (JP-8 without the military additive package) is currently stocked against aviation and diesel fuel requirements in Southwest Asia. Jet A-1 is also widely used throughout the SOUTHCOM area of responsibility. The Air Force is supporting a USCINCSOUTH proposal to convert from JP-4 and diesel fuel to JP-5 (a kerosene based fuel very similar to JP-8) in Panama, including Howard AFB. USCINCPAC has proposed converting Korea, Japan, and Okinawa to JP-8. (Lt Col Larry Dipoma, AF/LEYSE, AUTOVON 225-9798/0461)

Hazardous Materials

The revised AFR 71-4, *Preparation of Hazardous Materials for Military Air Shipment,* is now expected to be published in June 1987. The most significant changes relate to tactical/mobility operations. This regulation implements hazardous material air transportation requirements specified by the Code of Federal Regulations as well as those required for military air movements. (Mr Ted Sparks, AF/LETTC, AUTOVON 227-4742)

Self-Sufficient Utilities

AF/LEEE is developing new design criteria to ensure the reliability of utilities serving critical facilities which must remain operational at installations subject to the threat of conventional warfare. Central utility systems are vulnerable to the effects of conventional warfare. Utility distribution systems in particular are vulnerable under attack. The recommended criteria will be contained in an Engineering Technical Letter (ETL) authorized in accordance with AFR 8-7, *Air Force Engineering Technical Letters*. The ETL will be finalized and distributed to the MAJCOMs late this fiscal year. (N. Rochelle, AF/LEEEU, AUTOVON 297-6237)

Solutions for High Quality Power Requirements

High quality power for successful operation of new electronic equipment such as automated data processing equipment (ADPE) and communications-electronics (C-E) is an ever-increasing problem. The proposed revisions to AFR 172-1, *USAF Budget Manual,* will provide the most economic and expedient solution by including the requirement to procure Power Conditioning and Continuation Interfacing Equipment (PCCIE) as a part of the end item. PCCIE may be built-in (integral) or adjacent (separate), but must now be included in the acquisition package for any new electronic equipment that requires high quality electrical power.

Existing electronic equipment needing PCCIE larger than 5KVA should be provided with units from the Sacramento Air Logistics Center, SM-ALC/MMIK, centrally managed items purchased with 57-3080 funds. (D. Conkling, AF/LEEEU, AUTOVON 297-4082/6237)

Underground Heat Distribution Systems (UGHDS)

Current guidelines specify that UGHDS be designed based upon life-cycle cost analysis to make the selection of aboveground, shallow concrete trench and direct buried conduit distribution for the optimum routing of each type. Design should also be IAW the Tri-Service specification so suppliers can provide proper qualified piping systems. This guidance was issued by the Tri-Service Committee to provide maximum UGHDS life, improve competitive bidding procedures, and reduce maintenance. Hopefully, this will eliminate protests on projects that include UGHDS containing prefabricated, preinsulated piping systems. A report was given to the congressional Committee on Appropriations citing the efforts of DOD toward better UGHDS maintenance. (R. Wong, AF/LEEEU, AUTOVON 297-4082)

Air Force Use of Chlorofluorocarbons, Chlorocarbons, and Halons

The Environmental Protection Agency (EPA), under the Clean Air Act, is considering regulating the manufacture and use of potential ozone depleters (PODs). PODs include chlorofluorocarbons, chlorocarbons, and halons which the Air Force uses extensively as solvents and fire extinguishing agents. The Air Force uses PODs in performance of its mission. Regulations could severely impact some uses and require extensive engineering controls or product changes. Substitute refrigerants are being developed by some manufacturers; however, toxicity and oil migration problems have not yet been completely analyzed. Open drive refrigeration compressors in which leaks have the greatest potential appear to be the primary target for substitutive refrigerant use. Industry is starting to market portable refrigerant reclaim systems for saving refrigerant and reusing it. EPA may impose a tax on refrigerants and make reuse an economical advantage. If the Air Force is to participate effectively in the pending national policy on this issue, minimize any impact on the Air Force's mission, and fulfill our mandate as a leader in environmental issues, knowledge of the Air Force usage of PODs (refrigerants) is needed. Information requests for quantities and usage can be expected from time to time. (J. Williams, AF/LEEEU, AUTOVON 297-6237)

Transportation Education

The United States Merchant Marine Academy (USMMA) will soon begin offering juniors and seniors elective courses in transportation systems. At the same time, the Air Force plans to initiate efforts to recruit a small number of USMMA graduates as commissioned officers in the transportation career field and is working this program jointly with JCS/J-4 and Headquarters Army staffs. Following this short-range

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Strategies for Logistics C^3I

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This article presents an initial concept of operations for an Air Force Logistics Command (AFLC) Logistics Command, Control, Communications, and Intelligence (LOG C^3I) system. It outlines the development approach AFLC plans to use to build this capability. The goal of the LOG C^3I system is to provide information for orchestrating logistics management systems (LMS) and AFLC infrastructure elements to meet dynamic wartime environments. Unfortunately, funding for the AFLC LOG C^3I program has been curtailed inhibiting the initiation of some elements of the system. Nevertheless, the topic is of such vital importance that the Air Force logistics community should understand the role and importance of such a system.

Scope and Initial Program Focus

The AFLC LOG C^3I system covers the entire spectrum of military activity from peacetime operations to full-scale global warfare. The system must be able to assess and deliver logistics support across the full range of weapon systems—from aircraft to intercontinental ballistic missiles. In addition, the system must control the logistics distribution, maintenance, and procurement infrastructure so resources (reparable spares, engines, support equipment, expense items, and wartime consumables) are delivered to meet air operations requirements. The system must also have interfaces with national command authorities, higher headquarters, theater logistics C^3I operations, and all AFLC LMS programs.

Because the LOG C^3I system is a very large undertaking, the initial program should focus on the full range of *conventional* scenarios, from small contingencies to full-scale dynamic conflicts like that envisioned in the NATO environment. Further, the system should be initially designed to control the repair, distribution, and transportation of *reparable spares* only. This represents the most complex set of resources, involving base, theater, and depot level coordination of support activities. After the system is built and tested for reparable spares, it should be expanded incrementally to cover the full range of resources and infrastructure elements.

Threat and Environment

To understand the need for logistics command and control, one must first understand the potential threat and environment.[1] In a dynamic wartime scenario like that envisioned in a NATO conflict, there is a high likelihood of severe air base disruption and damage as a result of enemy actions. This creates uncertainties in the availability of resources and capability of the logistics infrastructure to support air operations. A great deal of damage to the support structure is likely to occur if facilities at a main operating base are targeted by enemy forces. In fact, as NATO improves its rapid runway repair capability, support facilities become preferred targets. Damage to air base communications and transportation is also probable. The current theater support structure is based to a great extent on individual base self-sufficiency. This presumes that base damage and disruption caused by enemy actions will be minimal. The growing enemy capability to attack theater air bases, disrupt repair activities, and damage spares stockage can no longer be ignored. Though theaters are trying to deal with the effects of these changes within their own resources, the AFLC LOG C^3I system should greatly help them by identifying how AFLC can be more responsive to the needs of combat forces.

Dealing with unpredictable damage and disruption is further complicated by inherent problems associated with forecasting demands, even in peacetime environments.[2] Forecasting problems will become much more critical in wartime environments. In peacetime, the effects of our inability to predict accurately are masked by relatively nondemanding flying hour programs and heavy reliance on the use of wartime assets to compensate for nonpredictable demand rates. Figures 1 through 5 provide some insights into the difficulty of predicting demands accurately.

Figure 1 shows the variability in demand rates for the F-15 converter programmer over a three-year period for three different TAC fighter wings. The patterns for each of the bases are distinctly unique. The measure of variability, the variance-to-mean ratio (VTMR), of 9 indicates there is high variability of demands for this part, making it very difficult to predict future demands accurately. Figure 2 shows a similar phenomenon with the F-100 unified fuel control. Figure 3 shows the distribution of the VTMRs for parts in the F-15 war readiness spares kit (WRSK). Note that 50% of these parts have a VTMR greater than 1.5. Present resourcing computations for WRSK assume the VTMR to be 1. The importance of this variability in actual demand rates for a given squadron is shown in Figure 4. This figure also shows the results of several Dyna-METRIC model runs with various VTMRs. The conclusion: high VTMRs dramatically impact expected aircraft availability.

Figure 5 shows that buying each F-15 WRSK based on the actual observed part-by-part VTMR would be inordinately expensive. Even if it were possible to "buy out" the stock based on actual VTMRs, they change over time. For example, the VTMR for the converter programmer dramatically *increased* over this observation period, while the F-100 unified fuel control system VTMR dramatically *decreased*. Therefore, basing buys on current values of VTMRs is not a prudent solution for handling uncertainties in predictions.

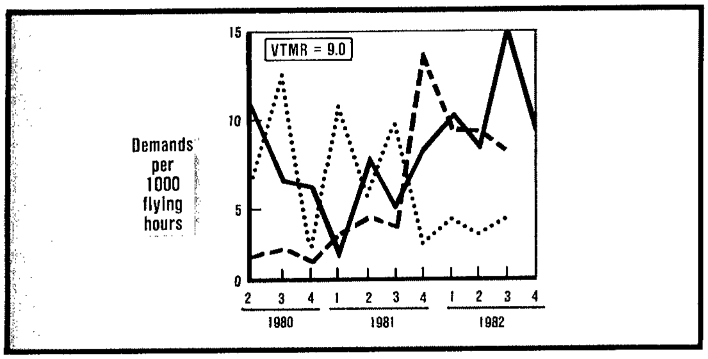


Figure 1: Variance in F-15 converter-programmer demand rates at three TAC wings. The variance-to-mean ratio (VTMR) in this case is 9.0.

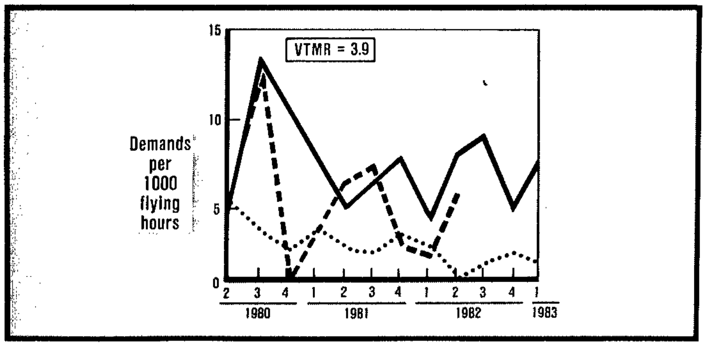


Figure 2: Variance data for the F100 engine unified fuel control. The VTMR in this case is 3.9.

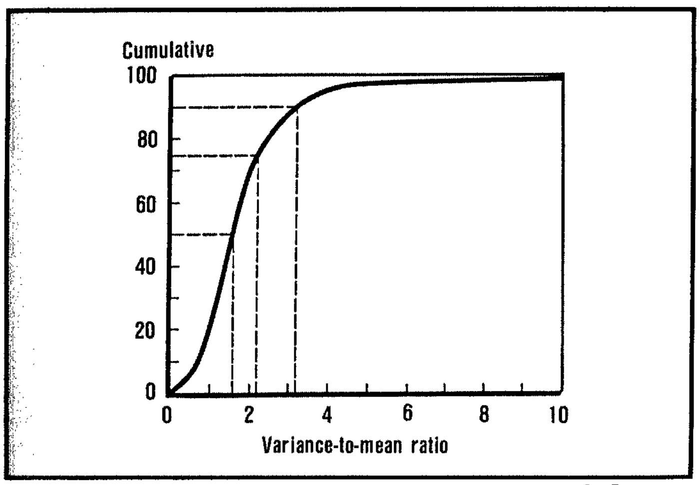


Figure 3: Distribution of VTMRs for parts in the F-15 war readiness spares kit (WRSK).

In wartime, the flying hour program, and variability, will be much more demanding. Frequent changes in fraggings and types of missions will also have an impact on variability of demand rates. In addition, some peacetime work-around options will be unavailable in wartime. For example, peacetime operating stock will not be available for deploying units—they will have to live solely from their WRSK.

Implications for Logistics Support

Likely air base disruptions, coupled with inability to predict accurate demands for logistics support, mean the logistics system needs to be particularly responsive. The C^3I network must determine demands and know the status of all logistics resources and infrastructure components. It must identify required actions and direct activities to guarantee coordinated front-end and back-end infrastructure actions.

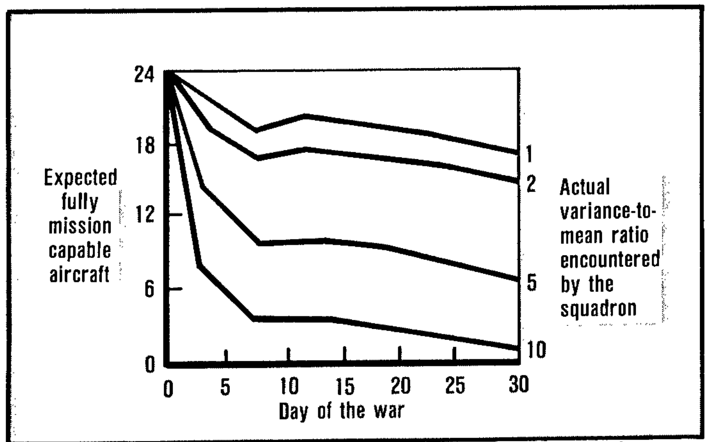


Figure 4: How variability affects a squadron's wartime capability. High VTMRs dramatically impact aircraft availability.

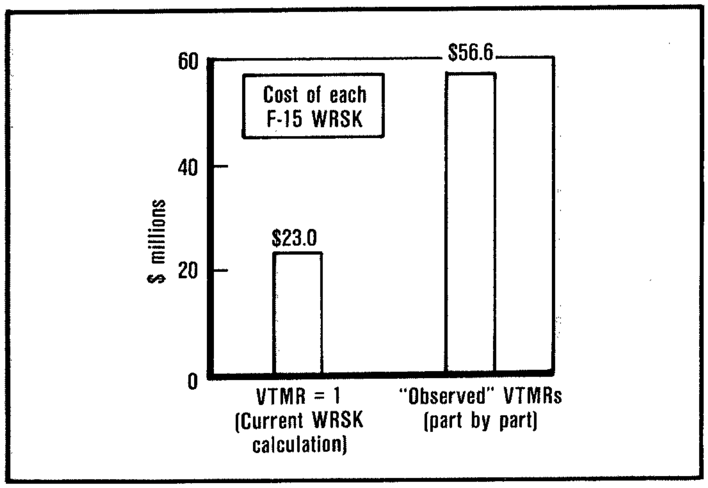


Figure 5: Comparison chart showing that buying spares for higher levels of variability is very expensive (there are about 20 F-15 WRSKs worldwide.)

An Integrated System

Figure 6 indicates how the base and depot are integrated to provide reparable spares. Demands initially generate from the flight line with aircraft flying hour and/or sortie generation requirements.[3] As weapon systems fulfill their flying hour requirements, parts on the aircraft fail, creating demands for parts from base supply. If supply does not have a part, an aircraft could be inoperable until a part is received from base maintenance or depot supply. The part that failed goes to base maintenance to determine if it can be repaired or must be evacuated to the depot. When assets are repaired at the base, they move to base supply for stockage or immediately to the flight line for installation if an aircraft is down for that part. When assets are repaired at the depot, the asset moves to depot or base supply according to the need.

The center of the figure outlines how lower level "bits and pieces" flow to the base to be used in repairing spares. The arrows on the chart indicate the major policies and procedures that can be *altered* to influence system support.

The figure shows that system support is directly related to *specific* base and depot logistics actions. In addition, the relationships are well defined and understood. This integrated system can be manipulated by policies and procedures which impact the "velocity" of parts flowing through the system as well as the "mass" of parts at various points in the system.

An Integrating Measure of Merit

To ensure the logistics base and depot infrastructures are providing coordinated and effective support, a single measure of merit is needed to drive logistics decisions at *both* echelons. This measure would relate how alternative base and depot actions impact combat capability. Recently, the logistics analysis community has established relationships about how base and depot logistics processes and decisions impact *aircraft availability* at the base level. This work provides the ability to identify and rank order items that most limit capability. This furnishes the framework to execute base and depot support actions for the greatest aircraft availability per resource investment. Gearing base and depot echelon logistics actions to this measure of merit provides the opportunity to orchestrate geographically dispersed and decentralized organizations to achieve specified numbers of operational aircraft. This measure can be used by base and depot maintenance to ensure the most limiting item for a weapon system is inducted for repair before other less limiting items. Similarly, buy and distribution decisions can be made in aircraft availability priority sequence.

To provide differential weapon system support, theater commanders need to specify availability goals for each weapon system. This rank ordering will be used to determine which weapon system gets the "next" item for items common to more than one system.

Such an "orchestrated" responsiveness is crucial for wartime but is also increasingly critical for peacetime support. The need for high readiness levels due to short warning times, the long distances needed for deployments, and adverse force ratios mean our forces must stand ready to engage in wartime activities. Weapon System Management Information System (WSMIS) unit-level readiness assessments, conducted on a weekly basis for each wing commander, provide the beginning of a measurement system that could be used to evaluate whether AFLC is indeed providing differentially responsive support consistent with aircraft availability goals specified very frequently by higher headquarters. If algorithms consistent with those embedded in WSMIS and the newly developed Rand DRIVE* concept could be used to drive the inputs to repair, and if such a system were coupled with a differential priority system that ordered priorities for particular units, AFLC would respond routinely in peacetime to situations similar to wartime patterns. This routine tailoring of the AFLC response should inhibit the development of mission capability (MICAP) shortages and generally provide higher states of readiness and sustainability. By responding to the dynamics and uncertainties observed even in defense readiness condition (DEFCON) 5, the control system and all the functional areas will routinely practice responsive support while improving the force's combat capability.

Support System Enhancements

A responsive logistics infrastructure is critical to meeting the support needs of a dynamic wartime scenario. The current

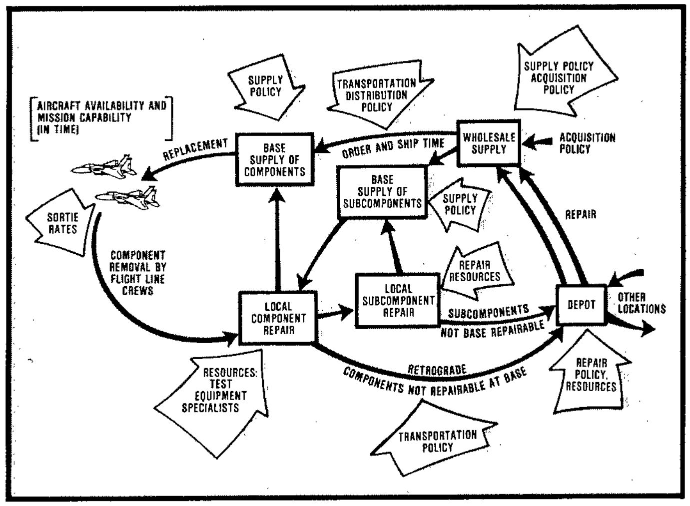


Figure 6: Component repair and the capability assessment problem. Arrows indicate the major policies and procedures that can be altered to influence weapon system support.

infrastructure, however, has been designed for a different environment and is *not* well suited to meet the threat and uncertainties outlined. In addition, the system is not orchestrated to achieve specific aircraft availability targets. AFLC has very limited depot capability to reallocate resources quickly either from one base to another or from one theater to another in reaction to base damage/disruption or unexpected resource consumption. Current repair processes take a relatively long time to process critical demands, particularly in the depot. In addition, the priority system is not typically sensitive to the real time condition of the force. For instance, most fighters happen to have the same force activity designator (FAD) and essentially the same urgency of need designator (UND). As a result, the depot structure finds itself processing requisitions for shortages to these units on a first-in/first-out basis, regardless of where these units are placed in any wartime scenario. In other words, the projected deployment times and, hence, readiness requirements for specific units are really not driving resource allocation decisions at the depot.

The current base and depot level systems were developed for a steady state environment in which demands are easily predictable and dynamic disruptions to the base support structure are not viewed as likely. Bases are designed essentially to depend on requisitions flowing to the depot and being satisfied in some orderly sequence. This is not the kind of structure that can support operational forces in a highly dynamic war. In addition, many unanticipated wartime events are not likely to be handled by routine procedures. For instance, damage to base communications disrupts the normal flow of requisitions, so alternative methods of transmitting supply requirements to the depot must be developed. In addition, the typical depot negotiation of repair workloads on a biweekly basis, using old data to determine what should be repaired, will not support changing battlefront conditions and allow depots to contribute to winning the war. Yet, given the difficulties in predicting the resources required—by combat forces, it is not unreasonable to assume the depot's help *will* be required—even within the first 30 days of a conflict.

To meet changing battlefront conditions, the AFLC infrastructure must respond to changing requirements on a near real time basis. The LOG C^3I system must act as "traffic cop," coordinating the flow of priority information. To ensure

*DRIVE: Dynamic Repair Induction in Variable Environment this system is effective in wartime, it must be exercised in peacetime and must move automatically from one DEFCON to another as events change. Further, it must be interfaced to information systems capable of providing and distributing accurate, meaningful data.

On the depot end of the support structure, two major initiatives are underway with the goal of enhancing system responsiveness and providing better input to the LOG C^3I system: AFLC LMS programs and the RAND Uncertainty Project.

LMS Interfacing

A number of LMS programs are underway in AFLC that will provide more responsive information for use by the depot infrastructure. Each of these must be carefully interfaced with the LOG C^3I system so theater needs can be quickly and precisely transmitted to depots and materiel can be routed to operational units without delay. The following examples describe four important new LMS programs and suggest some interfacing issues that deserve attention.

WSMIS

The Weapon System Management Information System (WSMIS) provides responsive wartime assessments projecting weapon system capability given current resources and infrastructure performance factors. WSMIS then ranks the factors most limiting sortie generation and aircraft availability. WSMIS also provides information to item managers to assist in developing responsive get well actions.

To be responsive, weapon system assessments can best be done *in the theater*. Communications on asset positions and aircraft status will be so dynamic that the transfer of this information back to a central AFLC site, where WSMIS analyses are currently done, may not be responsive enough to meet wartime assessment requirements. Therefore, WSMIS may need to be moved *forward* with only theater back-up capability at AFLC.

SC&D

The stock control and distribution (SC&D) system will provide real time visibility of worldwide assets and real time (not batched) renewal of requisitions. These features will allow item managers to recognize critical needs and allocate resources more responsively.

The scenario painted earlier indicated there will likely be damage, or at least disruption, to some base supply computers and communications systems. SC&D is currently designed to operate with communications intact between each of the worldwide bases and AFLC air logistics centers (ALC). To deal with this dynamic scenario, SC&D must have alternative ways of obtaining resupply requirements from the theater. One way to do this would be to have assured communications between each of the theater bases and the theater LOG C^3I center. The theater LOG C^3I center needs assured communications with the AFLC LOG C^3I center. The AFLC C^3I center then could have assured communications to each of the ALCs. This set of minimum essential communications links would ensure that resupply requirements could be forwarded from the theater to each ALC. Communications to the theater which tell when resupply actions will take place could be returned via this channel. Again, this illustrates the kinds of thought processes that need to take place in developing a survivable, supportable, and responsive wartime logistics support structure.

RDB

The requirements data bank (RDB) program is revamping the entire Air Force requirements determination process. A critical element of this development is a shift to *aircraft availability* as the measure of merit for materiel requirements planning, programming, and budget execution processes.

Changing operational priorities and base damage will require rapid and flexible depot repair during the first 30 days of battle. If this is the case, RDB must accept overlays of repair requirements needed to support theater priority resupply actions directly from SC&D operating in a wartime mode. RDB must then overlay these repair requirements into the Depot Maintenance Management Information System (DMMIS) with modifications to repair schedules to meet specific aircraft availability targets given frequently changing priorities. Changing battlefront conditions and priorities will likely necessitate changing repair schedules on *more than a biweekly basis*.

DMMIS

DMMIS provides advanced tracking of assets in repair, identifies repair bottlenecks, and inducts and repairs critical assets on a priority basis. DMMIS should provide the ability to determine asset repair status and adjust repair sequences as dictated by the battle.

DMMIS must be able to accept frequent changes to repair requirements from RDB and output repair schedules to meet priority requirements quickly. Given that repair actions are expedited, serviceable assets need to be returned to the theater as soon as possible to support the combat zone. The European Theater Automated Distribution System (ETADS) must have the capability to guarantee shipments will take place when needed. That means an interface between ETADS and channel transportation authorities is required to assure airlift of priority shipments is scheduled and ready. Currently, there is no feedback system that indicates MAC will have transportation on the ground at a specific point to lift cargo of very high priority needed for combat operations. In addition, ETADS may require information on what selected stock numbers are included in specific shipments. As a result, an enhancement to ETADS may be necessary to track *specific* requisitions within a transportation control number so theater C^3I operators will have the ability to expedite, cancel, or divert shipments with specific stock numbers included in them.

A lot of work still remains to be done in interfacing existing LMS programs to ensure they pass the right kinds of information from the battlefront via the base or through a theater command and control center to the ALCs to cause the right logistics repair, distribution, and procurement actions to take place in a responsive time frame.

RAND Uncertainty Interfacing

The RAND Uncertainty Project is being jointly sponsored by HQ USAF/LE and AFLC with the active participation of

Ogden Air Logistics Center.[4] The main thrust of the project is to explore ways to enhance depot infrastructure (repair, distribution, transportation, and procurement) functions in light of probable uncertainties of a dynamic wartime environment. The twin goals are to determine how to improve "orchestrated" infrastructure responsiveness to achieve specific aircraft availability targets with the *current* structure and decide what to pursue in the *long run*. The RAND work is therefore critical to the development of a responsive depot system. The Uncertainty Project and the LOG C^3I program need to be brought together in a single effort aimed at ensuring the infrastructure is responsive in wartime.

Key Functions

The key functions of the logistics C^3I system are to support planning, execution, and monitoring across all phases of military operations including peacetime operations, crisis actions, mobilization, deployment, employment, and reconstitution activities.

Planning

The LOG C^3I system must deal specifically with weapon system planning and logistics infrastructure planning. Weapon system planning involves projecting wartime sortie generation capability and aircraft availability given current materiel resources and logistics infrastructure performance characteristics. It also identifies specific materiel resources or logistics infrastructure components limiting aircraft availability or sortie generation. Finally, it assesses and tracks get well plans for correcting resource and/or infrastructure shortfalls.

Infrastructure planning functions are similar to those accomplished in the weapon system area. First, wartime repair, distribution, and procurement capabilities are projected for a given forecasted workload from the weapon system assessment area. Second, specific combat limiting infrastructure components are identified. Third, infrastructure get well plans are assessed and tracked to ensure the infrastructure can support combat operations in the scenarios investigated.

These planning needs are translated into WSMIS operating management systems for use in estimating wartime sortie limiting factors during peacetime. After close examination, however, the data requirements and algorithms currently in use may require change in order to operate efficiently *during* the more demanding wartime environment.

Execution

The C^3I system must have communications channels with the Joint Chiefs of Staff (JCS) and commanders in chief (CINC) to obtain theater and weapon system priorities within the theater. Once this information is obtained, the key execution function is to translate these priorities into dynamic and meaningful goals for use by the infrastructure. Specifically, repair workloads and time tables must be determined; transportation must be arranged to carry retrograde and serviceable cargo to and from the theater; procurement actions must be aligned with repair actions and combat theater resupply requirements; and unit level goals must be established so the infrastructure can support units on a differential basis. In wartime, the execution system must translate frequent priority changes to support worldwide requests and differential theater and weapon system support.

Monitoring

The major function of the monitoring segment of the LOG C^3I system is to provide system-wide oversight. This segment must provide the feedback to confirm or deny that support operations are balanced and consistent with the operational situation across resources for weapon systems within a theater. For example, if spare parts are required in certain quantities to support a given sortie generation capability or aircraft availability goal in one theater, and support equipment and/or wartime consumables are not being provided to support this level of activity, signals must be sent to the appropriate support managers so these resource groups can be brought into balance. If all theaters cannot be supported at desired levels, the theaters and support managers must be able to collaborate on joint allocation decisions. JCS arbitration may be necessary. The critical function of this part of the LOG C^3I system is to ensure the system is performing as planned and, when it is not, send signals to appropriate people to bring the system back into the planned performance. If this is not possible, adjustments to either operational or support plans may have to be made.

Graphic View of LOG C^3I Activities

A great deal of information must pass between various organizations to "orchestrate" the wartime logistics infrastructure. And, logistics C^3I needs to be tailored for different types of potential conflicts. In the description that follows, we assume the theater has a large infrastructure like that in Europe. Information flow in the Pacific will be different, as will other scenarios that have little or no infrastructure in the combat theater. The measure of merit for orchestrating the infrastructure, aircraft availability, defines certain standard information that must be collected and processed. However, *where* the information is collected and calculations take place, and *how* resultant infrastructure direction is passed, are theater dependent. An important feature of availability is that it can be partitioned so decentralized ALC actions can take place to support an overall central weapon system goal. In other words, each ALC's workload can be identified, placed in priority sequence, and worked in a decentralized fashion so the total consolidated effort meets weapon system availability goals in specific time frames.

Figure 7 shows a rather busy but very important graphic display of the kinds of information flow the LOG C^3I system must support between various organizational elements—including air bases, the theater C^3I center, AFLC Logistics Operations Center (LOC), and each of the ALCs—in a "NATO-like" scenario. The boxes in each of the bases represent communications gateways for information between various computers. The arrows indicate the information flow between sites. For instance, on the top of the diagram, the S shaped lines represent local area networks (LAN) where information is shredded out to appropriate people such as management and operations staffs of item managers (IM) and systems managers (SM). The diagram shows both the information flow and a limited view of the computer hardware

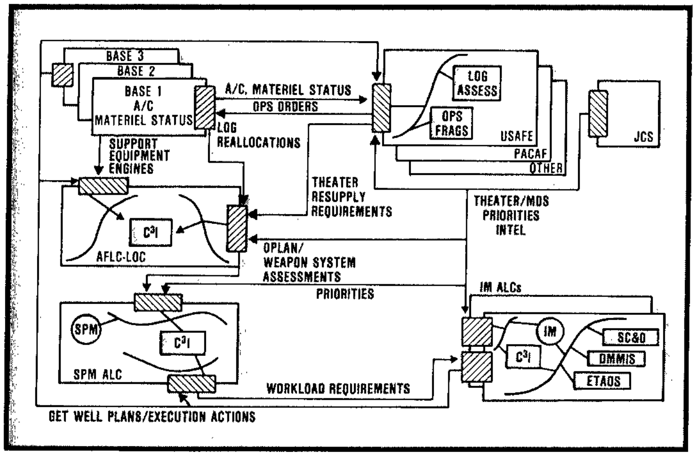


Figure 7: LOG C^{3}I activities and information flow in NATO-type environment.

and communications required to move the information. The boxes off the LANs represent computers.

The top portion of the chart illustrates information that must move between each of the bases in the theater and the theater C^{3}I center. As a minimum, the status of weapon systems and materiel at each base must flow to the theater C^{3}I center for use in determining the operational taskings to be flown for the next time sequence. While operations people are putting together projected sortie taskings against given targets, logistics people must be able to assess the ability to support given sortie generation goals. The logistics elements feed logistics supportability assessments of planned operations to the operations staff *before* operations orders are given. When the logistics support staff has a supportability problem, they must act to increase support to given bases. This could involve redistribution of stock from one base to another or, if maintenance capability has been damaged, the maintenance of reparables at a location other than where they failed. If, after all get well analyses have been evaluated, logistics people cannot come up with a supportable plan to meet the operations requirements, the operators may have to alter their orders. This responsive "give and take" between theater operations and logistics staff is one of the reasons that WSMIS assessment capability must be moved forward to the theater. Based on these assessments, operations orders and logistics reallocations flow between and among the bases.

The diagram shows information flowing from the base level into the AFLC LOC. Unclassified information, such as support equipment and engine status, flows through the local area network into the LOG C^{3}I AFLC computer. Along with the unclassified information, classified information flows through the classified gateways. Classified information includes aircraft and materiel status, such as reparable spares, petroleum, oil and lubricants (POL), tanks, and pylons. Assessments using this base level information could be accomplished at the AFLC C^{3}I computer if communications links are intact. The communication of this information from bases into the LOC may, however, be disrupted—this is represented by dashed lines. If communications are intact, the LOC, working with the theater LOG C^{3}I assessment group using JCS priorities for theaters, could then run intertheater assessments. Using this information, the LOC could inform higher command authorities of trade-offs that could be made among theaters to provide support for the highest priority at a given point in time. If base level information is not available, the theater LOG C^{3}I centers would have to provide, as a minimum, theater resupply requirements to the LOC so intertheater analyses could determine resources available for reallocation from AFLC into each theater. Given the minimum essential information flow of theater resupply requirements and JCS guidance on theater priority levels, the LOC could use the LOG C^{3}I system to orchestrate work loads for each of the ALCs to meet theater resupply requirements.

This activity is shown as classified information, moving from the LOC to system program managers, directing time-phased work loads for each type aircraft within a theater. At the same time, resupply requirements are provided to the IMs, who would use SC&D to determine asset locations that could fulfill particular requirements. If there are reparable carcasses due in or at the ALC, DMMIS could be used to determine when assets could be repaired to support the theater requirement. ETADS could be used to arrange for transportation. These get well plans and execution activities then would be furnished to the appropriate system program manager, the LOC, theater C^{3}I center, and higher command authorities *before* execution.

Depot Activities

Figure 8 shows more detail on the functional responsibilities that ALCs have in the LOG C^{3}I assessment arena. The figure shows landing gear wartime requirements coming in from the AFLC LOG C^{3}I center. These assessments would be extracted from WSMIS in a planning mode. Flowing into the other side is theater and system priority information. Maintenance analysts would determine if they have the capability to repair the number of carcasses forecast within the time frames required to support the theater at the desired levels. The shops could then determine how they would go about satisfying shortfalls. For instance, there could be some near-term actions to eliminate shortfalls, such as using extra shifts. Long-term solutions may involve adding more equipment or skilled people to handle specific work loads.

In the execution mode, maintenance would indicate to the LOC and the theater C^{3}I activity how much of the total requirement they can handle within the required time frame. If repair capabilities would constrain operations, this would be fed back to theater operations planners. Logistics requirements could then be modified by flying an adjusted sortie mix or by allocating sortie rates to capable airframes. At any rate, these trade-offs would need to be determined in quick order.

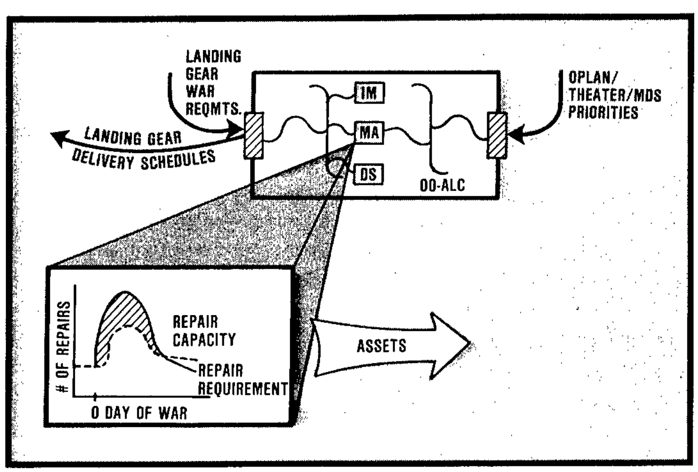


Figure 8: LOG C^{3}I activities at an air logistics center.

Building Blocks

Six major building blocks will provide this capability. The first three are the software, policy and procedures, and hardware and communications necessary to accomplish weapon system planning, infrastructure planning, and wartime execution functions. The fourth enhances current operation centers. Currently, AFLC has very limited capabilities to receive and generate message traffic among the various headquarters and depot components. Short run improvements will provide automated message handling capability, methods to generate automated situation reports, interface with the Intersite Command Post Communications Network to enable simultaneous viewing of information at ALCs and HQ AFLC, and more secure telephone links and data handling methods. These enhancements should improve the administrative functions associated with running the AFLC operation center in a wartime environment. The fifth building block will provide a command exercise system, and the final block will add an interface with the DOD Intelligence Information System.

Hardware will be compatible with the Joint World-Wide Military Command and Control System (WWMCCS) Information System (WIS) hardware and architecture. The communications necessary to interconnect the various activities and echelons of command, HQ AFLC, ALCs, the LOC, major commands, Joint Chiefs of Staff, etc., will use AUTODIN, Defense Data Network (DDN), and classified local area networks.

System Hierarchy

The entire LOG C^3I program, as shown in Figure 9, is nested within the overall WIS program. WIS contains both the AFWIS and LOG C^3I programs. The WIS program objective is to acquire replacement hardware and software to accomplish the joint missions now being handled on the WWMCCS system. This includes the acquisition of common user station (CUS) hardware to provide access to users of joint software. The program provides joint hardware for each major command and joint software conversion from the WWMCCS to the new hardware. AFWIS is the Air Force element of WIS. AFWIS provides the vehicle for acquiring Air Force unique hardware not included under the joint hardware umbrella. An example would be the display devices associated with the AFLC Intersite Command Post Communications Network (ICPCN). AFWIS is also responsible for the conversion and development of Air Force unique software. In the acquisition of AF unique hardware, AFWIS provides only the contract vehicle which could be used by AFLC to acquire off-the-shelf, WIS-compatible hardware needed to interface with the joint hardware. AFWIS is funding for the conversion and development of AF unique software; for example, the conversion of the Combat Supplies Management System (CSMS). If the Air Force has unique hardware to attach to the joint hardware, AFWIS will provide the interface hardware contract vehicle to allow this. AFWIS would also assist in the development of interface software between Air Force unique software and joint software. In addition, AFWIS could assist in the development of an AFLC architecture to fit within AFWIS in the WIS programs.

The LOG C^3I program provides the vehicle for AFLC to acquire CUS hardware; acquire AFLC unique hardware requirements such as the ICPCN; interface unique AFLC hardware with AFWIS hardware (including joint programs such as the Joint Deployment System—JDS); and develop AFLC unique LOG C^3I software. Basically, the AFLC LOG C^3I program handles the command unique set of software, hardware, and interface requirements.

Currently, WSMIS capability assessments are run on AFLC WWMCCS facilities. The Combat Ammunition System (CAS) is a current example of an execution system being operated in the WWMCCS environment. Several capability assessment data bases are also housed in the WWMCCS machine. This WWMCCS capability will be able to grow and expand into WIS/AFWIS replacement hardware to handle all the LOG C^3I functions discussed in this article. In addition, an unclassified portion of LOG C^3I will communicate "get well" solutions from functional and item management communities to the LOC and theaters. Currently, the unclassified portion of LOG C^3I resides at the Tinker Data Services Center at Oklahoma City ALC.

PROGRAM	FUNDING	PROVIDING	LEVEL
WIS	Acq joint hardware	Joint hardware	AFLC
	Acq joint software	Joint software	AFLC
	Acq customer hardware	Contract vehicle	AFLC/ALCs
AFWIS	Acq AF-unique hardware	Contract vehicle	AFLC
	Dev AF-unique software	AF-unique software	AFLC
	Acq interface hardware	Contract vehicle	AFLC
	Dev interface software	Interface software	AFLC
	Dev AF/AFLC architecture	Architecture	AFLC
LOG C^3I	Acq customer hardware	Cus hardware	AFLC/ALCs
	Acq AF-unique hardware	AF-unique hardware	AFLC/ALCs
	Acq interface hardware	Interface hardware	AFLC/ALCs
	Acq AFLC-unique hardware	AFLC-unique hardware	AFLC/ALCs
	Dev AFLC-unique software	AFLC-unique software	AFLC/ALCs
	Implem AFLC architecture	Hardware and software	AFLC/ALCs

Figure 9: LOG C^3I system hierarchy; the program is nested within the joint WWMCCS information system (WIS).

Strategy and Status

Due to risks and the size of the program, the LOG C^3I development strategy calls for incremental development. Accordingly, AFLC developed a program as a first start for immediate payback. The first start provided about 70 battle staff work stations at HQ AFLC and each ALC, enhanced secure data and voice communications between the ALCs and the LOC, improved electronic mail, and ICPCN interfacing with WWMCCS. In addition, the prototype will develop an automated operations report generator and automated crisis notebook containing a planning documentation library, battle staff directory, alternative communications routing data bases, battle staff checklists, suspense tracking system, and DEFCON attainment requirements to be used by people operating specific stations on the battle staff. This work is on track and progressing toward near-term implementation.

Development of the planning, execution, and monitoring software is a longer term project. The RAND Uncertainty Project needs to be integrated into this effort. An initial concept of operations has been developed and coordinated, but a draft functional description needs to be developed before this work can proceed. This work has been curtailed due to funding limitations mentioned earlier in this paper.

TO 39 ▶

Career and Personnel Information

Civilian Career Management

Logistics Civilian Career Enhancement Program (LCCEP)

Rebaselining LCCEP Positions

In January 1987, the LCCEP successfully completed a rebaselining effort which added or validated approximately 2,300 LCCEP positions, a net increase of approximately 250 positions. Rebaselining LCCEP positions was critical to the Policy Council's primary objective of returning autonomy to the MAJCOMs/ALCs. This action allowed those organizations the flexibility to determine which logistics positions should be/should not be identified as LCCEP positions.

When LCCEP originally began operations in 1980, the goal was to manage a certain portion of the logistics positions within each organization. This was then interpreted rigidly as an organizational percentage requirement without flexibility. Last year, the Policy Council opted to identify a new position baseline to correct this problem, with these objectives:

- Provide a stable register of centrally managed positions.
- Implement MAJCOM review and approval of positions in the program. This provided the opportunity to remove positions that management determined should not be in the program and to add positions which met the criteria established for logistics positions.
- Perform a top-down evaluation of logistics positions to facilitate a good support structure.
- Standardize Occupational Series (OCSRS)/skills coding of like positions. Standardization would simplify a registrant's career planning and allow managers to receive certificates with the highest qualified Air Force candidates.
- Provide commonality of LCCEP positions. This ensured like positions at the various bases would not have unique requirements which excluded registrants from other bases performing the same functions.
- Facilitate central Promotion Evaluation Pattern (PEP) development and maximize clustering—the same PEP would be used to fill the same types of jobs.

The LCCEP Policy Council provided these guidelines for rebaselining:

- All logistics positions would be considered for the purpose of rebaselining.
- Like positions at various locations would be included.
- Positions with shared position descriptions would normally be included.

The Policy Council provided the following guidelines for excluding positions from LCCEP:

- LCCEP career-broadening positions.
- Positions with less than 50% logistics duties.
- One-of-a-kind, or project-oriented positions.
- Air Reserve Technician (ART) positions.
- Obligated positions.
- Time limited positions (two years or less).
- Rotational positions at multiple locations.
- Joint Services positions.
- Required skills not normally found in LCCEP registrant population.

After Rebaselining

The Position Control Program Administrator was tasked to establish an audit trail on baselined positions, accept additional positions any time (with info to MAJCOM), remove baselined positions only when requested by MAJCOM letter, publish baseline position information, and provide statistics to the Policy Council.

Was rebaselining successful? Yes! As a result of this effort, the major commands (MAJCOMs) greatly increased the number of positions for LCCEP management—another step forward.

(R. Larry Edge, AFCPMC/DPCML)

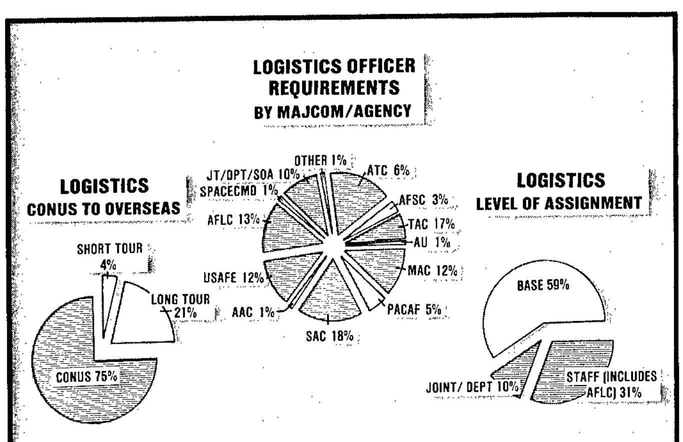
Military Career Management

Logistics Requirements

In making assignment decisions, the Air Force Military Personnel Center (AFMPC) must consider actions that meet the needs of the Air Force as well as the varying requirements of each Air Force specialty or discipline. Obviously, there are many complex, intertwining requirements; more driving ones are the distribution of the requirements (authorizations) by major command/agency, the level of authorizations, and the overseas requirements.

The pie charts detail these logistics officer discipline requirements. The statistics include lieutenant colonel through lieutenant authorizations in the following Air Force specialty codes (AFSC): 004X - Director of Logistics; 009X - Deputy Commander for Resource Management; 31XX - Missile Maintenance; 40XX - Aircraft/Munitions Maintenance; 60XX - Transportation; 64XX - Supply; and 66XX - Logistics Plans and Programs.

In developing professional objectives/goals, it is important for officers in logistics specialties to consider these requirements and plan their careers accordingly.



(Col Edwin C. Humphreys III, HQ AFMPC/DPMRSL (Palace Log))

POSSEM-ALERT:
The Search for a Requirements Forecasting System

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POSSEM-ALERT: Alarmed marsupials or serious requirements forecasting models?

Background

POSSEM (Peacetime Operating Stocks Spares Estimating Model) and ALERT (Air Logistics Early Requirements Technique) are mathematical models which have recently been used to forecast aircraft spare parts requirements for the Air Force Program Objective Memorandum (POM). By the term "requirements forecasting," we distinguish between the retail perspective (which considers imminent needs, such as a SAC Wing's scramble during an operational readiness inspection (ORI) or the sortie generation of a TAC F-16 squadron during a Red Flag exercise) and a wholesale perspective concerned with long-term solutions (such as preparation of the budget and POM—a multiyear forecast horizon). The former situation is usually thought of as an assessment process, whether it be the actual generation of aircraft or emulation of the generation process by use of some computer model such as DynaMETRIC. The distinction between the *assessment* process and the *requirements* process is the intervention of time.

Assessments are primarily performed using "right now" factors—current flying hours/sorties, failure patterns, and resupply times. They most readily apply to operating location exigencies. Requirements processes seek to achieve longer term logistics goals, encompassing estimation of logistics resource needs and articulation of these needs in the multiyear horizon of the budget and POM. They are the primary dominion of the Air Force Logistics Command (AFLC). The purpose of this article is to describe existing requirements forecasting models and their relative effectiveness for projecting wholesale needs.

Much can happen between assessing needs and effecting resource remedies. An example is the period between 1980 and 1982. In 1980, defense logistics budgets were cut by as much as one-half. In 1982, the requirements processes were simultaneously shocked by cumulative double-digit inflation; "catch-up" from 1980 budget cuts; induction of some of the most extensive weapon system modifications in history; and a host of imponderables ranging from national policy and economic recession to methodological changes in computational models. The result was an unexpected peak in most logistics budgets, one of the most visible being the rapid growth of the aircraft replenishment spares budget (BP15) from approximately two billion to three billion dollars. With national attention beginning to concentrate on the growing national debt, high-level attention focused on improving Air Force requirements forecasting accuracy—Air Force credibility.

Necessity is the mother of invention. In January 1983, the HQ USAF Directorate of Cost and Management Analysis introduced a new forecasting model which was subsequently named POSSEM.[1] This introduced a significantly different approach to forecasting aircraft spare part procurement needs for the out-years of the POM, a three-to-seven year forecast horizon. It was used to forecast BP15 requirements for both the FY85 and FY86 POMs. A refinement of the POSSEM model, ALERT, was introduced by the HQ AFLC Directorate of Materiel Requirements and Financial Management in January 1984.[2] ALERT is still used today.

Model Features

POSSEM and ALERT are long-range forecasting models. They use a mathematical method to describe the nature of multiple period historical data based upon its characteristics. Both are multiple linear regression constructs. POSSEM simply measures the historical relationship of two external variables, fleet value and fleet age, to past budget costs.

> ***"The models dropped the use of flying hours as usage predictors due to poor correlations."***

Conceptually, more expensive fleets may require proportionally more costly logistics support. Fleet age may also influence logistics needs. Young fleets are logistically immature, requiring more frequent repairs, whereas old fleets suffer the "tired iron" syndrome. ALERT uses the same variables but augments the equation with the actual computed requirement from the official AFLC item-by-item calculation for the first POM year. Due to poor correlations, both methods attempted—and then dropped—the use of flying hours as predictors. Both are macro-model approaches; that is, they compute requirements for entire weapon systems rather than on an item-by-item basis.

These models differ from the predominantly used benefit-cost models, such as METRIC (Multi-Echelon Technique for Recoverable Item Control)[3], used by HQ AFLC to compute recoverable item requirements. The latter typically use short-range averages or point estimates of factors, and then compute requirements by prescribed rules without regard for either how well the results actually emulate the real-world situation (model validity) or how well the historical data holds a pattern indicating its likely future behavior (model reliability). They are considered "micro" models due to their use of item-by-item computations which are then added together to compute a requirement.

Micro Versus Macro: Which Is Best?

Micro Models

Micro models make intuitive sense for *near-term* assessment situations. They attempt to emulate item logistics behavior using logical resupply rules. For each active item, a demand rate, typically an eight quarter moving average, is multiplied by a resupply time (a delay time due to base or depot maintenance, or procurement lead time, etc., as appropriate) to develop a resupply "pipeline." To this "pipeline," or average number of items in resupply, a safety stock is added. The safety stock is usually based upon a measure of the variability of the item's average demand. For example, AFLC's current item level requirements model computes a variance-to-mean ratio from demand data. This is used to establish the "spread" of the negative binomial distribution which the model uses. This "spread" is then used to establish additional stock requirements to assure some minimum confidence of achieving supply objectives. The model also "weights" the items by benefit-cost ratios. More sophisticated models currently being tested also prioritize by the amount of contribution to higher assembly/weapon system backorder reduction. Individual requirements are combined to determine a total requirement.

These models depend upon a lot of data being accurate (more than 30,000 items in a typical AFLC recoverable item computation, with associated logistics factors). They further depend upon the relationships of the data being properly specified so calculations of requirements are correct. And they depend upon these conditions being maintained through time.

Data accuracy has become a significant concern. Recent research has indicated that item demand stability is very short. The average reparable item is actively demanded for around two to four quarters and then becomes dormant.[4] Its magnitude can be appreciated by the "migration" of items into and out of the $400 to $4,400 size of business for Defense Logistics Agency (DLA) items in one year.[5] In Figure 1, the number of items falling into this annual size of business would appear to be relatively stable between 1980 (45,435) and 1981 (49,916). However, the migration of items from higher or lower cost groups (43,216) into this category, and from this cost category to others (40,216), implies significant dynamics ongoing in the demand process. Similar observations have been made with Air Force consumable and recoverable items.[6] Such observations are not surprising when one considers that only a small percentage of total items are "active" at any given time, allowing significant opportunity for items previously not considered by the model to become active participants (e.g., for AFLC recoverable items, about 30,000 of a total population of about 150,000 candidates, or around 20%).[7] The evidence indicates a high probability that models using such short-lived item level data will perform poorly at the micro level for requirements forecast horizons.

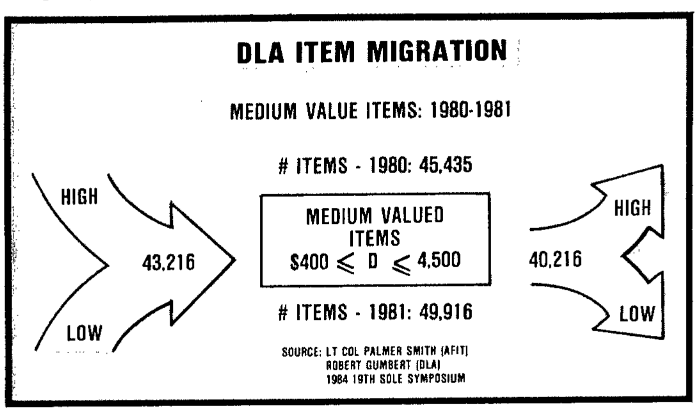

Figure 1.

"A plethora of reasons exist for variable demands over time."

There is also evidence that the data relationships may not be properly specified over time. It is beyond the scope of this paper to speculate upon the efficacy of the static relationships assumed in most models as the appropriateness of Palm's Theorem or proper methods of setting safety levels. It is important, however, to point out that modeling assumptions over multiperiod forecast horizons must allow for data dynamics. A recent observation of currently used recoverable item computations illustrates the short-lived properties of the data. In one recent internal AFLC review, a METRIC type computation demonstrated a computed "buy" requirement may be significantly understated by the second or third year of a computation relative to the "true" buy requirement which will be computed as those years arrive.[8] This was due to the modeling assumption that beginning demands were primarily the result of stable demand factors and that, once "bought out," the future logistics problem becomes one of buying additional condemnations for these same items. In fact, a plethora of reasons exist for variable demands over time such as program changes, modifications, or inflation. Their combined effects produce the new requirements, causing significant migration of items into and out of the computations of later periods.

Macro Models

ALERT is currently the only macro model currently used by the AFLC for logistics requirements forecasting; it replaced POSSEM in 1984. It offers intuitive appeal for forecasting the *long-range* forecast horizon. Its data base is multiyear, and the data is comprised of aggregated numbers likely to exist from period-to-period, thus circumventing the item migration problem. The notion is that *real* budgets are executed against *real* problems, regardless of what forecasted problems may have been envisioned. Thus, the history of real executed budgets is the model's benchmark, the foundation upon which it bases its equations. ALERT develops mathematical relationships between item-by-item management summaries for the third year (computed for recoverable items in DO41) and historical budgets which occurred through history. Where these relationships appear weak, the model adds additional independent variables such as fleet age, fleet value, or chronological time, to augment the equations.

Since the introduction of POSSEM and ALERT, there has been no shortage of healthy criticism. Both models have been reviewed in detail by internal and external experts. Both compute significant variance in weapon system level equations, which implies reduced forecast reliability. One study suggests that the ALERT modeling approach seems conceptually sound but experiences instabilities due to data volatility, and questions whether significant improvements to data are possible.[9] The report further suggests that because of data volatility, "management, not forecasting, is the answer."[10] Other criticisms point to a need to improve the specification of the underlying dynamics by identifying and understanding causality in the data used for such forecasts.[11]

"Even if the equations capture perfectly the requirements process dynamics and allow acceptably accurate forecasts, they do not allow management to consider alternative budget impacts."

Perhaps the most significant criticism, however, is that the ALERT is not programmatic. Even if the equations capture perfectly the requirements process dynamics and, in turn, allow acceptably accurate forecasts, they do not allow management to consider alternative budget impacts. For instance, in a forecasted budget for a C-5 aircraft, the decision maker cannot use the ALERT forecast to "game" a 10% decrease in budget relative to a decrease in expected available flying sorties.

"Recent efforts to improve requirements forecasting have shifted from a micro to a macro perspective—but both have their strengths and weaknesses."

The virtue of both POSSEM and ALERT is their introduction and use of macro-forecasting techniques more suitable to the multiyear forecast horizon of the budget and POM. As relatively simple models, they may allow more accurate forecasts than micro models by permitting better understanding of model operations.[12] This is not to say that current micro models may not be superior within the forecast horizon of their assumptions; for example, up to six months or even one year. But requirements forecasts must be realistically adapted to both the nature of available data and to the inherent characteristics of the forecast horizon.

New Requirements Forecasting Horizons

So, where now? The proposition that "management, not forecasting, is the answer" appears to overlook that one of the key ingredients to management *is* forecasting. General Douglas MacArthur is credited with saying: "Ninety-nine percent of brilliance is prior information." A key way to make a scientific guess as a proxy for prior information is to measure the properties of historical data in search for both benchmark validity and predictive reliability. Interestingly enough, a respectable level of activity has begun to stir concerning improved materiel forecasting techniques during the past two-to-three years. Key among these efforts have been attempts to understand the nature of the underlying historical data and, from this, to identify better modeling approaches. Once these efforts are accomplished, the Air Force hopes to accurately specify the true underlying logistics processes.

The "data problem" has been a major study effort. HQ AFLC has developed a state-of-the-art logistics analysis and forecasting "tool box" for tracking and analyzing recoverable item characteristics through time.[13] The data and mathematical tools are being developed in the AFLC Requirements Data Bank (RDB). Rudimentary history back to 1978 will be initially available in late 1987 to test new forecasting approaches. The data base will be flexible enough to allow either item level analysis or the aggregation of items for subsystem, system, or end item analysis, as appropriate for the forecast horizon. Additional research is being conducted concerning data volatility by several AF and contractor analysis groups under such names as item uncertainty, item churn, item migration, or demand variability.

"HQ AFLC has developed a state-of-the-art logistics analysis and forecasting tool box."

In developing the data study for the RDB, the AFLC analysts also hypothesized a potential conceptual approach to moderate both the item migration problems of micro models and the non-programmatic problems of the macro approach. The basic concept is represented in the requirements forecasting matrix in Figure 2.[14] The fundamental notion is to develop a flexible data base which allows adapting appropriate forecasting techniques as dictated by the forecasting situation. For example, if the problem is a near term allocation of available funds to competing item procurements, one might use an item level forecast. If the forecast situation requires forecasting into a longer range horizon, as the budget or POM, aggregation of item factors such as average stock group demands or resupply times may allow forecasting their likely values into the future. These pseudo factors might then be used in a requirements type computation.

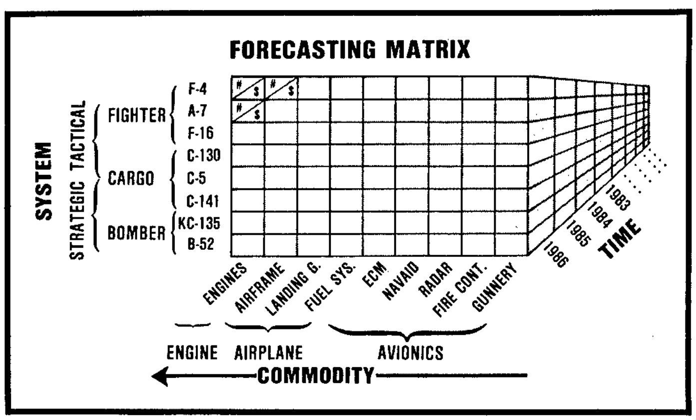

Figure 2.

This concept assumes that item factors can be aggregated to the level of a generic item factor which represents a class of items with similar logistics behavior over time. For example, the grouped mean demand and resupply rates for all avionics items for the F-4 aircraft computed over time may be more reliable than their item-level counterparts. Though items are entering and leaving the active demand population of avionics components, the behavior of the aggregate statistics may yield useful forecasting information. Groupings can be derived using system management codes, federal stock classes, or work unit codes, as appropriate.[15] Further, forecasts of expected numbers of these pseudo items or of generic inflation indices of their costs may be possible. If successful, this approach would offer an alternative around the item migration problem. It would also offer an improvement to the programmatic problem of macro models. By reducing the macro problem to forecasts of generic item factors, the factors could then be combined into pseudo requirements computations (e.g., the DO41 type computation might be emulated using generic item versus individual item factors). At least two models potentially capable of these computations, MACROSTAT and ALIGN, have been developed.[16]

Conclusion

Recent efforts to improve requirements forecasting have shifted from a micro to a macro perspective. There are apparent virtues and caveats to each extreme. The more traditional micro approach is appealing because it allows detailed monitoring of item level logistics. It rapidly exceeds model design capability, however, in the multiyear environment of the budget and POM due to data instabilities. Its strengths become its weaknesses.

The macro models attempt to circumvent the data problem by forecasting weapon system level requirements. They have intuitive appeal in that they measure both model validity and reliability. To achieve the longer range forecast, however, they must assume away the detailed information useful for requirements ''gaming.'' This obscures useful information concerning why requirements evolved, even if the forecasts can be made reliable.

The most recent research has suggested that some middle ground approach may be the next logical area to examine. The concept relies upon aggregation factors for logistics items. For example, the average demand rate for all avionics items within a weapon system may provide stabilities unavailable from item level data. Given concept validity, more programmatic treatment of the forecasted factors, used in a micro type model such as MACROSTAT, may be possible.

The challenge to develop more accurate Air Force requirements forecasting techniques continues. Recent research provides overwhelming evidence that both data volatility and modeling shortcomings are inhibiting improved forecasts at the present. Promising, however, is a resurgence of interest among both logistics managers and qualified analysts to tackle these perplexing problems.

Notes

[1]Headquarters United States Air Force. ''Study of Air Force Aircraft Replenishment Spares Requirements,'' HQ USAF/ACM, Washington, D.C., 5 January 1983.

[2]Brannock, James W. ''A Study of POM Forecasting for Aircraft Recoverable Spares,'' presented to Deputy Chief of Staff/Materiel Management, Wright- Patterson AFB, Ohio, January 1984.

[3]Sherbrooke, Craig C. ''METRIC: A Multi-Echelon Technique for Recoverable Item Control,'' *Operations Research*, Vol. 16, 1968, pp. 122-141; The Rand Corporation, RM-5078-PR, November 1966.

[4]Sherbrooke. ''Estimation of Variance-to-Mean Ratios for AFLC Recoverable Items'' (i.e., reports use of a .4 alpha in simple exponential smoothing best fits the data sample), AFLC Contract #F33600-82-6-0575, 27 January 1984, p. 25; Jim Mosley (OC-ALC) presentation to the AFLC Analysis-Information Management Conference (i.e., that for a study of depot repair demands, a four quarter moving average outperformed other periods), Tinker AFB, Oklahoma, 9 October 1986; Major Eugene Lindsey, Major Douglas L. Blazer, Charles Miller, ''Awaiting Parts (AWP) Enhancement.'' AFLMC Project LS831102, AFLMC, Gunter AFS Alabama, February 1986, pp. 25-26.

[5]Smith, Palmer W. and Robert Gumbert. ''The Impact of Item Migration on Stockage Policies, Inventory System Evaluation, and Stock Fund Monies,'' Proceedings of the Society of Logistics Engineers Annual Symposium, 1984, p. 3.

[6]Kennedy, John D. ''The Impact of Item Migration in the Air Force Logistics Command Inventory System,'' AFIT/GOR/OS/85D, Air Force Institute of Technology, WPAFB OH 45433, December 1985; HQ AFLC/MMMAA, ''POM Forecasting,'' Study No. 85-318, WPAFB OH 45433, June 1986, p. 7.

[7]''POM Forecasting,'' p. 2.

[8]HQ AFLC/XRS Internal Correspondence, 17 January 1986.

[9]Hanks, Christopher H. ''Can the Air Force Solve Its Spare Parts Forecasting Problem?'' LMI Report AF501R3, Logistics Management Institute, Besthesda, Maryland, September 1986, p. 4-17.

[10]Ibid., p. 5-1.

[11]Armstrong, Dr. J. Scott. Consultation visit to HQ AFLC, 18 December 1985.

[12]Armstrong. *Long-range Forecasting: From Crystal Ball to Computer*, John Wiley & Sons, New York, 1978, pp. 204-213.

[13]''POM Forecasting,'' p. A-11.

[14]Brannock. ''POM Forecasting Requirements for RDB,'' HQ AFLC/MMMAA working paper, 15 February 1984.

[15]Insley, Patricia A. and William P. Hutzler. ''POM FY85 BP 1500 Cost Growth and Leadtime Adjustments: Research Results,'' Contract F33615-81-C-5018, prepared for USAF Business Research Management Center, WPAFB OH 45433, 28 February 1983, p. II-4 (developed the concept of grouping item Federal Supply Classes by aircraft type for possible insight into resupply characteristics.)

[16]Sinergy, Inc. ''MACROSTAT: An Approach for Estimating Aircraft Replenishment Spares,'' briefing presented to HQ AFLC/MMM, Wright-Patterson AFB, Ohio, 5 December 1985; ALIGN (Air Logistics Items by Generic Need) is a prototype model at HQ AFLC/MMMA.

Writing for *AFJL:* Style and Content

Perhaps you have considered submitting an article to *AFJL*, but were unsure that ''your'' style matches ''our'' style. It's an unfounded concern. The primary measure of merit for articles is *content*. Readers expect *AFJL* articles to be based on sound premises; to be well supported; to include authoritative references (or be written by an acknowledged authority); and be meaningful to middle/senior leadership who are responsible for making decisions with broad, cross-functional implications.

Many of our writers are blessed with superb expressive skills; many are not. We hope you agree, though, that every article is clear and concise when published. We work with writers to whatever extent is necessary to ensure this.

On the matter of style, there are many—and that's good. In our last issue, Tom Sherman of Sullair Corporation wrote in a colloquial, breezy style that smacked of chewing the fat over a pitcher of margaritas—not the ''typical'' *AFJL* format. Yet, the article was very well received by readers. Why shouldn't it be? It was meaningful, well supported, logically presented, and addressed a timely topic. The fact that it was also *readable* didn't detract in the slightest!

It's easy for a professional journal to become bloated with writing that is haughty, esoteric, and laced with bureaucratic jargon and disclaimers. *AFJL* strongly resists this. We're after your *expertise, knowledge, ideas, concerns,* and *viewpoints* on current issues. Given quality in these areas, style tends to take care of itself. Besides, that's what editors are for.

AFJL Editors

CURRENT RESEARCH

Air Force Logistics Command (AFLC) Logistics Management Sciences Study Program

The AFLC Directorate of Management Sciences (AFLC/XRS) is responsible for developing, managing, and executing the Air Force Logistics Command's management sciences study program. Directorate personnel develop, modify, and assist in the implementation of mathematical models that quantify the relationship between logistics resource alternatives and readiness and sustainability. XRS is also involved in evaluating logistics operations research studies performed by other governmental, industrial, and academic institutions; providing management sciences consulting services to other AFLC organizations; and exchanging logistics operations research information and products between AFLC and other governmental, industrial, and academic institutions.

Directorate personnel have four major objectives for 1987:

(1) To have an algorithm that relates aircraft spares investment to peacetime aircraft availability ready for implementation in AFLC's requirements determination system for recoverable spare parts (D041).

(2) To help AFLC move toward more responsive logistics support to the operating forces in the early part of a war by demonstrating the effect of a specific change in depot maintenance scheduling policy on operational effectiveness.

(3) To quantify the relationship among investments in Stock Fund Items, maintenance awaiting parts times, and aircraft downtimes.

(4) To continue to enhance the ability of AFLC's Weapon System Management Information System (WSMIS) to project the number of aircraft available to generate sorties on a daily basis during the first 30 days of war.

The senior staff consists of:

Mr Victor J. Presutti, Jr., Director (XRS), AUTOVON 787-3201
Lt Col Michael Lacey, Deputy Director (XRS), AUTOVON 787-3201
Mr Curtis E. Neumann, Assessment Applications Division (XRSA), AUTOVON 787-6920
Mr John M. Hill, Concept Development Division (XRSC), AUTOVON 787-6920
Mr John L. Madden, Consultant Services Division (XRSM), AUTOVON 787-7408
Miss Mary E. Oaks, Study Program Administrator (XRS), AUTOVON 787-4535

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program, the USMMA plans to offer a two-year major in transportation, with selected graduates receiving a commission and entering Service transportation specialties. These programs will increase utilization of existing educational capability, while retaining the merchant seaman tone of the school for peacetime and wartime deck officer requirements. (Lt Col Harrington, AF/LETX, AUTOVON 227-7332)

Air Force Passive Solar Handbook

The Air Force Passive Solar Handbook (Volumes I and II) is being developed by contract to Architectural Energy Corporation. This handbook will describe techniques which are considered "normal passive," such as building orientation, shape, insulation, daylighting, vestibules, berming, and "unique passive" techniques such as atriums, Trombe walls, natural convection, sun spaces, extensive daylighting, etc. The handbook provides information about these and other techniques that can be applied to different types of facilities. An engineer, architect, or layperson at the base or MAJCOM level will be able to defend the features selected for further evaluation by the design firm through use of colorful charts and graphs. Volume II aids engineers and programmers when preparing programming documentation or project books by providing the right words and good cost estimates. (R. Fernandez, AF/LEEEU, AUTOVON 297-4083)

Construction Guidance

Within the next few months, the Air Force Engineering and Services Directorate expects the revised AFR 89-1, *Design and Construction Management*, to reach the field through the publications distribution system. This revised regulation provides the current policies and procedures for executing the Military Construction Program (MCP) and P-341, nonappropriated funds (NAF), and operations and maintenance (O&M) construction programs. Along with this regulation, the Air Staff will also issue new items called Construction Technical Letters (CTL) which will be in the same format as the Engineering Division's (AF/LEEE) Engineering Technical Letters (ETL). This allows the Air Staff to provide up-to-date information on such items as the project cost estimate (AF Form 1178), project books, early preliminary design, the Air Force Pricing Guide, inspectors guide (to replace AFM 88-13), design review checklists, and sample justification packages for reprogrammings, cost variations, and scope reductions. (Capt Bob Cullison, AF/LEECD, AUTOVON 225-8191)

Prewired Workstations

Beginning with the FY88 Military Construction Program (MCP), the cost for procuring prewired workstations will be included as part of the building cost for all new administrative facilities. Prewired workstations are acoustical panels and components which are panel-connected and panel supported to form complete individual offices. The panels contain building utilities, come in a variety of heights and widths, and have components such as work surfaces, shelving, lateral files, drawers, and task lighting for the work surface. These office components allow building space to be used effectively, can be easily rearranged, and will greatly increase the Air Force's ability to respond rapidly to mission changes affecting the layout of a building. (J. Nielsen, AF/LEEEU, AUTOVON 297-4250)

Military Construction Allocation

As a result of a decision made at CORONA SOUTH 87, beginning in FY90, military construction (MILCON) funds will be distributed to major commands using a new methodology. Since the early 1980s, MILCON resources in the Program Objective Memorandum (POM) process have been distributed to the commands based on the results of competition among all Air Force programs. The new methodology will establish a steady stream of funding for MILCON and distribute funds based on each major command's need to revitalize its physical plant and correct facility deficits. MILCON funding in command base operating support (BOS) accounts will be affected by this decision. We have forwarded detailed guidance for developing FY90-94 POM submissions to the major commands. (Maj R. Fernandez, AF/LEEPD, AUTOVON 227-1235)

TAC's Approach to Quantifying R&M

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Introduction

Reliability and maintainability (R&M) have long been recognized as important considerations in developing tactical weapon systems. However, R&M has historically taken a back seat to cost, schedule, and performance when offsets were needed in program development. These cost-cutting practices reduced development and acquisition costs, but resulted in increased operating and support costs. To redress this situation, the Air Force, in 1984, established the R&M 2000 Program to increase emphasis on R&M throughout the service. This increased emphasis has resulted in R&M being considered co-equal with cost, schedule, and performance for new system acquisitions and fielded systems.

"TAC wanted to tell the acquiring command and contractors 'what we want,' not 'how to do it.' "

Tactical Air Command's response to the USAF R&M 2000 Program was to establish a Special Management Organization for R&M (SMO-R&M) under the Deputy Chief of Staff, Requirements. Their charter is to ensure R&M receives its proper emphasis for new and fielded systems to indeed make R&M co-equal with cost, schedule, and performance. This article focuses on the TAC R&M 2000 organization's effort toward integrating quantifiable R&M parameters in the Statements of Operational Need (SONs) for new acquisitions. The SON was determined the key document to begin the work of increasing emphasis on R&M for two reasons. First, the SON is the initial document for the user to state requirements in operational terms with the purpose of validating the need for future funding and program development. Secondly, all follow-on documents—like specifications, test plans, and system operational requirements documents (SORDs)—are derived from the SON. The effort to integrate R&M parameters into the SON converged on two central issues: what R&M parameters should be quantified and how to ensure mathematical consistency among the parameters.

Selecting Operational R&M Parameters

In the past, requirements for R&M were often stated in contractual terms such as mean time between failure (MTBF) and mean time to repair (MTTR). Development of the advanced tactical fighter (ATF) SON revealed the inadequacy of this approach for a complex system. TAC found it more meaningful to express aircraft R&M requirements in terms like break rate, fix rate, and combat turn time to measure operational output. The *break rate* showed the reliability impact of the system in terms of required maintenance while the *fix rate* showed the maintainability impact in terms of the percent of aircraft returned to mission capable status in a given period of time. Finally, *combat turn time* showed the ability to refuel and reload a mission capable aircraft for the next sortie. These operational measures, in turn, equated to "sortie punch," or the ability to generate sortie after sortie to meet the wartime mission.

" 'Sortie punch' is the ability to generate sortie after sortie to meet the wartime mission."

Specifying requirements in operational language more clearly constrains the overall system design, system performance, and system support requirements. Furthermore, the use of these terms provided a positive way of tracking and measuring the R&M requirements in an operational environment with existing data collection systems. In essence, TAC wanted to tell the acquiring command and contractors "what we want," not "how to do it." In this way, the contractor would be allowed to make intelligent trade-offs to achieve the R&M and operational performance requirements.

TAC has since developed operational R&M parameters for avionics subsystems, munitions, and ground communications/radar equipment with guidance from AFP 57-9, *Defining Logistics Requirements in Statements of Operational Need*. System break rate and on and off equipment mean repair times are the R&M measures for avionics subsystems. System effectiveness, derived from incoming, dormant storage, and launch/flight reliabilities, and power-on post load check and mean time to assemble, are the R&M measures for munitions. Mission reliability, operational availability, mean time between critical failure, and mean downtime are used for ground communications/radar systems.

Ensuring Mathematical Consistency

When the operational R&M terms are being quantified, it is important to ensure mathematical consistency between parameters. This is usually an iterative process to determine the optimal mix of R&M. The following are some basic formulas to provide assistance in developing the appropriate level of R&M performance required to meet wartime mission scenarios. Additionally, the formulas illustrate the interdependency of the parameters in determining unknown values. For example, if meantime between critical maintenance is 130 hours and mean downtime is 1.5 hours, you can determine the operational availability (A_o) of the system as follows:

$$A_o = MTBCF \div MTBCF + MDT$$

Any change in the variables will impact the equation; thus, it is imperative that the relationships between each variable is understood and consistent.

Formulas

Combat rate (CR). The CR is the number of consecutive sorties an aircraft can achieve between critical maintenance. A given break rate will dicate the combat rate.

$$\text{Formula: } CR = \frac{1}{-\ln\,(1 - \text{break rate})}$$

Break rate (BR). The BR reveals the percent of time an aircraft will return from an assigned mission with one or more previously working systems on the mission essential subsystem list (MESL) inoperable, including air and ground aborts.

$$\text{Formulas: } BR = 1 - \text{mission reliability or } 1 - e^{\frac{-1}{CR}}$$

Mission reliability (MR). MR is the probability of a system functioning without a critical failure for a stated period of time. It is derived from the formula $R(t) = e^{\frac{-t}{\theta}}$

$$\text{Formula: } MR = e^{\frac{-\text{operating time}}{MTBCF}}$$

Mean time between critical failure (MTBCF). Unlike MTBF, which counts all failures in a system, MTBCF counts only those failures that incapacitate the system. Therefore, MTBCF is the average time between failure of mission essential system functions. MTBCF is used to compute mission reliability and operational availability. You can also compute MTBCF algebraically if operational availability and mean downtime are known.

$$\text{Formulas: } MTBCF = \frac{\text{mission duration}}{-\ln\,(MR)} \quad \text{or}$$

$$MTBCF = A_o \times \frac{MDT}{1 - A_o}$$

Operational availability (A_o). A_o measures the percent of time a system is capable of satisfactorily performing in the operational environment. It is assumed preventive maintenance and non-critical failures do not incapacitate the system. A_o is normally used for systems that operate for long periods of time such as ground communication or intermediate avionics test equipment.

$$\text{Formula: } A_o = \frac{MTBCF}{MTBCF + \text{mean downtime}}$$

Mean downtime (MDT). MDT is the average elapsed time between loss of mission capable status and restoration of the system to mission capable status. It includes the time to diagnose, repair, and verify the repair, as well as logistics and administrative delays. You can compute MDT if A_o and MTBCF values are known.

$$\text{Formula: } MDT = \frac{MTBCF}{A_o} - MTBCF$$

Conclusion

TAC's approach to R&M focuses on stating requirements in the way TAC understands them best—operationally. Stating operational requirements that are directly linked to the wartime mission allows the acquiring command (usually Air Force Systems Command) the latitude to do the engineering and program management to achieve the requirements. Additionally, using the formulas discussed in this article in a mathematically consistent manner provides the acquiring command's reliability engineer a starting point to begin translating the operational requirements into contractual ones.

"More formulas are being developed to define the relationships between other R&M terms."

The methodology described is a first step. More formulas are being developed to define the relationships between other R&M terms. Another challenge facing the Air Force R&M community is to build and publish an understandable methodology, with audit trail, to translate the operational parameters chosen by TAC into contractual terms for the system specification. Likewise, the contractual terms must be retranslated into operational terms for system evaluation and testing to ensure the user requirements are met by the system.

It should be obvious that R&M 2000 has had a profound influence upon TAC's way of doing business. R&M is a force multiplier and directly impacts readiness and combat capability. Through wise investment in R&M early in the acquisition process, combat capability will realize great dividends.

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Notes

[1]SALTY DEMO. Air Base Survivability Demonstration Final Report (SECRET). HQ Air Force Systems Command/AD/YQ, Eglin AFB, FL, 10 Jan 1986. All information referring to SALTY DEMO has been synthesized using unclassified portions of the report. In particular, comments are based on discussions that appear in the Executive Summary, Book 1, and Base Recovery After Attack, Vol 7, Books 10 and 11.

[2]Prime BEEF Combat Support Team Implementation Guidance (Draft), HQ Air Force Engineering and Services Center/DEO, Tyndall AFB, FL, 1 Nov 1986. All comments that address the latest Prime BEEF concepts and the current program direction have been extracted from the draft guidance, sections 1 and 3.

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System Engineering and Logistics Support Analysis

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The authors briefly describe the use of system engineering and logistics support analysis (LSA) to achieve the desired goals of a supportable weapon system.

An aircraft that will fly higher and faster, turn quicker, and shoot straighter is useless when grounded for lack of support. The converse is also very true. A system that is a supportable dream achieved at the expense of performance is merely a "lead sled" that will not perform up to the mission scenario. The key to developing a system that has the optimum relationship of cost, schedule, performance, and supportability is to keep everything in balance. This is the goal of system engineering and logistic support analysis. These processes are tools to achieve the desired system development goals. They are not goals within themselves, nor are they independent. They depend on each other to achieve desired system operational capabilities and still be affordable.

The complexity of current and proposed weapon systems, and the longer expected or actual lifetimes of these systems, have had the combined effect of increasing lifetime operation and support costs. Total life cycle costs have been visibly increasing for several years, so much so that funding for some otherwise viable systems may fall into jeopardy. Therefore, it is critical to recognize that, when we purchase a system, we are purchasing a support obligation for the lifetime of the system—even though we do not always fully account for these costs.

System Engineering

The goal of system engineering is to achieve proper balance among operational, economic, and logistics factors. In terms we are more used to hearing, system engineering is a *continual and iterative activity, with the output being the optimal balance between performance and support considerations and optimal trade-offs among costs of ownership, schedule, and system effectiveness.*

The system engineering process is replete with efforts intended to impact the system in favor of logistics. These efforts include mission requirements analysis, functional analysis, reliability allocation, modeling, support analysis, and maintainability and human factors analyses.

A quick look at some of these reveals how they impact design. *Mission requirements analysis* is a continual examination of the operational characteristics, mission objective, threat, environmental factors, minimum acceptable system functional requirements, technical performance, and system figures of merit. These factors are examined for validity, consistency, desirability, and attainability. The outcome of this analysis either verifies the existing requirements or develops new, more appropriate requirements.

Functional analysis refers to progressively identifying and analyzing a system's functions and subfunctions to identify alternatives for meeting system performance and design requirements. Each function and subfunction is allocated a set of performance and design requirements derived from the functional analysis.

System engineering also includes the *logistics support analysis* process. MIL-STD-1388-1A defines LSA as "the selective application of scientific and engineering efforts undertaken during the acquisition process, as part of the system engineering and design process, to assist in complying with supportability and other integrated logistics support (ILS) objectives." Let's take that statement apart and look at some of the key phrases. First, consider the phrase "selective application." LSA is not applied across the board; individuals need to know their programs and select ("tailor" is the buzz word) the tasks needed to reach the objectives of these programs.

The next phrase is "scientific and engineering efforts." "Scientific" indicates that LSA is systematic. Rather than a random process, it is rigorous and has a definite and repetitive discipline. The words "engineering efforts" mean that LSA is *not* just a "loggie" effort, but an integral part of the system engineering process.

The last part of the statement is "to assist in complying with supportability and other ILS objectives." The supportability objectives are defined and refined in the system engineering element of defining mission requirements. We are, or should be, designing systems to meet a certain or defined level of supportability—not just to meet a threat. A system must be designed in its entirety. To do otherwise would be to create a system to counter a threat or accomplish set performance objectives and ignore equally vital support requirements.

This leads to the last phrase "and other ILS objectives." The object of the integrated logistics support program is to "cause support considerations to influence both requirements and design, define support requirements optimally related to the design and to each other, acquire the support, and provide the required support in the operational phase at minimum cost." The first two objectives lead us to the design phase and cause us to look at the design from a supportability viewpoint. This ties into the system engineering process and permits the system to have supportability design requirements that impact system design.

Applying the system engineering process, the logistics support analysis, and the integrated logistics support program to the overall acquisition strategy should yield a system with optimal relationships between the four factors of cost, schedule, performance, and supportability.

Logistics Support Analysis

LSA tasks applied early in a program (conceptual and demonstration/validation phases) powerfully impact the design of a system and its support system. For example, LSA Task 201, Use Study, identifies support factors related to the *intended* use of the proposed system. It also documents the quantitative data which must be considered in developing system alternatives. Some of the data resulting from this task are system parameters, such as the operational scenario. We must know the needs of the system. How fast must it fly? How long? How fast must it shoot? How often? Where will it deploy? What is the environment? What is the maximum turnaround time for the operational scenario? These factors determine the time that can be allocated for maintenance. It also determines the mobility requirements of the system. As a result of this task, we should know some of the quantitative support factors such as mean time to repair, mean time between failures, and operational availability.

LSA Task 202 considers standardization of all parts of a system (mission hardware, software, and support system). This task evaluates current and planned resources to evaluate the benefits of the new system. It also evaluates the risks that may be involved if the standardized resource does not perform adequately. The results of this task are the design constraints that must be considered if the standard resource is used. This is important from a designer's viewpoint. If the Air Force intends to use certain support equipment, the system must be designed to accept that equipment and the design must be tilted in that direction from the very beginning. It is very wasteful to wait until the prototype has been completed to find out that standardized support equipment does not meet the requirements of the system and new support equipment must be designed and procured, or the system must be redesigned to accommodate the support equipment.

Another LSA task that has an impact on design is Comparative Analysis (Task 203). The purpose of this task is threefold:

(1) To redefine a solid analytical base for projecting the new system design and supportability features and identifying those which need improvements.

(2) To identify those features that drive the cost, support, and readiness of the new system.

(3) To document the risks involved in using the comparative data in subsequent analyses.

Under this task a baseline comparison system (BCS) is developed that closely matches the expected new system. Various subsystems might be used to build the optimum baseline system. This provides a base with which to compare the new system and evaluate how much improvement we should reasonably expect from it.

This leads to the LSA task of Technological Opportunities (Task 204). Here, logisticians and engineers identify technologies and state-of-the-art design improvements that can be incorporated into the new system. This allows the designer to improve support, cost, and readiness values in the new system and resolve support problems identified in existing systems.

These tasks lead to the ultimate goals, thresholds, constraints, and design objectives which move a system progressively into the next phase of development. The LSA process assists in identifying, evaluating, and supporting alternatives, and helps to determine which alternative gives the optimal solution. This alternative should provide the best mix between stated operational needs, engineering design, program schedule and budget, producibility, supportability, and life cycle costs. The optimal solution—and ultimately the chosen alternative—must consider each of these factors in proper relationship to each other.

Air Force Evaluates LSA

Concerned with how well the Air Force was using LSA, Lieutenant General Leo Marquez, Air Force Deputy Chief of Staff for Logistics and Engineering, directed an Air Force study of the LSA process in August 1986. The purpose was to determine the effectiveness of LSA and ways to improve its application. An acquisition review group was formed from HQ USAF, AFSC, AFLC, SAC, MAC, ATC, AFCC, TAC, AFSPACECOM, and AFOTEC. Using a detailed questionnaire, the study team interviewed Air Force developers, supporters, users, and contractors. The study effort resulted in the following general observations:

- There is insufficient policy on early analysis and the application of LSA to software.
- LSA and the LSA record are not integrated into engineering standards and system life cycle management policy.
- Formal education and training in the use of LSA, especially for engineers, is severely lacking.
- Resources constrain the process with insufficient qualified manpower available to perform required LSA functions.
- The impact of LSA on system design is hit and miss.
- Duplicate data are being procured.
- Inefficiencies in the use of existing data exist.
- LSA is not being used throughout system life.
- A standard state-of-the-art, automated data system for the LSA record does not exist.
- The interfaces among the LSA data base and other logistics data modernization efforts need investigation and definition.

The study was completed in December 1986 with 64 major recommendations.

Logistics Support Analysis (LSA)
Acquisition Review Group

▶ *FROM 29*

The AFLC C^3I development will influence virtually all facets of airpower planning and employment. Though complex and seemingly remote from daily flight line activities, its strategy and linkages should be understood by logisticians at all levels. Properly developed, understood, and used, this system can provide a crucial hedge against the mounting uncertainties of modern warfare.

Notes

[1]For a more detailed treatment of this topic, see: Michael Rich, et al, *Improving U.S. Air Force Readiness and Sustainability*, The RAND Corp, R-3113/1-AF, April 1984.

[2]Crawford, Gordon. *Variability in the Demand for Aircraft Spare Parts: Magnitude and Implications*, The RAND Corp, R3318-AF, forthcoming.

[3]Hillestad, R. J. *Dyna-METRIC: Dynamic Multi-Echelon Technique for Recoverable Item Control*, The RAND Corp, R-2785-AF, July 1982.

[4]Rich, Michael et al. *Implications of Uncertainty for Air Force Logistics Operations: An Overview*, The RAND Corp, R-3320-AF, forthcoming.

Joint Oversight of Service Ordnance Programs

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On 19 September 1985, the Joint Logistics Commanders (JLC) chartered the Joint Ordnance Commanders Group (JOCG) as an outgrowth of their concern as to how joint acquisition programs could be executed more effectively. The JOCG assumed the missions and responsibilities previously assigned to two former JLC groups, the Joint Conventional Ammunition Program - Coordinating Group and the Joint Technical Coordinating Group for Munitions Development. The JOCG was tasked to identify and implement, or recommend for implementation, opportunities to reduce cost and/or increase effectiveness and interoperability of ordnance systems managed by the Services. Membership in the group is designated by charter as the Commanders of the US Army, Armament Munitions and Chemical Command (AMCCOM); Naval Sea Systems Command (NAVSEA); Ogden Air Logistics Center (OO-ALC); Armament Division (AD); and the Commandant, US Marine Corps, Headquarters Materiel Division (MC-LM).

The group's primary mission is to review jointly all activities within its purview involving development, production or support of ordnance systems, subsystems, and components, and identify, implement, or recommend implementation of selected programs or projects for joint sponsorship or management.

The JOCG developed five primary objectives:

(1) To establish a systematic approval of joint program selection.

(2) To resolve the unique challenges of joint program initiation, management, and execution.

(3) To stabilize, to the degree possible, turbulence associated with joint service programs.

(4) To standardize, to the maximum extent possible, the different ways of doing business.

(5) To achieve uniform, and to the extent practicable, standard conventional ammunition policies and procedures for implementation of the Single Manager for Conventional Ammunition Mission and Functions, and the Conventional Ammunition Missions and Functions retained by the Military Services (Reference DODD 5160.65, *Single Manager for Conventional Ammunition (A&L))*.

To assist in accomplishing its objectives and mission, the JOCG approved an organizational structure which includes an Executive Director, Executive Committee, and 24 subgroups. The organizational structure recognizes both the development and logistics aspects of its assigned ordnance mission and the diversity between munitions and armament systems. The various groups and working parties that existed under two former JLC groups were used as the basis in developing the various subgroups under the new organization.

The Executive Director for the JOCG is located at the US Army Armament Munitions and Chemical Command and provides a central point for the interface of all JOCG activities. The Executive Committee is comprised of senior managers from each JOCG member's staff. These senior managers provide the level of management necessary to get the job done within their respective service. The various subgroups are comprised of representatives from each of the services on a part-time basis. Each subgroup has a specified mission and, as a need arises, it is tasked to pursue specific issues or initiatives or may develop its own. The Executive Committee vigorously monitors the activities of the various subgroups and reports the results to the JOCG.

Although the JOCG is still relatively new, it has already reviewed 81 ordnance programs (out of 105 potential Joint Service candidates), of which 63 previously identified as single service have now been identified as potential joint programs. Of the remaining 24 programs, 5 have been canceled, leaving 19 to be reviewed for possible jointness. The JOCG plans to complete its review of these remaining programs during FY87 along with any subsequent programs identified as being potential joint programs.

In addition, the JOCG has also looked for ways to improve business practices. Examples of success in this area include publishing a catalog which reflects worldwide conventional ammunition demilitarization and disposal capabilities for all services. This document provides demil/disposal managers, for the first time, with the knowledge of capabilities that exist at all service installations within a specific geographical area. It results in a significant opportunity to achieve cost avoidances when planning shipments of assets for demil/disposal.

Another success was an agreement to use standard maintenance documents to accomplish renovation of conventional ammunition within the Single Manager for Conventional Ammunition complex. All the services will now be using the same documentation, thus simplifying procedures within the depot system.

The JOCG has only looked at the tip of the iceberg in finding new ways of doing business which will ultimately reduce or avoid cost or increase effectiveness in the ordnance arena. The accomplishments of the JOCG over the next fiscal year should show it to be a truly viable organization and responsive to the JLC. The challenges and opportunities that lay ahead are numerous.

Most Significant Article Award

The Editorial Advisory Board has selected "Technology and the American Way of War: Worshiping a False Idol?" by Colonel Dennis M. Drew, USAF, as the most significant article in the Winter issue of the *Air Force Journal of Logistics*.

READER EXCHANGE

Dear Editor

I received my issue on Vietnam Logistics (*AFJL,* Fall 1986), and I thought it was your best to date. The article by Lt Col Templin on "Pyramids and Stovepipes" was outstanding and put the career dilemma eloquently. The article by Lt Col John Halliday was, as usual, outstanding. It proves again that Lt Col Halliday, along with Lt Cols Jim Masters and Ray Linville, are the most insightful and persuasive logistics theoriticians extant in the Air Force today. Their works are always well-rounded, well-documented, and, most importantly, firmly rooted in the premise that we logisticians must fight the force existing today while simultaneously planning for the always promised nirvanas of R&M and assured communications and transportation to come about.

Lt Col Halliday's comments on LCOM were particularly trenchant and timely. During my tenure on the Air Staff, I was appalled constantly at how the spares module was developed and how the data base was developed. To use 1982 peacetime data to determine 1987 projected breakrates is an interesting technique, especially when it conflicts massively with the failure data used to authorize and procure WRSK/BLSS spares for the same unit. This is, as I have previously pointed out, yet another symptom of our failure as logisticians to treat logistics as a continuous loop process rather than separate sections each ruled by competing (and often hostile) functional areas.

On the negative side, I was a touch disappointed in the article by Major Leach on "Logistics for the Fighter Wing of the Future." The article seemed to be another clarion call for R&M, a subject near and dear to all logisticians' hearts. However, to get there, the Major unfortunately overlooked some major issues and misstated some others. First, I am still looking for the report that says the centralized intermediate repair concept saves spares or manpower. In fact, the spares costs are much higher as witness the extra LRUs PACAF units must be given to offset the longer repair cycles caused by the transportation leg. Second, the entire treatment of the spares issue seems to lack a basic understanding of how spares requirements are computed and what a WRSK is designed to support. The spares to support 72 aircraft cannot be neatly divided into thirds to support 3 squadrons; instead, many more must be added to provide a basic level of support. A comparison would be the difference between a 24PAA and a 48PAA WRSK; the cost and quantities do not double. In fact, for many items, the figures are exactly the same. The real showstopper would be the cost to stock spares or, if not that, the costs to build the CIRFs and buy the assured logistics and communications that would have to substitute for increased stockage levels. There is no free lunch, and free flow of WRSK and massive cannibalization are already implicitly inherent in how we stock today.

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LOGISTICS VERSUS COMBAT SUPPORT

I would like to voice a dissenting opinion on the use of the term "Combat Support" in lieu of the term "Logistics" and the need for *Combat Support Doctrine* (AFM 2-15) to supersede *Air Force Logistics Doctrine* (AFR 400-2). If AFR 400-2 was unsatisfactory and required change, why wasn't it revised when the need was known and the status of the revision monitored by its OPR until successfully completed? While I believe that a revision of Air Force Logistics Doctrine was long overdue, I do not consider that it required a name change (i.e., Logistics to Combat Support) or its publication in an OPERATIONAL document in order to revise its content adequately.

This "venture" into aerospace OPERATIONAL doctrine culminating with the initial publication of AFM 2-15 (now AFM 1-10) provides the reader with an inaccurate combat perspective, unreal concepts, incorrect statements, and undefined terms. It presents a skewed, sterile, and very confined approach to the "preparation for" and the "waging of" war; yet, as AFM 2-15 states, it "represents the official views of the United States Air Force."

My observation of AFM 2-15 is that the creation of Military Capability, either by Logistics or Combat Support, is far too important to treat in such an undistinguished manner.

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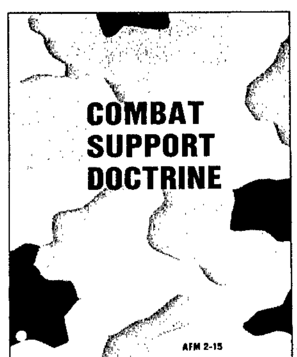
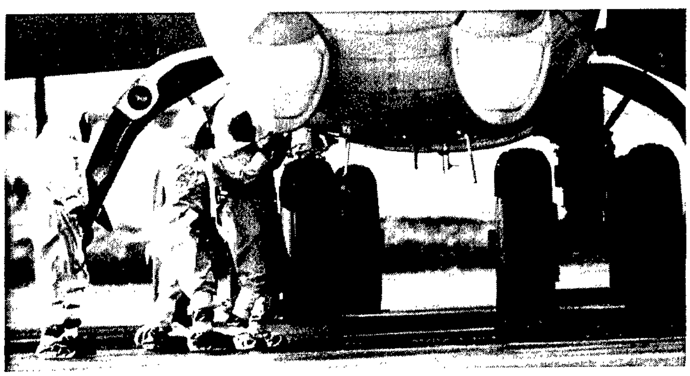
In 1985, AFM 2-15, *Combat Support Doctrine,* was published achieving an important breakthrough in validating the doctrinal importance and role of logistics in military affairs. The manual has now been republished as AFM 1-10. Upgrading to the 1-series elevates combat support from *operational* to *basic* doctrine. This is a significant step in recognizing the equality of operational and logistical dimensions of warfare.



Most Significant Article Award for 1986

The Editorial Advisory Board has selected "The Logistic Warrior" by Lieutenant General Leo Marquez, USAF, as the most significant article published in the *Air Force Journal of Logistics* during 1986.

- ***Logistics Under Fire***
- ***Combat Engineering***
- ***Earthbound Doctrine***
- ***Early Air Corps Logistics***
- ***Log C^3I***
- ***Forecasting and Assessment***
- ***Tac R&M***
- ***System Engineering and LSA***



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